



# **Kathir College of Engineering**

Wisdom Tree, Avinashi Road, Neelambur, Coimbatore 641062

## **Criteria-1**

### **Curricular Aspects**

#### **Sub-Criteria 1.2**

##### **Academic Flexibility**

##### **1.2.1**

**Percentage of Programmes in which Choice Based Credit System (CBCS)/ elective course system has been implemented**

##### **1.2.1.1**

**Number of Programmes in which CBCS / Elective course system implemented**



# Kathir College of Engineering

[Approved by AICTE | Affiliated to Anna University | Accredited by NAAC]

**Wisdom Tree, Neelambur, Avinashi Road, Coimbatore-62**

## 1.2.1 Number of Programmes in which Choice Based Credit System (CBCS)/ elective course system has been implemented

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ANNA UNIVERSITY : : CHENNAI - 600 025

AFFILIATED INSTITUTIONS

REGULATIONS 2017

CHOICE BASED CREDIT SYSTEM

Common to all B.E. / B.Tech. Full-Time Programmes

(For the students admitted to B.E. / B.Tech. Programme at various Affiliated Institutions)

**DEGREE OF BACHELOR OF ENGINEERING / BACHELOR OF TECHNOLOGY**


This Regulations is applicable to the students admitted to B.E./B.Tech. Programmes at all Engineering Colleges affiliated to Anna University, Chennai (other than Autonomous Colleges) and to all the University Colleges of Engineering of Anna University, Chennai from the academic year 2017-2018 onwards.

**1. PRELIMINARY DEFINITIONS AND NOMENCLATURE**

In these Regulations, unless the context otherwise requires:

- I) "Programme" means Degree Programme, that is B.E./B.Tech. Degree Programme.
- II) "Discipline" means specialization or branch of B.E./B.Tech. Degree Programme, like Civil Engineering, Textile Technology, etc.
- III) "Course" means a theory or practical subject that is normally studied in a semester, like Mathematics, Physics, etc.
- IV) "Director, Academic Courses" means the authority of the University who is responsible for all academic activities of the Academic Programmes for implementation of relevant rules of this Regulations pertaining to the Academic Programmes.
- V) "Chairman" means the Head of the Faculty.
- VI) "Head of the Institution" means the Principal of the College.
- VII) "Head of the Department" means head of the Department concerned.
- VIII) "Controller of Examinations" means the authority of the University who is responsible for all activities of the University Examinations.
- IX) "University" means ANNA UNIVERSITY, CHENNAI.



  
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## 2. ADMISSION

2.1 Candidates seeking admission to the first semester of the eight semester B.E. / B.Tech. Degree Programme:

Should have passed the Higher Secondary Examinations of (10+2) Curriculum (Academic Stream) prescribed by the Government of Tamil Nadu with Mathematics, Physics and Chemistry as three of the four subjects of study under Part-III or any examination of any other University or authority accepted by the Syndicate of Anna University as equivalent thereto.

(OR)

Should have passed the Higher Secondary Examination of Vocational stream (Vocational groups in Engineering / Technology) as prescribed by the Government of Tamil Nadu.

### 2.2 Lateral entry admission

(i) The candidates who possess the Diploma in Engineering / Technology awarded by the State Board of Technical Education, Tamilnadu or its equivalent are eligible to apply for Lateral entry admission to the third semester of B.E. / B.Tech. in the branch corresponding to the branch of study.

(OR)

(ii) The candidates who possess the Degree in Science (B.Sc.) (10+2+3 stream) with Mathematics as a subject at the B.Sc. Level are eligible to apply for Lateral entry admission to the third semester of B.E. / B.Tech.

Such candidates shall undergo two additional Engineering subject(s) in the **third and fourth semesters** as prescribed by the University.

## 3. PROGRAMMES OFFERED

B.E. / B.Tech. Programmes under the Faculty of Civil Engineering, Faculty of Mechanical Engineering, Faculty of Electrical Engineering, Faculty of Information and Communication Engineering and Faculty of Technology.

## 4. STRUCTURE OF PROGRAMMES

### 4.1 Categorization of Courses

Every B.E. / B. Tech. Programme will have a curriculum with syllabi consisting of theory and practical courses that shall be categorized as follows:

- i. **Humanities and Social Sciences (HS)** courses include Technical English, Engineering Ethics and Human Values, Communication skills, Environmental Science and Engineering.
- ii. **Basic Sciences (BS)** courses include Mathematics, Physics, Chemistry, Biology, etc.
- iii. **Engineering Sciences (ES)** courses include Engineering practices, Engineering Graphics, Basics of Electrical / Electronics / Mechanical / Computer Engineering, Instrumentation etc.
- iv. **Professional Core (PC)** courses include the core courses relevant to the chosen specialization/branch.
- v. **Professional Elective (PE)** courses include the elective courses relevant to the chosen specialization/ branch.

- vi. **Open Elective (OE)** courses include the courses from other branches which a student can choose from the list specified in the curriculum of the students B.E. / B. Tech. / B. Arch. Programmes.
- vii. **Employability Enhancement Courses (EEC)** include Project Work and/or Internship, Seminar, Professional Practices, Case Study and Industrial/Practical Training.

#### 4.2 Personality and Character Development

All students shall enroll, on admission, in any one of the personality and character development programmes (NCC/NSS/NSO/YRC) and undergo training for about 80 hours and attend a camp of about seven days. The training shall include classes on hygiene and health awareness and also training in first-aid.

**National Cadet Corps (NCC)** will have about 20 parades.

**National Service Scheme (NSS)** will have social service activities in and around the College / Institution.

**National Sports Organization (NSO)** will have sports, Games, Drills and Physical exercises.

**Youth Red Cross (YRC)** will have activities related to social services in and around College/Institutions.

While the training activities will normally be during weekends, the camp will normally be during vacation period.

#### 4.3 Number of courses per semester

Each semester curriculum shall normally have a blend of lecture courses not exceeding **7** and Laboratory courses and Employability Enhancement Course(s) not exceeding **4**. Each Employability Enhancement Course may have credits assigned as per clause 4.4. However, the total number of courses per semester shall not exceed 10.

#### 4.4 Credit Assignment

Each course is assigned certain number of credits based on the following:

| Contact period per week   | CREDITS |
|---|---------|
| 1 Lecture Period  | 1       |
| 2 Tutorial Periods  | 1       |
| 2 Laboratory Periods (also for EEC courses like / Seminar / Project Work / Case study / etc.) | 1       |

The Contact Periods per week for Tutorials and Practical can only be in multiples of 2.

#### 4.5. Industrial Training / Internship

The students may undergo Industrial training for a period as specified in the Curriculum during summer / winter vacation. In this case the training has to be undergone continuously for the entire period.

The students may undergo Internship at Research organization / University (after due approval from the Department Consultative Committee) for the period prescribed in the curriculum during summer / winter vacation, in lieu of Industrial training.

#### 4.6 Industrial Visit

Every student is required to go for at least one Industrial Visit every year starting from the second year of the Programme. The Heads of Departments shall ensure that necessary arrangements are made in this regard.

#### 4.7 Value Added Courses

The Students may optionally undergo Value Added Courses and the credits earned through the Value Added Courses shall be over and above the total credit requirement prescribed in the curriculum for the award of the degree. One / Two credit courses shall be offered by a Department **of an institution with the prior approval from the Head of the Institution**. The details of the syllabus, time table and faculty may be sent to the Centre for Academic Courses and the Controller of Examinations after approval from the **Head of the Institution** concerned atleast one month before the course is offered. **Students can take a maximum of two one credit courses / one two credit course** during the entire duration of the Programme.

#### 4.8 Online Courses

4.8.1 Students may be permitted to credit only one online course of 3 credits with the approval of **Head of the Institution** and Centre for Academic Courses.

4.8.2 Students may be permitted to credit one online course (which are provided with certificate) subject to a maximum of three credits. The approved list of online courses will be provided by the Centre for Academic courses from time to time. The student needs to obtain certification or credit to become eligible for writing the End Semester Examination to be conducted by Controller of Examinations, Anna University. The details regarding online courses taken up by students should be sent to the Controller of Examinations, Anna University and Centre for Academic Courses one month before the commencement of End Semester Examination.

4.9 The students satisfying the following conditions shall be permitted to carry out their final semester Project work for six months in industry/research organizations.

The student should not have current arrears and shall have CGPA of 7.50 and above.

The student shall undergo the eighth semester courses in the sixth and seventh semesters. The Head of Department, in consultation with the faculty handling the said courses shall forward the proposal recommended by the Head of Institution to the Controller of Examinations through the Director, Centre for Academic courses for approval at least 4 weeks before the commencement of the sixth semester of the programme for approval.

#### 4.10 Medium of Instruction

The medium of instruction is English for all courses, examinations, seminar presentations and project / thesis / dissertation reports except for the programmes offered in Tamil Medium.

#### 5. DURATION OF THE PROGRAMME

5.1 A student is ordinarily expected to complete the B.E. / B.Tech. Programme in 8 semesters (four academic years) but in any case not more than 14 Semesters for HSC (or equivalent) candidates and not more than 12 semesters for Lateral Entry Candidates.

5.1.1 A student is ordinarily expected to complete the B.E. Mechanical Engineering (Sandwich) Programme in 10 semesters (five academic years) but in any case not more than 18 Semesters for HSC (or equivalent) candidates.

5.2 Each semester shall normally consist of 75 working days or 540 periods of 50 minutes each. The Head of the Institution shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus and that the teacher teaches the full content of the specified syllabus for the course being taught.

5.3 The Head of the Institution may conduct additional classes for improvement, special coaching, conduct of model test etc., over and above the specified periods. But for the purpose of calculation of attendance requirement for writing the end semester examinations (as per clause 6) by the students, following method shall be used.

$$\text{Percentage of Attendance} = \frac{\text{Total no. of periods attended in all the courses per semester}}{(\text{No.of periods / week as prescribed in the curriculum}) \times 15 \text{ taken together for all courses of the semester}} \times 100$$

The University Examination will ordinarily follow immediately after the last working day of the semester commencing from I semester as per the academic schedule prescribed from time to time.

5.4 The total period for completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 5.1 irrespective of the period of break of study (vide clause 18) in order that he/she may be eligible for the award of the degree (vide clause 16).

#### 6. COURSE REGISTRATION

6.1 The Institution is responsible for registering the courses that each student is proposing to undergo in the ensuing semester. Each student has to register for all courses to be undergone in the curriculum of a particular semester (with the facility to drop courses to a maximum of 6 credits (vide clause 6.2)). The student can also register for courses for which the student has failed in the earlier semesters.

The registration details of the candidates may be approved by the Head of the Institution and forwarded to the Controller of Examinations. This registration is for undergoing the course as well as for writing the End Semester Examinations. No Elective course shall be offered by any department of any institution unless a minimum 10 students register for the course. However, if the students admitted in the associated Branch and Semester is less than 10, this minimum will not be applicable.

##### **The courses that a student registers in a particular semester may include**

- i. Courses of the current semester.
- ii. The core (Theory/Lab /EEC) courses that the student has not cleared in the previous semesters.
- iii. Elective courses which the student failed (either the same elective or a different elective instead).

## 6.2 Flexibility to Drop courses

- 6.2.1 A student has to earn the total number of credits specified in the curriculum of the respective Programme of study in order to be eligible to obtain the degree.
- 6.2.2 From the III to final semesters, the student has the option of dropping existing courses in a semester during registration. Total number of credits of such courses cannot exceed 6.
- 6.2.3 The student shall register for the project work in the final semester only.

## 7. ATTENDANCE REQUIREMENTS FOR COMPLETION OF THE SEMESTER

- 7.1 A Candidate who has fulfilled the following conditions shall be deemed to have satisfied the requirements for completion of a semester.

Ideally every student is expected to attend all classes of all the courses and secure 100% attendance. However, in order to give provision for certain unavoidable reasons such as Medical / participation in sports, the student is expected to attend atleast 75% of the classes.

Therefore, he/she shall **secure not less than 75%** (after rounding off to the nearest integer) of overall attendance as calculated as per clause 5.3.

- 7.2 However, a candidate who secures overall attendance between 65% and 74% in the current semester due to medical reasons (prolonged hospitalization / accident / specific illness) / Participation in Sports events may be permitted to appear for the current semester examinations subject to the condition that the candidate shall submit the medical certificate / sports participation certificate attested by the Head of the Institution. The same shall be forwarded to the Controller of Examinations for record purposes.
- 7.3 Candidates who **secure less than 65% overall attendance and candidates who do not satisfy the clause 7.1 and 7.2** shall not be permitted to write the University examination at the end of the semester and not permitted to move to the next semester. They are required to repeat the incomplete semester in the next academic year, as per the norms prescribed.

## 8. CLASS ADVISOR

There shall be a class advisor for each class. The class advisor will be one among the (course-instructors) of the class. He / She will be appointed by the HoD of the department concerned. The class advisor is the ex-officio member and the Convener of the class committee. The responsibilities for the class advisor shall be:

- To act as the channel of communication between the HoD and the students of the respective class.
- To collect and maintain various statistical details of students.
- To help the chairperson of the class committee in planning and conduct of the class committee meetings.
- To monitor the academic performance of the students including attendance and to inform the class committee.
- To attend to the students' welfare activities like awards, medals, scholarships and industrial visits.

## 9. CLASS COMMITTEE

- 9.1. Every class shall have a class committee consisting of teachers of the class concerned, student representatives and a chairperson who is not teaching the class. It is like the 'Quality Circle' (more commonly used in industries) with the overall goal of improving the teaching-learning process. The functions of the class committee include
- Solving problems experienced by students in the class room and in the laboratories.



- **Clarifying the regulations of the degree programme and the details of rules therein particularly (clause 5 and 7) which should be displayed on college Notice-Board.**
- Informing the student representatives, the academic schedule including the dates of assessments and the syllabus coverage for each assessment.
- Informing the student representatives the details of Regulations regarding weightage used for each assessment. In the case of practical courses (laboratory / drawing / project work / seminar etc.) the breakup of marks for each experiment / exercise / module of work, should be clearly discussed in the class committee meeting and informed to the students.
- Analyzing the performance of the students of the class after each test and finding the ways and means of solving problems, if any.
- Identifying the weak students, if any, and requesting the teachers concerned to provide some additional help or guidance or coaching to such weak students.

9.2 The class committee for a class under a particular branch is normally constituted by the Head of the Department. However, if the students of different branches are mixed in a class (like the first semester which is generally common to all branches), the class committee is to be constituted by the Head of the Institution.

9.3 The class committee shall be constituted within the first week of each semester.

9.4 At least 4 student representatives (usually 2 boys and 2 girls) shall be included in the class committee.

9.5 The Chairperson of the class committee may invite the Class adviser(s) and the Head of the Department to the class committee meeting.

9.6 The Head of the Institution may participate in any class committee of the institution.

9.7 The chairperson is required to prepare the minutes of every meeting, submit the same to Head of the Institution within two days of the meeting and arrange to circulate it among the students and teachers concerned. If there are some points in the minutes requiring action by the management, the same shall be brought to the notice of the Management by the Head of the Institution.

9.8 The first meeting of the class committee shall be held within one week from the date of commencement of the semester, in order to inform the students about the nature and weightage of assessments within the framework of the Regulations. Two or three subsequent meetings may be held in a semester at suitable intervals. **The Class Committee Chairman shall put on the Notice Board the cumulative attendance particulars of each student at the end of every such meeting to enable the students to know their attendance details to satisfy the clause 6 of this Regulation.** During these meetings the student members representing the entire class, shall meaningfully interact and express the opinions and suggestions of the other students of the class in order to improve the effectiveness of the teaching-learning process.

## 10. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group, shall have a "Course Committee" comprising all the teachers teaching the common course with one of them nominated as Course Coordinator. The nomination of the Course Coordinator shall be made by the Head of the Department / Head of the Institution depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The 'Course committee' shall meet in order to arrive at a common scheme of evaluation for the test and shall ensure a uniform evaluation of the tests. Wherever feasible, the course committee may also prepare a common question paper for the internal assessment test(s).

## **11. SYSTEM OF EXAMINATION**

11.1 Performance in each course of study shall be evaluated based on (i) continuous internal assessment throughout the semester and (ii) University examination at the end of the semester.

11.2 Each course, both theory and practical (including project work & viva voce Examinations) shall be evaluated for a maximum of 100 marks.

For all theory and practical courses including project work, the continuous internal assessment will carry **20 marks** while the End - Semester University examination will carry **80 marks**.

11.3 Industrial training and seminar shall carry 100 marks and shall be evaluated through internal assessment only.

11.4 The University examination (theory and practical) of 3 hours duration shall ordinarily be conducted between October and December during the odd semesters and between April and June during the even semesters.

11.5 The University examination for project work shall consist of evaluation of the final report submitted by the student or students of the project group (of not exceeding 4 students) by an external examiner and an internal examiner, followed by a viva-voce examination conducted separately for each student by a committee consisting of the external examiner, the supervisor of the project group and an internal examiner.

11.6 For the University examination in both theory and practical courses including project work the internal and external examiners shall be appointed by the Controller of Examinations.

## **12. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT**

For all theory and practical courses (including project work) the continuous assessment shall be for a maximum of 20 marks. The above continuous assessment shall be awarded as per the procedure given below:

### **12.1 THEORY COURSES**

Three tests each carrying 100 marks shall be conducted during the semester by the Department / College concerned. The total marks obtained in all tests put together out of 300, shall be proportionately reduced for 20 marks and rounded to the nearest integer (This also implies equal weightage to all the three tests).

### **12.2 LABORATORY COURSES**

The maximum marks for Internal Assessment shall be 20 in case of practical courses. Every practical exercise / experiment shall be evaluated based on conduct of experiment / exercise and records maintained. There shall be at least one test. The criteria for arriving at the Internal Assessment marks of 20 is as follows: 75 marks shall be awarded for successful completion of all the prescribed experiments done in the Laboratory and 25 marks for the test. The total mark shall be reduced to 20 and rounded to the nearest integer.

### **12.3 THEORY COURSES WITH LABORATORY COMPONENT**

If there is a theory course with Laboratory component, there shall be three tests: the first two tests (each 100 marks) will be from theory portions and the third test (maximum mark 100) will be for laboratory component. The sum of marks of first two tests shall be reduced to 60 marks and the third test mark shall be reduced to 40 marks. The sum of these 100 marks may then be arrived at for 20 and rounded to the nearest integer.

## 12.4 PROJECT WORK

Project work may be allotted to a single student or to a group of students not exceeding 4 per group.

The Head of the Institutions shall constitute a review committee for project work for each branch of study. There shall be three reviews during the semester by the review committee. The student shall make presentation on the progress made by him / her before the committee. The total marks obtained in the three reviews shall be **reduced for 20 marks** and rounded to the nearest integer (as per the scheme given in 12.4.1).

- 12.4.1 The project report shall carry a maximum 30 marks. The project report shall be submitted as per the approved guidelines as given by Director, Academic Courses. Same mark shall be awarded to every student within the project group for the project report. The viva-voce examination shall carry 50 marks. Marks are awarded to each student of the project group based on the individual performance in the viva-voce examination.

| Review I | Review II | Review III | End semester Examinations |          |                |          |            |
|----------|-----------|------------|---------------------------|----------|----------------|----------|------------|
|          |           |            | Thesis Submission (30)    |          | Viva-Voce (50) |          |            |
| 5        | 7.5       | 7.5        | Internal                  | External | Internal       | External | Supervisor |
|          |           |            | 15                        | 15       | 15             | 20       | 15         |

- 12.4.2 If a candidate fails to submit the project report on or before the specified deadline, he/she is deemed to have failed in the Project Work and shall re-register for the same in a subsequent semester.

## 12.5 OTHER EMPLOYABILITY ENHANCEMENT COURSES

- (a) The seminar / Case study is to be considered as purely INTERNAL (with 100% internal marks only). Every student is expected to present a minimum of 2 seminars per semester before the evaluation committee and for each seminar, marks can be equally apportioned. The three member committee appointed by Head of the Institution will evaluate the seminar and at the end of the semester the marks can be consolidated and taken as the final mark. The evaluation shall be based on the seminar paper (40%), presentation (40%) and response to the questions asked during presentation (20%).
- (b) The Industrial / Practical Training, Summer Project, Internship, shall carry 100 marks and shall be evaluated through internal assessment only. At the end of Industrial / Practical training / internship / Summer Project, the candidate shall submit a certificate from the organization where he / she has undergone training and a brief report. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a three member Departmental Committee constituted by the Head of the Institution. The certificates (issued by the organization) submitted by the students shall be attached to the mark list sent by the Head of the Institution to the Controller of Examinations.

## 12.6 ASSESSMENT FOR VALUE ADDED COURSE

The one / two credit course shall carry 100 marks and shall be evaluated through **continuous assessments only**. Two Assessments shall be conducted during the semester by the Department concerned. The total marks obtained in the tests shall be reduced to 100 marks and rounded to the nearest integer. A committee consisting of the Head of the Department, staff handling the course and a senior Faculty member nominated by the Head of the Institution shall monitor the evaluation process. The list of students along with the marks and the grades earned may be forwarded to the Controller of Examinations for appropriate action at least one month before the commencement of End Semester Examinations.

## 12.7 ASSESSMENT FOR ONLINE COURSES

Students may be permitted to credit one online course (which are provided with certificate) subject to a maximum of three credits. The approved list of online courses will be provided by the Centre for Academic courses from time to time. **This online course of 3 credits can be considered instead of one elective course.** The student needs to obtain certification or credit to become eligible for writing the End Semester Examination to be conducted by Anna University. **The course shall be evaluated through the End Semester Examination only conducted by Controller of Examinations, Anna University.**

12.8. Internal marks approved by the Head of the Institution shall be displayed by the respective HODs within 5 days from the last working day.

## 12.9 Attendance Record

Every teacher is required to maintain an 'ATTENDANCE AND ASSESSMENT RECORD' which consists of attendance marked in each lecture or practical or project work class, the test marks and the record of class work (topic covered), separately for each course. This should be submitted to the Head of the department periodically (at least three times in a semester) for checking the syllabus coverage and the records of test marks and attendance. The Head of the department will put his signature and date after due verification. At the end of the semester, the record should be verified by the Head of the Institution who will keep this document in safe custody (for five years). The University or any inspection team appointed by the University may verify the records of attendance and assessment of both current and previous semesters.

## 13. REQUIREMENTS FOR APPEARING FOR UNIVERSITY EXAMINATIONS

A candidate shall normally be permitted to appear for the University Examinations for all the courses registered in the current semester (vide clause 6) if he/she has satisfied the semester completion requirements (subject to Clause 7).

A candidate who has already appeared for any subject in a semester and passed the examination is not entitled to reappear in the same subject for improvement of grades.

## 14. PASSING REQUIREMENTS

14.1 A candidate who secures not less than 50% of total marks prescribed for the course [Internal Assessment + End semester University Examinations] with a minimum of 45% of the marks prescribed for the end-semester University Examination, shall be declared to have passed the course and acquired the relevant number of credits. This is applicable for both theory and practical courses (including project work).

14.2 If a student fails to secure a pass in theory courses in the current semester examination, he/she is allowed to write arrear examinations for the next three consecutive semesters and their internal marks shall be carried over for the above mentioned period of three consecutive semesters. If a student fails to secure a pass in a course even after three consecutive arrear attempts, the student has to redo the course in the semester in which it is offered along with regular students.

That is, the students should have successfully completed the courses of (n minus 4)<sup>th</sup> semester to register for courses in n<sup>th</sup> semester.

Based on the above, the following prerequisites shall be followed for completing the degree programme:

- i. To enter into Semester V, the student should have no arrear in Semester I. Failing which the student shall redo the Semester I course/courses along with the regular students.

- ii. To enter into Semester VI, the student should have no arrear in Semester II. Failing which the student shall redo the Semester II course/courses along with the regular students.
- iii. To enter into Semester VII, the student should have no arrear in Semester III. Failing which the student shall redo the Semester III course/courses along with the regular students.
- iv. To enter into Semester VIII, the student should have no arrear in Semester IV. Failing which the student shall redo the Semester IV course/courses along with the regular students.

In case, if he/she has not successfully completed all the courses of semester V at the end of semester VIII, he/she shall redo the Semester V courses along with regular students. For the subsequent semesters of VI, VII and VIII, the same procedure shall be followed, subject to the maximum permissible period for this programme.

**Note:**

- The students who are admitted in **2017-2018 and 2018 – 2019** are permitted to appear for arrears upto VI semesters and will be allowed to move to VII semester only on completion of all the courses in the I semester.

In addition the following prerequisites shall be followed for completing the degree programme.

- i. To enter into Semester VII, the student should have no arrear in Semester I. Failing which the student shall redo the Semester I course/courses along with the regular students.
- ii. To enter into Semester VIII, the student should have no arrear in Semester II. Failing which the student shall redo the Semester II course/courses along with the regular students.

In case, if he/she has not successfully completed all the courses of semester III at the end of semester VIII, he/she shall redo the Semester III courses along with regular students. For the subsequent semesters of IV, V, VI, VII and VIII, the same procedure shall be followed, subject to the maximum permissible period for this programme.

- 14.3 If a student fails to secure a pass in a laboratory course, **the student shall register** for the course again, when offered next.
- 14.4 If a student fails to secure a pass in project work, **the student shall register** for the course again, when offered next.
- 14.5 The passing requirement for the courses which are assessed only through purely internal assessments (EEC courses except project work), is 50% of the internal assessment (continuous assessment) marks only.
- 14.6 A student can apply for revaluation of the student's semester examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee along with prescribed application to the COE through the Head of the Institution. The COE will arrange for the revaluation and the results will be intimated to the student concerned through the Head of the Institution. Revaluation is not permitted for laboratory course and project work.

## 15. AWARD OF LETTER GRADES

- 15.1 All assessments of a course will be evaluated on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each subject as detailed below:

| Letter Grade                | Grade Points | Marks Range |
|-----------------------------|--------------|-------------|
| O (Outstanding)             | 10           | 91 - 100    |
| A + (Excellent)             | 9            | 81 - 90     |
| A (Very Good)               | 8            | 71 - 80     |
| B + (Good)                  | 7            | 61 - 70     |
| B (Average)                 | 6            | 50 - 60     |
| RA                          | 0            | <50         |
| SA (Shortage of Attendance) | 0            |             |
| W                           | 0            |             |

A student is deemed to have passed and acquired the corresponding credits in a particular course if he/she obtains any one of the following grades: "O", "A+", "A", "B+", "B".

'SA' denotes shortage of attendance (as per clause 7.3) and hence prevention from writing the end semester examinations. 'SA' will appear only in the result sheet.

"RA" denotes that the student has failed to pass in that course. "W" denotes **withdrawal** from the exam for the particular course. The grades RA and W will figure both in Marks Sheet as well as in Result Sheet). In both cases the student has to earn Continuous Assessment marks and appear for the End Semester Examinations.

If the grade W is given to course, the attendance requirement need not be satisfied.

If the grade RA is given to a core **theory course**, the attendance requirement need not be satisfied, but if the grade RA is given to a **Laboratory Course/ Project work / Seminar and any other EEC course**, the attendance requirements (vide clause 7) should be satisfied.

- 15.2 For the Co-curricular activities such as National Cadet Corps (NCC)/ National Service Scheme (NSS) / NSO / YRC, a satisfactory / not satisfactory grading will appear in the mark sheet. Every student shall put in a minimum of 75% attendance in the training and attend the camp compulsorily. The training and camp shall be completed during the first year of the programme. However, for valid reasons, the Head of the Institution may permit a student to complete this requirement in the second year. **A satisfactory grade in the above co-curricular activities is compulsory for the award of degree.**
- 15.3 The grades O, A+, A, B+, B obtained for the one credit course shall figure in the Mark sheet under the title '**Value Added Courses**'. The Courses for which the grades are RA, SA **will not figure in the mark sheet.**

## Grade sheet

After results are declared, Grade Sheets will be issued to each student which will contain the following details:

- The college in which the candidate has studied
- The list of courses enrolled during the semester and the grade scored.
- The Grade Point Average (GPA) for the semester and
- The Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

GPA for a semester is the ratio of the sum of the products of the number of credits for courses acquired and the corresponding points to the sum of the number of credits for the courses acquired in the semester.

CGPA will be calculated in a similar manner, considering all the courses registered from first semester. RA grades will be excluded for calculating GPA and CGPA.

$$\text{GPA / CGPA} = \frac{\sum_{i=1}^n C_i \text{ GP}_i}{\sum_{i=1}^n C_i}$$

where  $C_i$  is the number of Credits assigned to the course

$\text{GP}_i$  is the point corresponding to the grade obtained for each course

$n$  is number of all courses successfully cleared during the particular semester in the case of GPA and during all the semesters in the case of CGPA.

## 16 ELIGIBILITY FOR THE AWARD OF THE DEGREE

**16.1** A student shall be declared to be eligible for the award of the B.E. / B.Tech. Degree provided the student has

- Successfully gained the required number of total credits as specified in the curriculum corresponding to the student's programme within the stipulated time.
- Successfully completed the course requirements, appeared for the End-Semester examinations and passed all the subjects prescribed in all the 8 semesters / (10 Semesters for B.E. Mechanical Engineering (Sandwich)) within a maximum period of 7 years (9 years in case of B.E. Mechanical Engineering (Sandwich) and 6 years in the case of Lateral Entry) reckoned from the commencement of the first (third in the case of Lateral Entry) semester to which the candidate was admitted.
- Successfully passed any additional courses prescribed by the Director, Academic Courses whenever readmitted under regulations R-2017 (vide clause 18.3)
- Successfully completed the NCC / NSS / NSO / YRC requirements.
- No disciplinary action pending against the student.
- The award of Degree must have been approved by the Syndicate of the University.

## 16.2 CLASSIFICATION OF THE DEGREE AWARDED

### 16.2.1 FIRST CLASS WITH DISTINCTION

A student who satisfies the following conditions shall be declared to have passed the examination in First class with Distinction:

- Should have passed the examination in all the courses of all the eight semesters (10 Semesters in case of Mechanical (Sandwich) and 6 semesters in the case of Lateral Entry) in the student's First Appearance within **five** years (Six years in the case of Mechanical (Sandwich) and Four years in the case of Lateral Entry). Withdrawal from examination (vide Clause 17) will not be considered as an appearance.
- Should have secured a CGPA of not less than **8.50**.
- One year authorized break of study (if availed of) is included in the five years (Six years in the case of Mechanical (Sandwich) and four years in the case of lateral entry) for award of First class with Distinction.
- Should NOT have been prevented from writing end semester examination due to lack of attendance in any semester.

#### 16.2.2 **FIRST CLASS:**

A student who satisfies the following conditions shall be declared to have passed the examination in **First class**:

- Should have passed the examination in all the courses of all eight semesters (10 Semesters in case of Mechanical (Sandwich) and 6 semesters in the case of Lateral Entry) **within Six years**. (Seven years in case of Mechanical (Sandwich) and Five years in the case of Lateral Entry)
- One year authorized break of study (if availed of) or prevention from writing the End Semester examination due to lack of attendance (if applicable) is included in the duration of six years (Seven years in case of Mechanical (Sandwich) and five years in the case of lateral entry) for award of First class
- Should have secured a CGPA of not less than **7.00**.

#### 16.2.3 **SECOND CLASS:**

All other students (not covered in clauses 16.2.1 and 16.2.2) who qualify for the award of the degree (vide Clause 16.1) shall be declared to have passed the examination in **Second Class**.

**16.3** A candidate who is absent in end semester examination in a course / project work after having registered for the same shall be considered to have appeared in that examination for the purpose of classification. (subject to clause 17 and 18)

#### 16.4 **Photocopy / Revaluation**

A candidate can apply for photocopy of his/her semester examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Head of Institutions. The answer script is to be valued and justified by a faculty member, who handled the subject and recommend for revaluation with breakup of marks for each question. Based on the recommendation, the candidate can register for the revaluation through proper application to the Controller of Examinations. The Controller of Examinations will arrange for the revaluation and the results will be intimated to the candidate concerned through the Head of the Institutions. Revaluation is not permitted for practical courses and for project work.

A candidate can apply for revaluation of answer scripts for not exceeding 5 subjects at a time.

#### 16.5 **Review**

Candidates not satisfied with Revaluation can apply for Review of his/ her examination answer paper in a theory course, within the prescribed date on payment of a prescribed fee through proper application to Controller of Examination through the Head of the Institution.

Candidates applying for Revaluation only are eligible to apply for Review.



## 17. PROVISION FOR WITHDRAWAL FROM END-SEMESTER EXAMINATION

- 17.1 A student may, for valid reasons, (medically unfit / unexpected family situations / sports approved by Chairman, sports board and HOD) be granted permission to withdraw from appearing for the end semester examination in any course or courses in **ANY ONE** of the semester examinations during the entire duration of the degree programme. The application shall be sent to Director, Student Affairs through the Head of the Institutions with required documents.
- 17.2 Withdrawal application is valid if the student is otherwise eligible to write the examination (Clause 7) and if it is made within TEN days prior to the commencement of the examination in that course or courses and recommended by the Head of the Institution and approved by the Controller of Examinations.
- 17.2.1 Notwithstanding the requirement of mandatory 10 days notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.
- 17.3 In case of withdrawal from a course / courses (Clause 13) the course will figure both in Marks Sheet as well as in Result Sheet. **Withdrawal essentially requires the student to register for the course/courses** The student has to register for the course, fulfill the attendance requirements (vide clause 7), earn continuous assessment marks and attend the end semester examination. However, withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction.
- 17.4 Withdrawal is permitted for the end semester examinations in the final semester only if the period of study the student concerned does not exceed 5 years as per clause 16.2.1.

## 18. PROVISION FOR AUTHORISED BREAK OF STUDY

- 18.1 A student is permitted to go on break of study for a maximum period of one year as a single spell.
- 18.2 Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for valid reasons, and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he / she applies to the Director, Student Affairs in advance, but not later than the last date for registering for the end semester examination of the semester in question, through the Head of the Institution stating the reasons therefore and the probable date of rejoining the programme.
- 18.3 The candidates permitted to rejoin the programme after break of study / prevention due to lack of attendance, shall be governed by the Curriculum and Regulations in force at the time of rejoining. The students rejoining in new Regulations shall apply to the Director, Academic Courses in the prescribed format through Head of the Institution at the beginning of the readmitted semester itself for prescribing additional courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.
- 18.4 The authorized break of study would not be counted towards the duration specified for passing all the courses for the purpose of classification (vide Clause 16.2).
- 18.5 The total period for completion of the Programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 5.1 irrespective of the period of break of study in order that he/she may be eligible for the award of the degree.
- 18.6 If any student is prevented for want of required attendance, the period of prevention shall not be considered as authorized 'Break of Study' (Clause 18.1)


**19. DISCIPLINE**

- 19.1 Every student is required to observe disciplined and decorous behavior both inside and outside the college and not to indulge in any activity which will tend to bring down the prestige of the University / College. The Head of Institution shall constitute a disciplinary committee consisting of Head of Institution, Two Heads of Department of which one should be from the faculty of the student, to enquire into acts of indiscipline and notify the University about the disciplinary action recommended for approval. In case of any serious disciplinary action which leads to suspension or dismissal, then a committee shall be constituted including one representative from Anna University, Chennai. In this regard, the member will be nominated by the University on getting information from the Head of the Institution.
- 19.2 If a student indulges in malpractice in any of the University / internal examination he / she shall be liable for punitive action as prescribed by the University from time to time.

**20. REVISION OF REGULATIONS, CURRICULUM AND SYLLABI**

The University may from time to time revise, amend or change the Regulations, Curriculum, Syllabus and scheme of examinations through the Academic Council with the approval of Syndicate.



  
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**ANNA UNIVERSITY, CHENNAI**  
**AFFILIATED INSTITUTIONS**  
**B.E. CIVIL ENGINEERING**  
**REGULATIONS – 2017**  
**CHOICE BASED CREDIT SYSTEM**

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :**

- I. To prepare students for successful careers in Civil Engineering field that meets the needs of Indian and multinational companies.
- II. To develop the confidence and ability among students to synthesize data and technical concepts and thereby apply it in real world problems.
- III. To develop students to use modern techniques, skill and mathematical engineering tools for solving problems in Civil Engineering.
- IV. To provide students with a sound foundation in mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyse engineering problems and to prepare them for graduate studies.
- V. To promote students to work collaboratively on multi-disciplinary projects and make them engage in life-long learning process throughout their professional life.

**PROGRAMME OUTCOMES (POs):**

On successful completion of the programme,

1. Graduates will demonstrate knowledge of mathematics, science and engineering.
2. Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
3. Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.
4. Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
5. Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.
6. Graduate will demonstrate skills to use modern engineering tools, software and equipment to analyze problems.
7. Graduates will demonstrate knowledge of professional and ethical responsibilities.
8. Graduate will be able to communicate effectively in both verbal and written form.
9. Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
10. Graduate will develop confidence for self education and ability for life-long learning.



## PEOs & POs

The B.E. Civil Engineering Program outcomes leading to the achievement of the objectives are summarized in the following Table.

| Programme Educational Objectives | Programme Outcomes |   |   |   |   |   |   |   |   |   |
|----------------------------------|--------------------|---|---|---|---|---|---|---|---|---|
|                                  | a                  | b | c | d | e | f | g | h | i | j |
| I                                | X                  | X |   | X | X |   |   |   |   |   |
| II                               |                    | X | X |   |   |   |   |   |   |   |
| III                              |                    |   |   | X |   |   | X |   |   |   |
| IV                               | X                  |   |   |   | X |   |   |   |   |   |
| V                                |                    |   |   |   |   | X |   | X | X | X |

|                                  |       |   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |  |
|----------------------------------|-------|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|--|
| YEAR 1                           | SEM 1 | Communicative English                             |     |     |     | ☐   |     |     |     | ☐   |     |      |  |
|                                  |       | Engineering Mathematics - I                       | ☐   |     |     |     |     |     |     |     |     |      |  |
|                                  |       | Engineering Physics                               | ☐   | ☐   | ☐   | ☐   | ☐   | ☐   |     |     |     |      |  |
|                                  |       | Engineering Chemistry                             | ☐   | ☐   | ☐   |     | ☐   | ☐   | ☐   |     |     |      |  |
|                                  |       | Problem Solving and Python Programming            | ☐   | ☐   |     |     | ☐   | ☐   | ☐   |     |     |      |  |
|                                  |       | Engineering Graphics                              | ☐   | ☐   | ☐   |     | ☐   | ☐   | ☐   |     | ☐   | ☐    |  |
|                                  |       | Problem Solving and Python Programming Laboratory | ☐   | ☐   |     |     | ☐   | ☐   | ☐   |     |     |      |  |
|                                  |       | Physics and Chemistry Laboratory                  | ☐   | ☐   |     |     | ☐   | ☐   | ☐   |     |     |      |  |
|                                  |       |   |     |     |     |     |     |     |     |     |     |      |  |
|                                  | SEM 2 | Technical English                                 |     |     |     | ☐   |     |     |     |     | ☐   |      |  |
|                                  |       | Engineering Mathematics - II                      | ☐   |     |     |     |     |     |     |     |     |      |  |
|                                  |       | Physics for Civil Engineering                     | ☐   | ☐   | ☐   | ☐   | ☐   | ☐   |     |     |     |      |  |
|                                  |       | Basic Electrical and Electronics Engineering      |     |     |     |     |     |     |     |     |     |      |  |
|                                  |       | Environmental Science and Engineering             |     |     |     |     |     |     |     | ✓   |     | ✓    |  |
|                                  |       | Engineering Mechanics                             | ☐   | ☐   | ☐   |     | ☐   | ☐   | ☐   |     | ☐   | ☐    |  |
| Engineering Practices Laboratory |       | ☐   | ☐   |     |     |     | ☐   | ☐   |     |     |     |      |  |
| Computer Aided Building Drawing  |       |   |     |     |     |     |     |     |     |     |     |      |  |
|                                  |       |   |     |     |     |     |     |     |     |     |     |      |  |
|                                  |       |   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |  |
| YEAR 2                           | SEM 3 | Transforms and Partial Differential Equations     |     |     |     |     |     |     |     |     |     |      |  |
|                                  |       | Engineering Geology                               |     | ✓   | ✓   |     | ✓   |     | ✓   |     |     | ✓    |  |
|                                  |       | Construction Materials                            |     | ✓   | ✓   |     | ✓   |     | ✓   |     |     | ✓    |  |
|                                  |       | Strength of Materials I                           | ✓   | ✓   | ✓   | ✓   | ✓   |     |     |     |     | ✓    |  |
|                                  |       | Fluid Mechanics                                   | ✓   | ✓   |     | ✓   |     |     | ✓   | ✓   | ✓   | ✓    |  |
|                                  |       | Surveying   |     | ✓   | ✓   |     | ✓   |     | ✓   |     |     | ✓    |  |
|                                  |       | Surveying Laboratory                              |     |     |     |     |     |     |     |     |     |      |  |
|                                  |       | Construction Materials Laboratory                 |     |     |     |     |     |     |     |     |     |      |  |

|               |                              |   |   |            |            |            |            |            |            |            |            |             |   |
|---------------|------------------------------|---|---|------------|------------|------------|------------|------------|------------|------------|------------|-------------|---|
|               |                              | Interpersonal Skills / Listening and Speaking |   |            |            |            |            |            |            |            |            |             |   |
|               |                              |   |   |            |            |            |            |            |            |            |            |             |   |
|               | <b>SEM 4</b>                 |   | Numerical Methods                             |            |            |            |            |            |            |            |            |             |   |
|               |                              |   | Construction Techniques and Practices         |            | ✓          |            |            | ✓          |            | ✓          |            | ✓           | ✓ |
|               |                              |   | Strength of Materials II                      | ✓          | ✓          | ✓          | ✓          | ✓          |            |            |            |             | ✓ |
|               |                              |   | Applied Hydraulic Engineering                 | ✓          | ✓          |            | ✓          |            |            | ✓          | ✓          | ✓           | ✓ |
|               |                              |   | Concrete Technology                           | ✓          | ✓          |            | ✓          |            |            | ✓          | ✓          | ✓           | ✓ |
|               |                              |   | Soil Mechanics                                | ✓          | ✓          |            |            |            |            | ✓          | ✓          | ✓           | ✓ |
|               |                              |   | Strength of Materials Laboratory              | ✓          | ✓          | ✓          | ✓          | ✓          |            |            |            |             | ✓ |
|               |                              | Hydraulic Engineering Laboratory              | ✓   |            | ✓          |            | ✓          | ✓          | ✓          | ✓          | ✓          | ✓           |   |
|               | Advanced Reading and Writing |   |   |            |            |            |            |            |            |            |            |             |   |
|               |                              |   | <b>PO1</b>                                    | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PO6</b> | <b>PO7</b> | <b>PO8</b> | <b>PO9</b> | <b>PO10</b> |   |
| <b>YEAR 3</b> | <b>SEM 5</b>                 |   | Design of Reinforced Cement Concrete Elements | ✓          | ✓          | ✓          | ✓          | ✓          |            |            |            | ✓           |   |
|               |                              |   | Foundation Engineering                        |            | ✓          |            | ✓          |            |            | ✓          |            | ✓           | ✓ |
|               |                              |   | Structural Analysis I                         | ✓          | ✓          | ✓          | ✓          | ✓          |            |            |            | ✓           | ✓ |
|               |                              |   | Water Supply Engineering                      |            |            | ✓          | ✓          | ✓          | ✓          |            |            | ✓           |   |
|               |                              |   | Open Elective- I*                             |            |            |            |            |            |            |            |            |             |   |
|               |                              |   | Professional Elective I                       |            |            |            |            |            |            |            |            |             |   |
|               |                              |   | Water and Waste Water Analysis Laboratory     |            | ✓          |            | ✓          |            |            | ✓          |            |             | ✓ |
|               |                              |   | Soil Mechanics Laboratory                     |            |            | ✓          |            | ✓          | ✓          |            |            |             |   |
|               |                              | Survey Camp (2 weeks-During V Semester)       |   |            | ✓          | ✓          |            |            |            |            | ✓          |             |   |
|               |                              |   |   |            |            |            |            |            |            |            |            |             |   |
|               | <b>SEM 6</b>                 |   | Design of Steel Structural Elements           | ✓          | ✓          | ✓          | ✓          | ✓          |            |            |            |             | ✓ |
|               |                              |   | Structural Analysis II                        | ✓          | ✓          | ✓          | ✓          | ✓          |            |            |            | ✓           | ✓ |
|               |                              |   | Irrigation Engineering                        | ✓          | ✓          |            | ✓          |            |            |            |            |             |   |
|               |                              | Wastewater Engineering                        | ✓   | ✓          |            | ✓          |            |            |            |            |            |             |   |

|               |              |  |            |            |            |            |            |            |            |            |            |             |   |
|---------------|--------------|--|------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|---|
|               |              | Highway Engineering  |            | ✓          | ✓          | ✓          | ✓          |            |            | ✓          |            |             |   |
|               |              | Professional Elective II   |            |            |            |            |            |            |            |            |            |             |   |
|               |              | Highway Engineering Laboratory                                     |            |            |            |            |            |            |            | ✓          |            |             |   |
|               |              | Irrigation and Environmental Engineering Drawing                   |            |            |            |            |            |            |            |            |            |             |   |
|               |              | Professional Communication   |            |            |            |            |            |            |            |            |            |             |   |
|               |              |  | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PO6</b> | <b>PO7</b> | <b>PO8</b> | <b>PO9</b> | <b>PO10</b> |   |
| <b>YEAR 4</b> | <b>SEM 7</b> | Estimation, Costing and Valuation Engineering                      | ✓          | ✓          |            |            |            | ✓          | ✓          |            |            | ✓           |   |
|               |              | Railways, Airports, Docks and Harbour Engineering                  |            | ✓          |            | ✓          |            |            | ✓          |            | ✓          | ✓           |   |
|               |              | Structural Design and Drawing                                      | ✓          | ✓          | ✓          | ✓          |            | ✓          |            |            |            | ✓           |   |
|               |              | Professional Elective III  |            |            |            |            |            |            |            |            |            |             |   |
|               |              | Open Elective II*  |            |            |            |            |            |            |            |            |            |             |   |
|               |              | Creative and Innovative Project (Activity Based - Subject Related) |            | ✓          |            | ✓          |            |            |            | ✓          |            |             | ✓ |
|               |              | Industrial Training (4 weeks During VI semester-Summer)            |            |            |            |            | ✓          |            |            | ✓          | ✓          |             | ✓ |
|               |              |  |            |            |            |            |            |            |            |            |            |             |   |
|               | <b>SEM 8</b> | Professional Elective IV   |            |            |            |            |            |            |            |            |            |             |   |
|               |              | Professional Elective V  |            |            |            |            |            |            |            |            |            |             |   |
| Project Work  |              |  | ✓          |            | ✓          |            |            |            | ✓          |            |            | ✓           |   |

**ANNA UNIVERSITY, CHENNAI**  
**AFFILIATED INSTITUTIONS**  
**B.E. CIVIL ENGINEERING**  
**REGULATIONS – 2017**  
**CHOICE BASED CREDIT SYSTEM**  
**I TO VIII SEMESTERS CURRICULA & SYLLABI**  
**SEMESTER I**

| S.No              | COURSE CODE | COURSE TITLE                                      | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |           |           |
| 1.                | HS8151      | Communicative English                             | HS       | 4               | 4         | 0        | 0         | 4         |
| 2.                | MA8151      | Engineering Mathematics - I                       | BS       | 4               | 4         | 0        | 0         | 4         |
| 3.                | PH8151      | Engineering Physics                               | BS       | 3               | 3         | 0        | 0         | 3         |
| 4.                | CY8151      | Engineering Chemistry                             | BS       | 3               | 3         | 0        | 0         | 3         |
| 5.                | GE8151      | Problem Solving and Python Programming            | ES       | 3               | 3         | 0        | 0         | 3         |
| 6.                | GE8152      | Engineering Graphics                              | ES       | 6               | 2         | 0        | 4         | 4         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |           |           |
| 7.                | GE8161      | Problem Solving and Python Programming Laboratory | ES       | 4               | 0         | 0        | 4         | 2         |
| 8.                | BS8161      | Physics and Chemistry Laboratory                  | BS       | 4               | 0         | 0        | 4         | 2         |
| <b>TOTAL</b>      |             |   |          | <b>31</b>       | <b>19</b> | <b>0</b> | <b>12</b> | <b>25</b> |

**SEMESTER II**

| S.No              | COURSE CODE | COURSE TITLE                                 | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|--|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |  |          |                 |           |          |          |           |
| 1.                | HS8251      | Technical English                            | HS       | 4               | 4         | 0        | 0        | 4         |
| 2.                | MA8251      | Engineering Mathematics - II                 | BS       | 4               | 4         | 0        | 0        | 4         |
| 3.                | PH8201      | Physics For Civil Engineering                | BS       | 3               | 3         | 0        | 0        | 3         |
| 4.                | BE8251      | Basic Electrical and Electronics Engineering | ES       | 3               | 3         | 0        | 0        | 3         |
| 5.                | GE8291      | Environmental Science and Engineering        | HS       | 3               | 3         | 0        | 0        | 3         |
| 6.                | GE8292      | Engineering Mechanics                        | ES       | 5               | 3         | 2        | 0        | 4         |
| <b>PRACTICALS</b> |             |  |          |                 |           |          |          |           |
| 7.                | GE8261      | Engineering Practices Laboratory             | ES       | 4               | 0         | 0        | 4        | 2         |
| 8.                | CE8211      | Computer Aided Building Drawing              | PC       | 4               | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>      |             |  |          | <b>30</b>       | <b>20</b> | <b>2</b> | <b>8</b> | <b>25</b> |



**SEMESTER III**

| S.No              | COURSE CODE | COURSE TITLE                                  | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |           |           |
| 1.                | MA8353      | Transforms and Partial Differential Equations | BS       | 4               | 4         | 0        | 0         | 4         |
| 2.                | CE8301      | Strength of Materials I                       | PC       | 3               | 3         | 0        | 0         | 3         |
| 3.                | CE8302      | Fluid Mechanics                               | PC       | 3               | 3         | 0        | 0         | 3         |
| 4.                | CE8351      | Surveying                                     | PC       | 3               | 3         | 0        | 0         | 3         |
| 5.                | CE8391      | Construction Materials                        | PC       | 3               | 3         | 0        | 0         | 3         |
| 6.                | CE8392      | Engineering Geology                           | ES       | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |           |           |
| 7.                | CE8311      | Construction Materials Laboratory             | PC       | 4               | 0         | 0        | 4         | 2         |
| 8.                | CE8361      | Surveying Laboratory                          | PC       | 4               | 0         | 0        | 4         | 2         |
| 9.                | HS8381      | Interpersonal Skills / Listening and Speaking | EEC      | 2               | 0         | 0        | 2         | 1         |
| <b>TOTAL</b>      |             |   |          | <b>29</b>       | <b>19</b> | <b>0</b> | <b>10</b> | <b>24</b> |

**SEMESTER IV**

| S.No              | COURSE CODE | COURSE TITLE                          | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---------------------------------------|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |                                       |          |                 |           |          |           |           |
| 1.                | MA8491      | Numerical Methods                     | BS       | 4               | 4         | 0        | 0         | 4         |
| 2.                | CE8401      | Construction Techniques and Practices | PC       | 3               | 3         | 0        | 0         | 3         |
| 3.                | CE8402      | Strength of Materials II              | PC       | 3               | 3         | 0        | 0         | 3         |
| 4.                | CE8403      | Applied Hydraulic Engineering         | PC       | 3               | 3         | 0        | 0         | 3         |
| 5.                | CE8404      | Concrete Technology                   | PC       | 3               | 3         | 0        | 0         | 3         |
| 6.                | CE8491      | Soil Mechanics                        | PC       | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |                                       |          |                 |           |          |           |           |
| 7.                | CE8481      | Strength of Materials Laboratory      | PC       | 4               | 0         | 0        | 4         | 2         |
| 8.                | CE8461      | Hydraulic Engineering Laboratory      | PC       | 4               | 0         | 0        | 4         | 2         |
| 9.                | HS8461      | Advanced Reading and Writing          | EEC      | 2               | 0         | 0        | 2         | 1         |
| <b>TOTAL</b>      |             |                                       |          | <b>29</b>       | <b>19</b> | <b>0</b> | <b>10</b> | <b>24</b> |

### SEMESTER V

| S.No              | COURSE CODE | COURSE TITLE                                  | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |          |           |
| 1.                | CE8501      | Design of Reinforced Cement Concrete Elements | PC       | 5               | 3         | 2        | 0        | 4         |
| 2.                | CE8502      | Structural Analysis I                         | PC       | 3               | 3         | 0        | 0        | 3         |
| 3.                | EN8491      | Water Supply Engineering                      | PC       | 3               | 3         | 0        | 0        | 3         |
| 4.                | CE8591      | Foundation Engineering                        | PC       | 3               | 3         | 0        | 0        | 3         |
| 5.                |             | Professional Elective I                       | PE       | 3               | 3         | 0        | 0        | 3         |
| 6.                |             | Open Elective I*                              | OE       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |          |           |
| 7.                | CE8511      | Soil Mechanics Laboratory                     | PC       | 4               | 0         | 0        | 4        | 2         |
| 8.                | CE8512      | Water and Waste Water Analysis Laboratory     | PC       | 4               | 0         | 0        | 4        | 2         |
| 9.                | CE8513      | Survey Camp (2 weeks -During IV Semester)     | EEC      | 0               | 0         | 0        | 0        | 2         |
| <b>TOTAL</b>      |             |   |          | <b>28</b>       | <b>18</b> | <b>2</b> | <b>8</b> | <b>25</b> |

### SEMESTER VI

| S.No              | COURSE CODE | COURSE TITLE                                     | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|--|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |  |          |                 |           |          |           |           |
| 1.                | CE8601      | Design of Steel Structural Elements              | PC       | 5               | 3         | 2        | 0         | 4         |
| 2.                | CE8602      | Structural Analysis II                           | PC       | 3               | 3         | 0        | 0         | 3         |
| 3.                | CE8603      | Irrigation Engineering                           | PC       | 3               | 3         | 0        | 0         | 3         |
| 4.                | CE8604      | Highway Engineering                              | PC       | 3               | 3         | 0        | 0         | 3         |
| 5.                | EN8592      | Wastewater Engineering                           | PC       | 3               | 3         | 0        | 0         | 3         |
| 6.                |             | Professional Elective II                         | PE       | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |  |          |                 |           |          |           |           |
| 7.                | CE8611      | Highway Engineering Laboratory                   | PC       | 4               | 0         | 0        | 4         | 2         |
| 8.                | CE8612      | Irrigation and Environmental Engineering Drawing | PC       | 4               | 0         | 0        | 4         | 2         |
| 9.                | HS8581      | Professional Communication                       | EEC      | 2               | 0         | 0        | 2         | 1         |
| <b>TOTAL</b>      |             |  |          | <b>30</b>       | <b>18</b> | <b>2</b> | <b>10</b> | <b>24</b> |

**SEMESTER VII**

| S.No              | COURSE CODE | COURSE TITLE   | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|--|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |  |          |                 |           |          |          |           |
| 1.                | CE8701      | Estimation, Costing and Valuation Engineering                      | PC       | 3               | 3         | 0        | 0        | 3         |
| 2.                | CE8702      | Railways, Airports, Docks and Harbour Engineering                  | PC       | 3               | 3         | 0        | 0        | 3         |
| 3.                | CE8703      | Structural Design and Drawing                                      | PC       | 5               | 3         | 0        | 2        | 4         |
| 4.                |             | Professional Elective III  | PE       | 3               | 3         | 0        | 0        | 3         |
| 5.                |             | Open Elective II*  | OE       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |  |          |                 |           |          |          |           |
| 6.                | CE8711      | Creative and Innovative Project (Activity Based - Subject Related) | EEC      | 4               | 0         | 0        | 4        | 2         |
| 7.                | CE8712      | Industrial Training (4 weeks During VI Semester – Summer)          | EEC      | 0               | 0         | 0        | 0        | 2         |
| <b>TOTAL</b>      |             |  |          | <b>21</b>       | <b>15</b> | <b>0</b> | <b>6</b> | <b>20</b> |

**SEMESTER VIII**

| S.No              | COURSE CODE | COURSE TITLE             | CATEGORY | CONTACT PERIODS | L        | T        | P         | C         |
|-------------------|-------------|--------------------------|----------|-----------------|----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |                          |          |                 |          |          |           |           |
| 1.                |             | Professional Elective IV | PE       | 3               | 3        | 0        | 0         | 3         |
| 2.                |             | Professional Elective V  | PE       | 3               | 3        | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |                          |          |                 |          |          |           |           |
| 3.                | CE8811      | Project Work             | EEC      | 20              | 0        | 0        | 20        | 10        |
| <b>TOTAL</b>      |             |                          |          | <b>26</b>       | <b>6</b> | <b>0</b> | <b>20</b> | <b>16</b> |

**TOTAL NO. OF CREDITS: 183**

\*Course from the curriculum of other UG Programmes.

### HUMANITIES AND SOCIAL SCIENCES (HS)

| S.No | COURSE CODE | COURSE TITLE                          | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|---------------------------------------|----------|-----------------|---|---|---|---|
| 1.   | HS8151      | Communicative English                 | HS       | 4               | 4 | 0 | 0 | 4 |
| 2.   | HS8251      | Technical English                     | HS       | 4               | 4 | 0 | 0 | 4 |
| 3.   | GE8291      | Environmental Science and Engineering | HS       | 3               | 3 | 0 | 0 | 3 |

### BASIC SCIENCES (BS)

| S.No | COURSE CODE | COURSE TITLE                                  | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|---|----------|-----------------|---|---|---|---|
| 1.   | MA8151      | Engineering Mathematics - I                   | BS       | 4               | 4 | 0 | 0 | 4 |
| 2.   | PH8151      | Engineering Physics                           | BS       | 3               | 3 | 0 | 0 | 3 |
| 3.   | CY8151      | Engineering Chemistry                         | BS       | 3               | 3 | 0 | 0 | 3 |
| 4.   | BS8161      | Physics and Chemistry Laboratory              | BS       | 4               | 0 | 0 | 4 | 2 |
| 5.   | MA8251      | Engineering Mathematics - II                  | BS       | 4               | 4 | 0 | 0 | 4 |
| 6.   | PH8201      | Physics for Civil Engineering                 | BS       | 3               | 3 | 0 | 0 | 3 |
| 7.   | MA8353      | Transforms and Partial Differential Equations | BS       | 4               | 4 | 0 | 0 | 4 |
| 8.   | MA8491      | Numerical Methods                             | BS       | 4               | 4 | 0 | 0 | 4 |

### ENGINEERING SCIENCES (ES)

| S.No. | COURSE CODE | COURSE TITLE                                      | CATEGORY | CONTACT PERIODS | L | T | P | C |
|-------|-------------|---|----------|-----------------|---|---|---|---|
| 1.    | GE8151      | Problem Solving and Python Programming            | ES       | 3               | 3 | 0 | 0 | 3 |
| 2.    | GE8152      | Engineering Graphics                              | ES       | 6               | 2 | 0 | 4 | 4 |
| 3.    | GE8161      | Problem Solving and Python Programming Laboratory | ES       | 4               | 0 | 0 | 4 | 2 |
| 4.    | BE8251      | Basic Electrical and Electronics Engineering      | ES       | 3               | 3 | 0 | 0 | 3 |
| 5.    | GE8292      | Engineering Mechanics                             | ES       | 5               | 3 | 2 | 0 | 4 |
| 6.    | GE8261      | Engineering Practices Laboratory                  | ES       | 4               | 0 | 0 | 4 | 2 |
| 7.    | CE8392      | Engineering Geology                               | ES       | 3               | 3 | 0 | 0 | 3 |

### PROFESSIONAL CORE (PC)

| S.No | COURSE CODE | COURSE TITLE                    | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|---------------------------------|----------|-----------------|---|---|---|---|
| 1.   | CE8211      | Computer Aided Building Drawing | PC       | 4               | 0 | 0 | 4 | 2 |
| 2.   | CE8391      | Construction Materials          | PC       | 3               | 3 | 0 | 0 | 3 |
| 3.   | CE8301      | Strength of Materials I         | PC       | 3               | 3 | 0 | 0 | 3 |
| 4.   | CE8302      | Fluid Mechanics                 | PC       | 3               | 3 | 0 | 0 | 3 |
| 5.   | CE8351      | Surveying                       | PC       | 3               | 3 | 0 | 0 | 3 |

|     |        |   |    |   |   |   |   |   |
|-----|--------|---|----|---|---|---|---|---|
| 6.  | CE8481 | Strength of Materials Laboratory                  | PC | 4 | 0 | 0 | 4 | 2 |
| 7.  | CE8361 | Surveying Laboratory                              | PC | 4 | 0 | 0 | 4 | 2 |
| 8.  | CE8311 | Construction Materials Laboratory                 | PC | 4 | 0 | 0 | 4 | 2 |
| 9.  | CE8401 | Construction Techniques and Practices             | PC | 3 | 3 | 0 | 0 | 3 |
| 10. | CE8402 | Strength of Materials II                          | PC | 3 | 3 | 0 | 0 | 3 |
| 11. | CE8403 | Applied Hydraulic Engineering                     | PC | 3 | 3 | 0 | 0 | 3 |
| 12. | CE8404 | Concrete Technology                               | PC | 3 | 3 | 0 | 0 | 3 |
| 13. | CE8491 | Soil Mechanics                                    | PC | 3 | 3 | 0 | 0 | 3 |
| 14. | CE8461 | Hydraulic Engineering Laboratory                  | PC | 4 | 0 | 0 | 4 | 2 |
| 15. | CE8501 | Design of Reinforced Cement Concrete Elements     | PC | 5 | 3 | 2 | 0 | 4 |
| 16. | CE8502 | Structural Analysis I                             | PC | 3 | 3 | 0 | 0 | 3 |
| 17. | CE8511 | Soil Mechanics Laboratory                         | PC | 4 | 0 | 0 | 4 | 2 |
| 18. | CE8512 | Water and Waste Water Analysis Laboratory         | PC | 4 | 0 | 0 | 4 | 2 |
| 19. | CE8591 | Foundation Engineering                            | PC | 3 | 3 | 0 | 0 | 3 |
| 20. | CE8601 | Design of Steel Structural Elements               | PC | 5 | 3 | 2 | 0 | 4 |
| 21. | CE8602 | Structural Analysis II                            | PC | 3 | 3 | 0 | 0 | 3 |
| 22. | CE8603 | Irrigation Engineering                            | PC | 3 | 3 | 0 | 0 | 3 |
| 23. | CE8604 | Highway Engineering                               | PC | 3 | 3 | 0 | 0 | 3 |
| 24. | CE8611 | Highway Engineering Laboratory                    | PC | 4 | 0 | 0 | 4 | 2 |
| 25. | CE8612 | Irrigation and Environmental Engineering Drawing  | PC | 4 | 0 | 0 | 4 | 2 |
| 26. | EN8592 | Wastewater Engineering                            | PC | 3 | 3 | 0 | 0 | 3 |
| 27. | EN8491 | Water Supply Engineering                          | PC | 3 | 3 | 0 | 0 | 3 |
| 28. | CE8701 | Estimation, Costing and Valuation Engineering     | PC | 3 | 3 | 0 | 0 | 3 |
| 29. | CE8702 | Railways, Airports, Docks and Harbour Engineering | PC | 3 | 3 | 0 | 0 | 3 |
| 30. | CE8703 | Structural Design and Drawing                     | PC | 5 | 3 | 0 | 2 | 4 |

**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

| S.No | COURSE CODE | COURSE TITLE   | CATEGORY | CONTACT PERIODS | L | T | P  | C  |
|------|-------------|--|----------|-----------------|---|---|----|----|
| 1.   | HS8381      | Interpersonal Skills / Listening and Speaking                      | EEC      | 2               | 0 | 0 | 2  | 1  |
| 2.   | HS8461      | Advanced Reading and Writing                                       | EEC      | 2               | 0 | 0 | 2  | 1  |
| 3.   | CE8513      | Survey Camp (2 weeks - During IV Semester)                         | EEC      | 0               | 0 | 0 | 0  | 2  |
| 4.   | HS8581      | Professional Communication   | EEC      | 2               | 0 | 0 | 2  | 1  |
| 5.   | CE8711      | Creative and Innovative Project (Activity Based - Subject Related) | EEC      | 4               | 0 | 0 | 4  | 2  |
| 6.   | CE8712      | Industrial Training (4 weeks During VI Semester - Summer)          | EEC      | 0               | 0 | 0 | 0  | 2  |
| 7.   | CE8811      | Project Work   | EEC      | 20              | 0 | 0 | 20 | 10 |

**PROFESSIONAL ELECTIVE  
SEMESTER V  
ELECTIVE - I**

| S.No | COURSE CODE | COURSE TITLE                                    | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|---|----------|-----------------|---|---|---|---|
| 1.   | GI8012      | Digital Cadastre                                | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.   | GI8013      | Advanced Surveying                              | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.   | GI8014      | Geographic Information System                   | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.   | GI8015      | Geoinformatics Applications for Civil Engineers | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.   | GI8491      | Total Station and GPS Surveying                 | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.   | GE8071      | Disaster Management                             | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.   | GE8074      | Human Rights                                    | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VI  
ELECTIVE - II**

| S.No | COURSE CODE | COURSE TITLE  | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|---|----------|-----------------|---|---|---|---|
| 1.   | CE8001      | Ground Improvement Techniques                         | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.   | CE8002      | Introduction to Soil Dynamics and Machine Foundations | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.   | CE8003      | Rock Engineering                                      | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.   | CE8004      | Urban Planning and Development                        | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.   | CE8005      | Air Pollution and Control Engineering                 | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.   | GE8075      | Intellectual Property Rights                          | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VII  
ELECTIVE – III**

| S.No | COURSE CODE | COURSE TITLE  | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|---|----------|-----------------|---|---|---|---|
| 1.   | CE8006      | Pavement Engineering                                | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.   | CE8007      | Traffic Engineering and Management                  | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.   | CE8008      | Transport and Environment                           | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.   | CE8009      | Industrial Structures                               | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.   | CE8010      | Environmental and Social Impact Assessment          | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.   | CE8011      | Design of Prestressed Concrete Structures           | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.   | CE8012      | Construction Planning and Scheduling                | PE       | 3               | 3 | 0 | 0 | 3 |
| 8.   | EN8591      | Municipal Solid Waste Management                    | PE       | 3               | 3 | 0 | 0 | 3 |
| 9.   | GE8077      | Total Quality Management                            | PE       | 3               | 3 | 0 | 0 | 3 |
| 10.  | GE8072      | Foundation Skills In Integrated Product Development | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VIII  
ELECTIVE – IV**

| S.No | COURSE CODE | COURSE TITLE                              | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|---|----------|-----------------|---|---|---|---|
| 1.   | CE8013      | Coastal Engineering                       | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.   | CE8014      | Participatory Water Resources Management  | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.   | CE8015      | Integrated Water Resources Management     | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.   | CE8016      | Groundwater Engineering                   | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.   | CE8017      | Water Resources Systems Engineering       | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.   | CE8018      | Geo-Environmental Engineering             | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.   | CE8091      | Hydrology and Water Resources Engineering | PE       | 3               | 3 | 0 | 0 | 3 |
| 8.   | GE8076      | Professional Ethics in Engineering        | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VIII  
ELECTIVE – V**

| S.No | COURSE CODE | COURSE TITLE   | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|--|----------|-----------------|---|---|---|---|
| 1.   | CE8019      | Computer Aided Design of Structures                  | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.   | CE8020      | Maintenance, Repair and Rehabilitation of Structures | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.   | CE8021      | Structural Dynamics and Earthquake Engineering       | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.   | CE8022      | Prefabricated Structures                             | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.   | CE8023      | Bridge Engineering                                   | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.   | GE8073      | Fundamentals of Nanoscience                          | PE       | 3               | 3 | 0 | 0 | 3 |

**SUMMARY**

| S.No | Subject Area                | Credits per Semester |           |           |           |           |           |           |           | Credits Total |
|------|-----------------------------|----------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------------|
|      |                             | I                    | II        | III       | IV        | V         | VI        | VII       | VIII      |               |
| 1    | HS                          | 4                    | 7         |           |           |           |           |           |           | 11            |
| 2    | BS                          | 12                   | 7         | 4         | 4         |           |           |           |           | 27            |
| 3    | ES                          | 9                    | 9         | 3         |           |           |           |           |           | 21            |
| 4    | PC                          |                      | 2         | 16        | 19        | 17        | 20        | 10        |           | 84            |
| 5    | PE                          |                      |           |           |           | 3         | 3         | 3         | 6         | 15            |
| 6    | OE                          |                      |           |           |           | 3         |           | 3         |           | 6             |
| 7    | EEC                         |                      |           | 1         | 1         | 2         | 1         | 4         | 10        | 19            |
|      | <b>Total</b>                | <b>25</b>            | <b>25</b> | <b>24</b> | <b>24</b> | <b>25</b> | <b>24</b> | <b>20</b> | <b>16</b> | <b>183</b>    |
| 8    | <b>Non-Credit/Mandatory</b> |                      |           |           |           |           |           |           |           |               |



**OBJECTIVES:**

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

**UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 12**

**Reading-** short comprehension passages, practice in skimming-scanning and predicting-  
**Writing-** completing sentences- - developing hints. **Listening-** short texts- short formal and informal conversations. **Speaking-** introducing oneself - exchanging personal information-  
**Language development-** Wh- Questions- asking and answering-yes or no questions- parts of speech. **Vocabulary development--** prefixes- suffixes- articles.- count/ uncount nouns.

**UNIT II GENERAL READING AND FREE WRITING 12**

**Reading** - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register- **Writing** - paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures -**Listening-** telephonic conversations. **Speaking** – sharing information of a personal kind–greeting - taking leave- **Language development** – prepositions, conjunctions **Vocabulary development-** guessing meanings of words in context.

**UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 12**

**Reading-** short texts and longer passages (close reading) **Writing-** understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences  
**Listening** – listening to longer texts and filling up the table- product description- narratives from different sources. **Speaking-** asking about routine actions and expressing opinions. **Language development-** degrees of comparison- pronouns- direct vs indirect questions- **Vocabulary development** – single word substitutes- adverbs.

**UNIT IV READING AND LANGUAGE DEVELOPMENT 12**

**Reading-** comprehension-reading longer texts- reading different types of texts- magazines  
**Writing-** letter writing, informal or personal letters-e-mails-conventions of personal email-  
**Listening-** listening to dialogues or conversations and completing exercises based on them.  
**Speaking-** speaking about oneself- speaking about one's friend- **Language development-** Tenses- simple present-simple past- present continuous and past continuous- **Vocabulary development-** synonyms-antonyms- phrasal verbs

**UNIT V EXTENDED WRITING 12**

**Reading-** longer texts- close reading -**Writing-** brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing-**Listening** – listening to talks- conversations- **Speaking** – participating in conversations- short group conversations-**Language development-**modal verbs- present/ past perfect tense - **Vocabulary development-**collocations- fixed and semi-fixed expressions

**OUTCOMES: At the end of the course, learners will be able to:**

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English
- Write short essays of a general kind and personal letters and emails in English.

## TEXT BOOKS:

1. Board of Editors. **Using English** A Coursebook for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015
2. Richards, C. Jack. **Interchange Students' Book-2** New Delhi: CUP, 2015.

## REFERENCES

1. Bailey, Stephen. **Academic Writing: A practical guide for students**. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. **Speaking Effectively: Developing Speaking Skills for Business English**. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and Rajeevan Geeta. **Basic Communication Skills**, Foundation Books: 2013
4. Means, L. Thomas and Elaine Langlois. **English & Communication For Colleges**. Cengage Learning, USA: 2007
5. Redston, Chris & Gillies Cunningham **Face2Face** (Pre-intermediate Student's Book & Workbook) Cambridge University Press, New Delhi: 2005

MA8151

ENGINEERING MATHEMATICS – I

L T P C

4 0 0 4

## OBJECTIVES :

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

### UNIT I DIFFERENTIAL CALCULUS

12

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

### UNIT II 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 - Lagrange's method of undetermined multipliers.

### UNIT III 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 IV 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.

### UNIT V DIFFERENTIAL EQUATIONS

12

Higher order linear differential equations with constant coefficients - Method of variation of parameters - Homogeneous equation of Euler's and Legendre's type - System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

**TOTAL : 60 PERIODS**

## OUTCOMES :

After completing this course, students should demonstrate competency in the following skills:

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.

- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Apply various techniques in solving differential equations.

#### TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7<sup>th</sup> Edition, New Delhi, 2015. [For Units I & III - 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].

#### REFERENCES:

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10<sup>th</sup> Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3<sup>rd</sup> Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, "Thomas Calculus", 12<sup>th</sup> Edition, Pearson India, 2016.

PH8151

ENGINEERING PHYSICS

| L | T | P | C |
|---|---|---|---|
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#### OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

#### UNIT I                      PROPERTIES OF MATTER                      9

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment - cantilever: theory and experiment - uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

#### UNIT II                      WAVES AND FIBER OPTICS                      9

Oscillatory motion - forced and damped oscillations: differential equation and its solution - plane progressive waves - wave equation. Lasers : population of energy levels, Einstein's A and B coefficients derivation - resonant cavity, optical amplification (qualitative) - Semiconductor lasers: homojunction and heterojunction - Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) - losses associated with optical fibers - fibre optic sensors: pressure and displacement.

#### UNIT III                      THERMAL PHYSICS                      9

Transfer of heat energy - thermal expansion of solids and liquids - expansion joints - bimetallic strips - thermal conduction, convection and radiation - heat conduction in solids - thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) - thermal insulation - applications: heat exchangers, refrigerators, ovens and solar water heaters.

**UNIT IV QUANTUM PHYSICS 9**

Black body radiation - Planck's theory (derivation) - Compton effect: theory and experimental verification - wave particle duality - electron diffraction - concept of wave function and its physical significance - Schrödinger's wave equation - time independent and time dependent equations - particle in a one-dimensional rigid box - tunnelling (qualitative) - scanning tunnelling microscope.

**UNIT V CRYSTAL PHYSICS 9**

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

**TOTAL :45 PERIODS**

**OUTCOMES:**

Upon completion of this course,

- the students will gain knowledge on the basics of properties of matter and its applications,
- the students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
- the students will understand the basics of crystals, their structures and different crystal growth techniques.

**TEXT BOOKS:**

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

**REFERENCES:**

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics". W.H.Freeman, 2007.

**CY8151**

**ENGINEERING CHEMISTRY**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

**UNIT I WATER AND ITS TREATMENT 9**

Hardness of water - types - expression of hardness - units - estimation of hardness of water by EDTA - numerical problems - boiler troubles (scale and sludge) - treatment of boiler feed water - Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment - Ion exchange process, zeolite process - desalination of brackish water - Reverse Osmosis.

**UNIT II SURFACE CHEMISTRY AND CATALYSIS 9**

Adsorption: Types of adsorption - adsorption of gases on solids - adsorption of solute from solutions - adsorption isotherms - Freundlich's adsorption isotherm - Langmuir's adsorption isotherm - contact theory - kinetics of surface reactions, unimolecular reactions, Langmuir - applications of adsorption on pollution abatement.

Catalysis: Catalyst - types of catalysis - criteria - autocatalysis - catalytic poisoning and catalytic promoters - acid base catalysis - applications (catalytic convertor) - enzyme catalysis- Michaelis - Menten equation.

**UNIT III ALLOYS AND PHASE RULE 9**

Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel. Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.

**UNIT IV FUELS AND COMBUSTION 9**

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel. Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

**UNIT V ENERGY SOURCES AND STORAGE DEVICES 9**

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H<sub>2</sub>-O<sub>2</sub> fuel cell.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

**TEXT BOOKS:**

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

**REFERENCES:**

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

**OBJECTIVES:**

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures – lists, tuples, dictionaries.
- To do input/output with files in Python.

**UNIT I ALGORITHMIC PROBLEM SOLVING 9**

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

**UNIT II DATA, EXPRESSIONS, STATEMENTS 9**

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

**UNIT III CONTROL FLOW, FUNCTIONS 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. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

**UNIT IV 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; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

**UNIT V FILES, MODULES, PACKAGES 9**

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

**TOTAL : 45 PERIODS****OUTCOMES:****Upon completion of the course, students will be able to**

- Develop algorithmic solutions to simple computational problems
- Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python Programs.

**TEXT BOOKS:**

1. Allen B. Downey, ‘ ‘ Think Python: How to Think Like a Computer Scientist’, 2<sup>nd</sup> edition, Updated for Python 3, Shroff/O’Reilly Publishers, 2016 (<http://greenteapress.com/wp/think-python/>)

- Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

#### REFERENCES:

- Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
- John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
- Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
- Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers,LLC,2013.
- Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
- Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,, 2015.

**GE8152**

**ENGINEERING GRAPHICS**

**L T P C**  
**2 0 4 4**

#### OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
- To expose them to existing national standards related to technical drawings.

#### CONCEPTS AND CONVENTIONS (Not for Examination)

**1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications - Size, layout and folding of drawing sheets - Lettering and dimensioning.

#### UNIT I PLANE CURVES AND FREEHAND SKETCHING

**7+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloid - construction of involutes of square and circle - Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles -Representation of Three Dimensional objects - Layout of views- Freehand sketching of multiple views from pictorial views of objects

#### UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE

**6+12**

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

#### UNIT III PROJECTION OF SOLIDS

**5+12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

#### UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES

**5+12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

## UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS

6+12

Principles of isometric projection – isometric scale -Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

**TOTAL: 90 PERIODS**

### OUTCOMES:

On successful completion of this course, the student will be able to

- familiarize with the fundamentals and standards of Engineering graphics
- perform freehand sketching of basic geometrical constructions and multiple views of objects.
- project orthographic projections of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- visualize and to project isometric and perspective sections of simple solids.

### TEXT BOOK:

1. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008.

### REFERENCES:

1. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50<sup>th</sup> Edition, 2010.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy And Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2<sup>nd</sup> Edition, 2009.

### Publication of Bureau of Indian Standards:

1. IS 10711 - 2001: Technical products Documentation - Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) - 2001: Technical products Documentation - Lettering.
3. IS 10714 (Part 20) - 2001 & SP 46 - 2003: Lines for technical drawings.
4. IS 11669 - 1986 & SP 46 - 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) - 2001: Technical drawings - Projection Methods.

### Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day



**OBJECTIVES:**

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data **from/to files in Python.**

**LIST OF PROGRAMS**

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

**PLATFORM NEEDED**

**Python 3 interpreter for Windows/Linux**

**TOTAL : 60 PERIODS**

**OUTCOMES:**

**Upon completion of the course, students will be able to**

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

**OBJECTIVES:**

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

**LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)**

1. Determination of rigidity modulus - Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser  
(b) Determination of acceptance angle in an optical fiber.
4. Determination of thermal conductivity of a bad conductor - Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid - Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum - spectrometer grating

7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire - Air wedge method

**TOTAL: 30 PERIODS**

**OUTCOMES:**

Upon completion of the course, the students will be able to

- apply principles of elasticity, optics and thermal properties for engineering applications.

**CHEMISTRY LABORATORY: (Any seven experiments to be conducted)**

**OBJECTIVES:**

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
  - To acquaint the students with the determination of molecular weight of a polymer by viscometry.
1. Estimation of HCl using  $\text{Na}_2\text{CO}_3$  as primary standard and Determination of alkalinity in water sample.
  2. Determination of total, temporary & permanent hardness of water by EDTA method.
  3. Determination of DO content of water sample by Winkler's method.
  4. Determination of chloride content of water sample by argentometric method.
  5. Estimation of copper content of the given solution by Iodometry.
  6. Determination of strength of given hydrochloric acid using pH meter.
  7. Determination of strength of acids in a mixture of acids using conductivity meter.
  8. Estimation of iron content of the given solution using potentiometer.
  9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
  10. Estimation of sodium and potassium present in water using flame photometer.
  11. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
  12. Pseudo first order kinetics-ester hydrolysis.
  13. Corrosion experiment-weight loss method.
  14. Determination of CMC.
  15. Phase change in a solid.
  16. Conductometric titration of strong acid vs strong base.

**TOTAL: 30 PERIODS**

**OUTCOMES:**

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

**TEXTBOOKS:**

1. Vogel's Textbook of Quantitative Chemical Analysis (8<sup>TH</sup> edition, 2014)

**HS8251**

**TECHNICAL ENGLISH**

**L T P C**  
**4 0 0 4**

**OBJECTIVES:**

**The Course prepares second semester engineering and Technology students to:**

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations , participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialisation.

**UNIT I INTRODUCTION TECHNICAL ENGLISH 12**

**Listening-** Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- **Speaking** -Asking for and giving directions- **Reading** – reading short technical texts from journals- newspapers- **Writing-** purpose statements – extended definitions – issue- writing instructions – checklists-recommendations-**Vocabulary Development-** technical vocabulary **Language Development** -subject verb agreement – compound words.

**UNIT II READING AND STUDY SKILLS 12**

**Listening-** Listening to longer technical talks and completing exercises based on them-**Speaking** – describing a process-**Reading** – reading longer technical texts- identifying the various transitions in a text- paragraphing- **Writing-** interpreting charts, graphs- **Vocabulary Development** - vocabulary used in formal letters/emails and reports **Language Development-** impersonal passive voice, numerical adjectives.

**UNIT III TECHNICAL WRITING AND GRAMMAR 12**

**Listening-** Listening to classroom lectures/ talks on engineering/technology -**Speaking** – introduction to technical presentations- **Reading** – longer texts both general and technical, practice in speed reading; **Writing-**Describing a process, use of sequence words- **Vocabulary Development-** sequence words- Misspelled words. **Language Development-** embedded sentences.

**UNIT IV REPORT WRITING 12**

**Listening-** Listening to documentaries and making notes. **Speaking** – mechanics of presentations- **Reading** – reading for detailed comprehension- **Writing-** email etiquette- job application – cover letter -Résumé preparation( via email and hard copy)- analytical essays and issue based essays--**Vocabulary Development-** finding suitable synonyms-paraphrasing-. **Language Development-** clauses- if conditionals.

**UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 12**

**Listening-** TED/Ink talks; **Speaking** -participating in a group discussion -**Reading-** reading and understanding technical articles **Writing-** Writing reports- minutes of a meeting- accident and survey-**Vocabulary Development-** verbal analogies **Language Development-** reported speech.

**TOTAL :60 PERIODS**

**OUTCOMES:**

**At the end of the course learners will be able to:**

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

**TEXT BOOKS:**

1. Board of editors. **Fluency in English A Course book for Engineering and Technology.** Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. **English for Technical Communication.** Cambridge University Press: New Delhi, 2016.

**REFERENCES:**

1. Booth-L. Diana, **Project Work**, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, **English for Presentations**, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. **Engineering English.** Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, **English & Communication For Colleges.** Cengage Learning, USA: 2007
5. Raman, Meenakshi and Sharma, Sangeetha- **Technical Communication Principles and Practice.**Oxford University Press: New Delhi, 2014.

**Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading.**

**OBJECTIVES :**

- This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

**UNIT I MATRICES****12**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors - Cayley-Hamilton theorem - Diagonalization of matrices - Reduction of a quadratic form to canonical form by orthogonal transformation - Nature of quadratic forms.

**UNIT II VECTOR CALCULUS****12**

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

**UNIT III ANALYTIC FUNCTIONS****12**

Analytic functions - Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties - Harmonic conjugates - Construction of analytic function - Conformal mapping - Mapping by functions  $w = z + c$ ,  $cz$ ,  $\frac{1}{z}$ ,  $z^2$  - Bilinear transformation.

**UNIT IV COMPLEX INTEGRATION****12**

Line integral - Cauchy's integral theorem - Cauchy's integral formula - Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals - Use of circular contour and semicircular contour.

**UNIT V LAPLACE TRANSFORMS****12**

Existence conditions - Transforms of elementary functions - Transform of unit step function and unit impulse function - Basic properties - Shifting theorems - Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions - Application to solution of linear second order ordinary differential equations with constant coefficients.

**TOTAL: 60 PERIODS****OUTCOMES :**

After successfully completing the course, the student will have a good understanding of the following topics and their applications:

- Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
- Gradient, divergence and curl of a vector point function and related identities.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Analytic functions, conformal mapping and complex integration.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

**TEXT BOOKS :**

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10<sup>th</sup> Edition, New Delhi, 2016.

## REFERENCES :

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7<sup>th</sup> Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3<sup>rd</sup> Edition, 2007.
3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4<sup>th</sup> Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6<sup>th</sup> Edition, New Delhi, 2012.

PH8201

## PHYSICS FOR CIVIL ENGINEERING (for B.E. Civil Engineering)

L T P C  
3 0 0 3

### OBJECTIVE:

- To introduce the principles of thermal, acoustics, optics and new materials for civil engineering applications.

### UNIT I THERMAL PERFORMANCE OF BUILDINGS 9

Heat transfer through fenestrations, thermal insulation and its benefits - heat gain and heat loss estimation - factors affecting the thermal performance of buildings, thermal measurements, thermal comfort, indices of thermal comfort, climate and design of solar radiation, shading devices - central heating. Principles of natural ventilation - ventilation measurements, design for natural ventilation - Window types and packaged air conditioners - chilled water plant - fan coil systems - water piping - cooling load - Air conditioning systems for different types of buildings - Protection against fire to be caused by A. C. Systems.

### UNIT II ACOUSTICS 9

Classification of sound- decibel- Weber-Fechner law - Sabine's formula- derivation using growth and decay method - Absorption Coefficient and its determination -factors affecting acoustics of buildings and their remedies. Methods of sound absorptions - absorbing materials - noise and its measurements, sound insulation and its measurements, impact of noise in multi-storeyed buildings.

### UNIT III LIGHTING DESIGNS 9

Radiation quantities - spectral quantities - relationship between luminescence and radiant quantities - hemispherical reflectance and transmittance - photometry: cosines law, inverse square law. Vision - photopic, mesopic, scotopic visions. Colour - luminous efficiency function - Visual field glare, colour - day light calculations - day light design of windows, measurement of day-light and use of models and artificial skies, principles of artificial lighting, supplementary artificial lighting.

### UNIT IV NEW ENGINEERING MATERIALS 9

Composites - definition and classification - Fibre reinforced plastics (FRP) and fiber reinforced metals (FRM) - Metallic glasses - Shape memory alloys - Ceramics - Classification - Crystalline - Non Crystalline - Bonded ceramics, Manufacturing methods - Slip casting - Isostatic pressing - Gas pressure bonding - Properties - thermal, mechanical, electrical and chemical ceramic fibres - ferroelectric and ferromagnetic ceramics - High Aluminium ceramics.

**UNIT V HAZARDS****9**

Seismology and Seismic waves - Earth quake ground motion - Basic concepts and estimation techniques - site effects - Probabilistic and deterministic Seismic hazard analysis - Cyclone and flood hazards - Fire hazards and fire protection, fire-proofing of materials, fire safety regulations and firefighting equipment - Prevention and safety measures.

**TOTAL: 45 PERIODS****OUTCOMES:**

Upon completion of this course,

- the students will have knowledge on the thermal performance of buildings,
- the students will acquire knowledge on the acoustic properties of buildings,
- the students will get knowledge on various lighting designs for buildings,
- the students will gain knowledge on the properties and performance of engineering materials, and
- the students will understand the hazards of buildings.

**TEXT BOOKS:**

1. Alexander, D. "Natural disaster", Springer (1993).
2. Budinski, K.G. & Budinski, M.K. "Engineering Materials Properties and Selection", Prentice Hall, 2009.
3. Severns, W.H. & Fellows, J.R. "Air conditioning and Refrigeration", John Wiley and Sons, London, 1988.
4. Stevens, W.R., "Building Physics: Lighting: Seeing in the Artificial Environment, Pergaman Press, 2013.

**REFERENCES:**

1. Gaur R.K. and Gupta S.L., Engineering Physics. Dhanpat Rai publishers, 2012.
2. Reiter, L. "Earthquake hazard analysis - Issues and insights", Columbia University Press, 1991.
3. Shearer, P.M. "Introduction to Seismology", Cambridge University Press, 1999.

**BE8251****BASIC ELECTRICAL AND ELECTRONICS ENGINEERING****L T P C  
3 0 0 3****OBJECTIVES:**

- To explain the basic theorems used in Electrical circuits and the different components and function of electrical machines.
- To explain the fundamentals of semiconductor and applications.
- To explain the principles of digital electronics
- To impart knowledge of communication.

**UNIT I ELECTRICAL CIRCUITS & MEASUREMENTS****9**

Fundamental laws of electric circuits- Steady State Solution of DC Circuits – Introduction to AC Circuits -Sinusoidal steady state analysis- Power and Power factor – Single Phase and Three Phase Balanced Circuits. Classification of instruments – Operating Principles of indicating Instruments

**UNIT II ELECTRICAL MACHINES****9**

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.

**UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 9**  
Introduction - Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics - Half wave and Full wave Rectifiers - Voltage Regulation.  
Bipolar Junction Transistor - CB, CE, CC Configurations and Characteristics - Elementary Treatment of Small Signal Amplifier.

**UNIT IV DIGITAL ELECTRONICS 9**  
Binary Number System - Boolean Algebra theorems- Digital circuits - Introduction to sequential Circuits- Flip-Flops - Registers and Counters - A/D and D/A Conversion - digital processing architecture.

**UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING 9**  
Introduction - Elements of Communication Systems- Modulation and Demodulation: Principles of Amplitude and Frequency Modulations. Digital Communication - Communication Systems: Radio, Antenna, TV, Fax, ISDN, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- ability to identify the electrical components and explain the characteristics of electrical machines.
- ability to identify electronics components and understand the characteristics

**TEXT BOOKS:**

1. D P Kothari and I.J Nagarath, "Electrical Machines "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint ,2016
2. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson India, 2011
3. Sedha R.S., "Applied Electronics", S. Chand & Co., 2006

**REFERENCES:**

1. A.E. Fitzgerald, David E Higginbotham and Arvin Gabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009
2. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007
3. Leonard S Bobrow, " Foundations of Electrical Engineering", Oxford University Press, 2013
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
5. Mehta V K, "Principles of Electronics", S.Chand & Company Ltd, 1994.
6. Nagsarkar T K and Sukhija M S, "Basics of Electrical Engineering", Oxford press 2005.

**GE8291 ENVIRONMENTAL SCIENCE AND ENGINEERING**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth"s interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

|  |   |           |
|--|---|-----------|
| <b>UNIT I</b>  | <b>ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY</b> | <b>14</b> |
| <p>Definition, scope and importance of environment - need for public awareness - concept of an ecosystem - structure and function of an ecosystem - producers, consumers and decomposers - energy flow in the ecosystem - ecological succession - food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) - Introduction to biodiversity definition: genetic, species and ecosystem diversity - biogeographical classification of India - value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - endangered and endemic species of India - conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems - pond, river, hill slopes, etc.</p> |   |           |
| <b>UNIT II</b>   | <b>ENVIRONMENTAL POLLUTION</b>                  | <b>8</b>  |
| <p>Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site - Urban / Rural / Industrial / Agricultural.</p>   |   |           |
| <b>UNIT III</b>  | <b>NATURAL RESOURCES</b>                        | <b>10</b> |
| <p>Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people - Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies - Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets - river / forest / grassland / hill / mountain.</p>   |   |           |
| <b>UNIT IV</b>   | <b>SOCIAL ISSUES AND THE ENVIRONMENT</b>        | <b>7</b>  |
| <p>From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management - resettlement and rehabilitation of people; its problems and concerns, case studies - role of non-governmental organization- environmental ethics: Issues and possible solutions - climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. - wasteland reclamation - consumerism and waste products - environment production act - Air (Prevention and Control of Pollution) act - Water (Prevention and control of Pollution) act - Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.</p>  |   |           |
| <b>UNIT V</b>  | <b>HUMAN POPULATION AND THE ENVIRONMENT</b>     | <b>6</b>  |
| <p>Population growth, variation among nations - population explosion - family welfare programme - environment and human health – human rights - value education - HIV / AIDS - women and child welfare - role of information technology in environment and human health - Case studies.</p>  |   |           |

**TOTAL: 45 PERIODS**



**OUTCOMES:**

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

**TEXTBOOKS:**

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2<sup>nd</sup> edition, Pearson Education, 2004.

**REFERENCES :**

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India Pvt Ltd, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) Pvt, Ltd, Hydrabad, 2015.
3. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.

**GE8292****ENGINEERING MECHANICS****L T P C****3 2 0 4****OBJECTIVES:**

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

**UNIT I            STATICS OF PARTICLES****9+6**

Introduction - Units and Dimensions - Laws of Mechanics - Lami's theorem, Parallelogram and triangular Law of forces - Vectorial representation of forces - Vector operations of forces - additions, subtraction, dot product, cross product - Coplanar Forces - rectangular components - Equilibrium of a particle - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility .

**UNIT II            EQUILIBRIUM OF RIGID BODIES****9+6**

Free body diagram - Types of supports -Action and reaction forces -stable equilibrium - Moments and Couples - Moment of a force about a point and about an axis - Vectorial representation of moments and couples - Scalar components of a moment - Varignon's theorem - Single equivalent force -Equilibrium of Rigid bodies in two dimensions - Equilibrium of Rigid bodies in three dimensions

**UNIT III            PROPERTIES OF SURFACES AND SOLIDS****9+6**

Centroids and centre of mass - Centroids of lines and areas - Rectangular, circular, triangular areas by integration - T section, I section, - Angle section, Hollow section by using standard formula -Theorems of Pappus - Area moments of inertia of plane areas - Rectangular, circular, triangular areas by integration - T section, I section, Angle section, Hollow section by using standard formula - Parallel axis theorem and perpendicular axis theorem - Principal moments of inertia of plane areas - Principal axes of inertia-Mass moment of inertia -mass moment of inertia for prismatic, cylindrical and spherical solids from first principle - Relation to area moments of inertia.

**UNIT IV DYNAMICS OF PARTICLES****9+6**

Displacements, Velocity and acceleration, their relationship - Relative motion - Curvilinear motion - Newton's laws of motion - Work Energy Equation- Impulse and Momentum - Impact of elastic bodies.

**UNIT V FRICTION AND RIGID BODY DYNAMICS****9+6**

Friction force - Laws of sliding friction - equilibrium analysis of simple systems with sliding friction -wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

**TOTAL : (45+30)=75 PERIODS****OUTCOMES:**

On successful completion of this course, the student will be able to

- illustrate the vectorial and scalar representation of forces and moments
- analyse the rigid body in equilibrium
- evaluate the properties of surfaces and solids
- calculate dynamic forces exerted in rigid body
- determine the friction and the effects by the laws of friction

**TEXT BOOKS:**

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8<sup>th</sup> Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

**REFERENCES:**

1. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
2. Hibbeler, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11<sup>th</sup> Edition, Pearson Education 2010.
3. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4<sup>th</sup> Edition, Pearson Education 2006.
4. Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons, 1993.
5. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3<sup>rd</sup> Edition, Vikas Publishing House Pvt. Ltd., 2005.

**GE8261****ENGINEERING PRACTICES LABORATORY****L T P C  
0 0 4 2****OBJECTIVES:**

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

**GROUP A (CIVIL & MECHANICAL)****I CIVIL ENGINEERING PRACTICE****13****Buildings:**

- (a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

**Plumbing Works:**

- (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
- (b) Study of pipe connections requirements for pumps and turbines.

- (c) Preparation of plumbing line sketches for water supply and sewage works.
- (d) Hands-on-exercise:  
Basic pipe connections - Mixed pipe material connection - Pipe connections with different joining components.
- (e) Demonstration of plumbing requirements of high-rise buildings.

**Carpentry using Power Tools only:**

- (a) Study of the joints in roofs, doors, windows and furniture.
- (b) Hands-on-exercise:  
Wood work, joints by sawing, planing and cutting.

**II MECHANICAL ENGINEERING PRACTICE**

**18**

**Welding:**

- (a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
- (b) Gas welding practice

**Basic Machining:**

- (a) Simple Turning and Taper turning
- (b) Drilling Practice

**Sheet Metal Work:**

- (a) Forming & Bending:
- (b) Model making - Trays and funnels.
- (c) Different type of joints.

**Machine assembly practice:**

- (a) Study of centrifugal pump
- (b) Study of air conditioner

**Demonstration on:**

- (a) Smithy operations, upsetting, swaging, setting down and bending. Example - Exercise - Production of hexagonal headed bolt.
- (b) Foundry operations like mould preparation for gear and step cone pulley.
- (c) Fitting - Exercises - Preparation of square fitting and V - fitting models.

**GROUP B (ELECTRICAL & ELECTRONICS)**

**III ELECTRICAL ENGINEERING PRACTICE**

**13**

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

**IV ELECTRONICS ENGINEERING PRACTICE**

**16**

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice - Components Devices and Circuits - Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

On successful completion of this course, the student will be able to

- fabricate carpentry components and pipe connections including plumbing works.
- use welding equipments to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metal works

- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundry and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

### LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

#### CIVIL

- |   |          |
|---|----------|
| 1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. | 15 Sets. |
| 2. Carpentry vice (fitted to work bench)  | 15 Nos.  |
| 3. Standard woodworking tools   | 15 Sets. |
| 4. Models of industrial trusses, door joints, furniture joints  | 5 each   |
| 5. Power Tools:   |          |
| (a) Rotary Hammer   | 2 Nos    |
| (b) Demolition Hammer   | 2 Nos    |
| (c) Circular Saw  | 2 Nos    |
| (d) Planer  | 2 Nos    |
| (e) Hand Drilling Machine   | 2 Nos    |
| (f) Jigsaw  | 2 Nos    |

#### MECHANICAL

- |   |           |
|---|-----------|
| 1. Arc welding transformer with cables and holders                            | 5 Nos.    |
| 2. Welding booth with exhaust facility  | 5 Nos.    |
| 3. Welding accessories like welding shield, chipping hammer, wire brush, etc. | 5 Sets.   |
| 4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.    | 2 Nos.    |
| 5. Centre lathe   | 2 Nos.    |
| 6. Hearth furnace, anvil and smithy tools                                     | 2 Sets.   |
| 7. Moulding table, foundry tools  | 2 Sets.   |
| 8. Power Tool: Angle Grinder  | 2 Nos     |
| 9. Study-purpose items: centrifugal pump, air-conditioner                     | One each. |

#### ELECTRICAL

- |   |         |
|---|---------|
| 1. Assorted electrical components for house wiring                  | 15 Sets |
| 2. Electrical measuring instruments                                 | 10 Sets |
| 3. Study purpose items: Iron box, fan and regulator, emergency lamp | 1 each  |
| 4. Megger (250V/500V)   | 1 No.   |
| 5. Power Tools: (a) Range Finder                                    | 2 Nos   |
| (b) Digital Live-wire detector                                      | 2 Nos   |

#### ELECTRONICS

- |   |         |
|---|---------|
| 1. Soldering guns   | 10 Nos. |
| 2. Assorted electronic components for making circuits                 | 50 Nos. |
| 3. Small PCBs   | 10 Nos. |
| 4. Multimeters  | 10 Nos. |
| 5. Study purpose items: Telephone, FM radio, low-voltage power supply |         |

**OBJECTIVES:**

- To introduce the students to draft the plan, elevation and sectional views of buildings in accordance with development and control rules satisfying orientation and functional requirements as per National Building Code.

**LIST OF EXPERIMENTS**

1. Principles of planning, orientation and complete joinery details (Paneled and Glazed Doors and Windows)
2. Buildings with load bearing walls
3. Buildings with sloping roof
4. R.C.C. framed structures.
5. Industrial buildings - North light roof structures

**TOTAL: 60 PERIODS****OUTCOMES:**

- The students will be able to draft the plan, elevation and sectional views of the buildings, industrial structures, and framed buildings using computer softwares.

**TEXTBOOKS:**

1. Sikka V.B., A Course in Civil Engineering Drawing, 4<sup>th</sup> Edition, S.K.Kataria and Sons, 2015.
2. George Omura, Mastering in Autocad 2005 and Autocad LT 2005- BPB Publications, 2008

**REFERENCES:**

1. Chuck Eastman, Paul Teicholz, Rafael Sacks, Kathleen Liston, BIM Handbook:A Guide to building information modeling for Owners, Managers, Designers, Engineers, and Contractors, John Wiley and Sons. Inc.,2011.
2. Marimuthu V.M., Murugesan R. and Padmini S., Civil Engineering Drawing-I, Pratheeba Publishers, 2008.
3. Shah.M.G., Kale. C.M. and Patki.S.Y., Building Drawing with an Integrated Approach to Built Environment, Tata McGraw Hill Publishers Limited, 2007.
4. Verma.B.P., Civil Engineering Drawing and House Planning, Khanna Publishers, 2010.

**OBJECTIVES :**

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

**UNIT I      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 II      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 III      APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS      12**

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

**UNIT IV      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 V      Z - TRANSFORMS AND DIFFERENCE EQUATIONS      12**

Z-transforms - Elementary properties - Inverse Z-transform (using partial fraction and residues) - Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

**TOTAL: 60 PERIODS**

**OUTCOMES :**

Upon successful completion of the course, students should be able to:

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

**TEXT BOOKS:**

1. Grewal B.S., "Higher Engineering Mathematics", 43<sup>rd</sup> Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

**REFERENCES :**

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", 9<sup>th</sup> Edition, Laxmi Publications Pvt. Ltd, 2014.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10<sup>th</sup> Edition, John Wiley, India, 2016.
4. James, G., "Advanced Modern Engineering Mathematics", 3<sup>rd</sup> Edition, Pearson Education, 2007.

5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

**CE8301**

**STRENGTH OF MATERIALS I**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To learn the fundamental concepts of Stress, Strain and deformation of solids.
- To know the mechanism of load transfer in beams, the induced stress resultants and deformations.
- To understand the effect of torsion on shafts and springs.
- To analyze plane and space trusses

**UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS**

**9**

Simple Stresses and strains - Elastic constants - Relationship between elastic constants - Stress Strain Diagram - Ultimate Stress - Yield Stress - Deformation of axially loaded member - Composite Bars - Thermal Stresses - State of Stress in two dimensions - Stresses on inclined planes - Principal Stresses and Principal Planes - Maximum shear stress - Mohr's circle method.

**UNIT II TRANSFER OF LOADS AND STRESSES IN BEAMS**

**9**

Types of loads, supports, beams – concept of shearing force and bending moment - Relationship between intensity of load, Shear Force and Bending moment - Shear Force and Bending Moment Diagrams for Cantilever, simply supported and overhanging beams with concentrated load, uniformly distributed load, uniformly varying load and concentrated moment. Theory of Simple Bending – Stress Distribution due to bending moment and shearing force - Flitched Beams - Leaf Springs.

**UNIT III DEFLECTION OF BEAMS**

**9**

Elastic curve - Governing differential equation - Double integration method - Macaulay's method - Area moment method - conjugate beam method for computation of slope and deflection of determinant beams.

**UNIT IV TORSION**

**9**

Theory of Torsion - Stresses and Deformations in Solid and Hollow Circular Shafts - combined bending moment and torsion of shafts - Power transmitted to shaft - Shaft in series and parallel - Closed and Open Coiled helical springs - springs in series and parallel - Design of buffer springs.

**UNIT V ANALYSIS OF TRUSSES**

**9**

Determinate and indeterminate trusses - Analysis of pin jointed plane determinate trusses by method of joints, method of sections and tension coefficient – Analysis of Space trusses by tension coefficient method.

**TOTAL :45 PERIODS**

**OUTCOMES:**

Students will be able to

- Understand the concepts of stress and strain, principal stresses and principal planes.
- Determine Shear force and bending moment in beams and understand concept of theory of simple bending.
- Calculate the deflection of beams by different methods and selection of method for determining slope or deflection.
- Apply basic equation of torsion in design of circular shafts and helical springs, .
- Analyze the pin jointed plane and space trusses

**TEXTBOOKS:**

1. Rajput.R.K. "Strength of Materials", S.Chand and Co, New Delhi, 2015.
2. Punmia.B.C., Ashok Kumar Jain and Arun Kumar Jain, SMTS -I Strength of materials, Laxmi publications. New Delhi, 2015
3. Rattan . S. S, "Strength of Materials", Tata McGraw Hill Education Private Limited, New Delhi, 2012
4. Bansal. R.K. "Strength of Materials", Laxmi Publications Pvt. Ltd., New Delhi, 2010

**REFERENCES :**

1. Timoshenko.S.B. and Gere.J.M, "Mechanics of Materials", Van Nos Reinhold, New Delhi 1999.
2. Vazirani.V.N and Ratwani.M.M, "Analysis of Structures", Vol I Khanna Publishers, New Delhi, 1995.
3. Junnarkar.S.B. and Shah.H.J, "Mechanics of Structures", Vol I, Charotar Publishing House, New Delhi 2016.
4. Singh. D.K., " Strength of Materials", Ane Books Pvt. Ltd., New Delhi, 2016
5. Basavarajaiah, B.S. and Mahadevappa, P., Strength of Materials, Universities Press, Hyderabad, 2010.
6. Gambhir. M.L., "Fundamentals of Solid Mechanics", PHI Learning Private Limited., New Delhi, 2009.

**CE8302****FLUID MECHANICS****L T P C  
3 0 0 3****OBJECTIVE:**

- To understand the basic properties of the fluid, fluid kinematics, fluid dynamics and to analyze and appreciate the complexities involved in solving the fluid flow problems.

**UNIT I FLUID PROPERTIES AND FLUID STATICS 9**

Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, capillarity and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers-forces on planes - centre of pressure - buoyancy and floatation.

**UNIT II FLUID KINEMATICS AND DYNAMICS 9**

Fluid Kinematics – Classification and types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- stream line-streak line-path line- stream function - velocity potential function - flow net. Fluid dynamics - equations of motion -Euler's equation along a streamline - Bernoulli's equation – applications - venturi meter, orifice meter and Pitot tube- linear momentum equation and its application to pipe bend.

**UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 9**

Fundamental dimensions - dimensional homogeneity - Rayleigh's method and Buckingham Pi-theorem - dimensionless parameters - similitudes and model studies - distorted models.

**UNIT IV FLOW THROUGH PIPES 9**

Reynold's experiment - laminar flow through circular pipe (Hagen poiseulle's) - hydraulic and energy gradient – flow through pipes - Darcy - Weisbach's equation - pipe roughness -friction factor-Moody's diagram- major and minor losses of flow in pipes - pipes in series and in parallel.

**UNIT V BOUNDARY LAYER 9**

Boundary layer - definition- boundary layer on a flat plate - laminar and turbulent boundary layer-displacement, energy and momentum thickness - Momentum integral equation-Boundary layer separation and control – drag on flat plate.

**TOTAL: 45 PERIODS**



**OUTCOMES:**

At the end of the course students will be able to

- Get a basic knowledge of fluids in static, kinematic and dynamic equilibrium.
- Understand and solve the problems related to equation of motion.
- Gain knowledge about dimensional and model analysis.
- Learn types of flow and losses of flow in pipes.
- Understand and solve the boundary layer problems.

**TEXT BOOKS:**

1. Modi P.N and Seth "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House New Delhi, 2009.
2. Jain.A.K., "Fluid Mechanics" (Including Hydraulic Machines), Khanna Publishers, Twelfth Edition, 2016.
3. Subramanya.K " Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Education Private Limited, New Delhi, 2010.
4. Rajput.R.K. "Fluid Mechanics", S.Chand and Co, New Delhi, 2008.

**REFERENCES:**

1. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw Hill, 2000.
2. Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons, Singapore, 2013.
3. White, F.M., "Fluid Mechanics", Tata McGraw Hill, 5th Edition, New Delhi, 2017.
4. Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University Press, New Delhi, 2015.
5. Bansal.R.K., "Fluid Mechanics and Hydraulic Machines", Laxmi Publications Pvt. Ltd., New Delhi, 2013.

**CE8351****SURVEYING****L T P C  
3 0 0 3****OBJECTIVES :**

- To introduce the rudiments of plane surveying and geodetic principles to Civil Engineers.
- To learn the various methods of plane and geodetic surveying to solve the real world Civil Engineering problems.
- To introduce the concepts of Control Surveying
- To introduce the basics of Astronomical Surveying

**UNIT I                    FUNDAMENTALS OF CONVENTIONAL SURVEYING AND LEVELLING                    9**

Classifications and basic principles of surveying - Equipment and accessories for ranging and chaining - Methods of ranging - Compass - Types of Compass - Basic Principles- Bearing – Types - True Bearing - Magnetic Bearing - Levelling- Principles and theory of Levelling - Datum- - Bench Marks – Temporary and Permanent Adjustments- Methods of Levelling- Booking – Reduction - Sources of errors in Levelling - Curvature and refraction.

**UNIT II                    THEODOLITE AND TACHEOMETRIC SURVEYING                    9**

Horizontal and vertical angle measurements - Temporary and permanent adjustments - Heights and distances - Tacheometer - Stadia Constants - Analytic Lens -Tangential and Stadia Tacheometry surveying - Contour - Contouring - Characteristics of contours - Methods of contouring - Tacheometric contouring - Contour gradient - Uses of contour plan and map

**UNIT III                    CONTROL SURVEYING AND ADJUSTMENT                    9**

Horizontal and vertical control - Methods - specifications - triangulation- baseline - satellite stations - reduction to centre- trigonometrical levelling - single and reciprocal observations - traversing - Gale's table. - Errors Sources- precautions and corrections - classification of errors -

true and most probable values - weighed observations - method of equal shifts - principle of least squares - normal equation - correlates- level nets- adjustment of simple triangulation networks.

#### **UNIT IV           ADVANCED TOPICS IN SURVEYING**

**9**

Hydrographic Surveying - Tides - MSL - Sounding methods - Three point problem - Strength of fix - astronomical Surveying - Field observations and determination of Azimuth by altitude and hour angle methods -.Astronomical terms and definitions - Motion of sun and stars - Celestial coordinate systems - different time systems - Nautical Almanac - Apparent altitude and corrections - Field observations and determination of time, longitude, latitude and azimuth by altitude and hour angle method

#### **UNIT V           MODERN SURVEYING**

**9**

Total Station : Advantages - Fundamental quantities measured - Parts and accessories - working principle - On board calculations - Field procedure - Errors and Good practices in using Total Station GPS Surveying : Different segments - space, control and user segments - satellite configuration - signal structure - Orbit determination and representation - Anti Spoofing and Selective Availability - Task of control segment - Hand Held and Geodetic receivers - data processing - Traversing and triangulation.

**TOTAL : 45 PERIODS**

#### **OUTCOMES :**

At the end of the course the student will be able to understand

- The use of various surveying instruments and mapping
- Measuring Horizontal angle and vertical angle using different instruments
- Methods of Leveling and setting Levels with different instruments
- Concepts of astronomical surveying and methods to determine time, longitude, latitude and azimuth
- Concept and principle of modern surveying.

#### **TEXTBOOKS :**

1. Kanetkar.T.P and Kulkarni.S.V, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi Griha Prakashan, Pune, 2008
2. Punmia.B.C., Ashok K.Jain and Arun K Jain , Surveying Vol. I & II, Lakshmi Publications Pvt Ltd, New Delhi, 2005
3. James M. Anderson and Edward M. Mikhail, "Surveying, Theory and Practice", 7th Edition, McGraw Hill, 2001.
4. Bannister and S. Raymond, "Surveying", 7th Edition, Longman 2004.
5. Laurila, S.H. "Electronic Surveying in Practice", John Wiley and Sons Inc, 1993
6. Venkatramaiah, Text book of Surveying, University press, New Delhi, 2014

#### **REFERENCES :**

1. Alfred Leick, "GPS satellite surveying", John Wiley & Sons Inc., 3<sup>rd</sup> Edition, 2004.
2. Guocheng Xu, "GPS Theory , Algorithms and Applications", Springer - Berlin, 2003.
3. SatheeshGopi, rasathishkumar, N. madhu, "Advanced Surveying, Total Station GPS and Remote Sensing" Pearson education, 2007
4. Roy S.K., "Fundamentals of Surveying", 2nd Edition, Prentice Hall of India, 2004.
5. Arora K.R., "Surveying Vol I & II", Standard Book house, 10<sup>th</sup> Edition 2008

**CE8391**

**CONSTRUCTION MATERIALS**

**L T P C**

**3 0 0 3**

#### **OBJECTIVE:**

- To introduce students to various materials commonly used in civil engineering construction and their properties.

|   |  |                          |
|---|--|--------------------------|
| <b>UNIT I</b>   | <b>STONES – BRICKS – CONCRETE BLOCKS</b>   | <b>9</b>                 |
| Stone as building material – Criteria for selection – Tests on stones – Deterioration and Preservation of stone work - Bricks - Classification - Manufacturing of clay bricks - Tests on bricks - Compressive Strength - Water Absorption - Efflorescence - Bricks for special use - Refractory bricks - Concrete blocks - Lightweight concrete blocks.   |  |                          |
| <b>UNIT II</b>  | <b>LIME – CEMENT – AGGREGATES – MORTAR</b> | <b>9</b>                 |
| Lime - Preparation of lime mortar - Cement - Ingredients - Manufacturing process - Types and Grades - Properties of cement and Cement mortar - Hydration - Compressive strength - Tensile strength - Fineness- Soundness and consistency - Setting time - fine aggregates - river sand - crushed stone sand - properties - coarse Aggregates - Crushing strength - Impact strength - Flakiness Index - Elongation Index - Abrasion Resistance - Grading |  |                          |
| <b>UNIT III</b>   | <b>CONCRETE</b>                            | <b>9</b>                 |
| Concrete – Ingredients – Manufacturing Process – Batching plants -mixing – transporting – placing - compaction of concrete -curing and finishing – Ready mix Concrete - Mix specification.  |  |                          |
| <b>UNIT IV</b>  | <b>TIMBER AND OTHER MATERIALS</b>          | <b>9</b>                 |
| Timber - Market forms - Industrial timber- Plywood - Veneer - Thermocol - Panels of laminates - Steel - Aluminum and Other Metallic Materials - Composition - Aluminium composite panel - Market forms - Mechanical treatment - Paints - Varnishes - Distempers - Bitumens.   |  |                          |
| <b>UNIT V</b>   | <b>MODERN MATERIALS</b>                    | <b>9</b>                 |
| Glass – Ceramics – Sealants for joints – Fibre glass reinforced plastic – Clay products – Refractories - Composite materials - Types - Applications of laminar composites - Fibre textiles- Geomembranes and Geotextiles for earth reinforcement.   |  |                          |
|   |  | <b>TOTAL: 45 PERIODS</b> |

**OUTCOMES:**

On completion of this course the students will be able to

- Compare the properties of most common and advanced building materials.
- understand the typical and potential applications of lime, cement and aggregates
- know the production of concrete and also the method of placing and making of concrete elements.
- understand the applications of timbers and other materials
- Understand the importance of modern material for construction.

**TEXT BOOKS:**

1. Varghese.P.C, "Building Materials", PHI Learning Pvt. Ltd, New Delhi, 2015.
2. Rajput. R.K., "Engineering Materials", S. Chand and Company Ltd., 2008.
3. Gambhir.M.L., "Concrete Technology", 3rd Edition, Tata McGraw Hill Education, 2004
4. Duggal.S.K., "Building Materials", 4th Edition, New Age International, 2008.

**REFERENCES:**

1. Jagadish.K.S, "Alternative Building Materials Technology", New Age International, 2007.
2. Gambhir. M.L., & Neha Jamwal., "Building Materials, products, properties and systems", Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2012.
3. IS456 - 2000: Indian Standard specification for plain and reinforced concrete, 2011
4. IS4926 - 2003: Indian Standard specification for ready-mixed concrete, 2012
5. IS383 - 1970: Indian Standard specification for coarse and fine aggregate from natural Sources for concrete, 2011
6. IS1542-1992: Indian standard specification for sand for plaster, 2009
7. IS 10262-2009: Indian Standard Concrete Mix Proportioning -Guidelines, 2009

**OBJECTIVE:**

- At the end of this course the students will be able to understand the importance of geological knowledge such as earth, earthquake, volcanism and to apply this knowledge in projects such as dams, tunnels, bridges, roads, airport and harbor.

**UNIT I PHYSICAL GEOLOGY****9**

Geology in civil engineering - branches of geology - structure of earth and its composition weathering of rocks - scale of weathering - soils - landforms and processes associated with river, wind, groundwater and sea - relevance to civil engineering. Plate tectonics - Earth quakes - Seismic zones in India.

**UNIT II MINEROLOGY****9**

Physical properties of minerals - Quartz group, Feldspar group, Pyroxene - hypersthene and augite, Amphibole - hornblende, Mica - muscovite and biotite, Calcite, Gypsum and Clay minerals.

**UNIT III PETROLOGY****9**

Classification of rocks, distinction between Igneous, Sedimentary and Metamorphic rocks. Engineering properties of rocks. Description, occurrence, engineering properties, distribution and uses of Granite, Dolerite, Basalt, Sandstone, Limestone, Laterite, Shale, Quartzite, Marble, Slate, Gneiss and Schist.

**UNIT IV STRUCTURAL GEOLOGY AND GEOPHYSICAL METHODS****9**

Geological maps - attitude of beds, study of structures - folds, faults and joints - relevance to civil engineering. Geophysical methods - Seismic and electrical methods for subsurface investigations.

**UNIT V APPLICATION OF GEOLOGICAL INVESTIGATIONS****9**

Remote sensing for civil engineering applications; Geological conditions necessary for design and construction of Dams, Reservoirs, Tunnels, and Road cuttings - Hydrogeological investigations and mining - Coastal protection structures. Investigation of Landslides, causes and mitigation.

**TOTAL: 45 PERIODS****OUTCOMES:**

The students completing this course

- Will be able to understand the importance of geological knowledge such as earth, earthquake, volcanism and the action of various geological agencies.
- Will get basics knowledge on properties of minerals.
- Gain knowledge about types of rocks, their distribution and uses.
- Will understand the methods of study on geological structure.
- Will understand the application of geological investigation in projects such as dams, tunnels, bridges, roads, airport and harbor

**TEXT BOOKS:**

1. Varghese, P.C., Engineering Geology for Civil Engineering Prentice Hall of India Learning Private Limited, New Delhi, 2012.
2. Venkat Reddy. D. Engineering Geology, Vikas Publishing House Pvt. Lt, 2010.
3. Gokhale KVGK, "Principles of Engineering Geology", B.S. Publications, Hyderabad 2011.
4. Chenna Kesavulu N. "Textbook of Engineering Geology", Macmillan India Ltd., 2009.
5. Parbin Singh. A "Text book of Engineering and General Geology", Katson publishing house, Ludhiana 2009.

**REFERENCES:**

1. Blyth F.G.H. and de Freitas M.H., Geology for Engineers, Edward Arnold, London, 2010.
2. Bell .F.G.. "Fundamentals of Engineering Geology", B.S. Publications. Hyderabad 2011.
3. Dobrin, M.B "An introduction to geophysical prospecting", McGraw Hill, New Delhi, 1988.

**OBJECTIVE:**

- To facilitate the understanding of the behavior of construction materials.

**I. TEST ON FINE AGGREGATES**

15

1. Grading of fine aggregates
2. Test for specific gravity and test for bulk density
3. Compacted and loose bulk density of fine aggregate

**II. TEST ON COARSE AGGREGATE**

15

1. Determination of impact value of coarse aggregate
2. Determination of elongation index
3. Determination of flakiness index
4. Determination of aggregate crushing value of coarse aggregate

**III. TEST ON CONCRETE**

15

1. Test for Slump
2. Test for Compaction factor
3. Test for Compressive strength - Cube & Cylinder
4. Test for Flexural strength

**IV. TEST ON BRICKS AND BLOCKS**

15

1. Test for compressive strength of bricks and blocks
2. Test for Water absorption of bricks and blocks
3. Determination of Efflorescence of bricks
4. Test on tiles

**TOTAL: 60 PERIODS****OUTCOME:**

- The students will have the required knowledge in the area of testing of construction materials and components of construction elements experimentally.

**REFERENCES:**

1. Construction Materials Laboratory Manual, Anna University, Chennai-600 025.
2. IS 4031 (Part 1) – 1996 – Indian Standard Method for determination of fineness by drysieving.
3. IS 2386 (Part 1 to Part 6) - 1963 - Indian Standard methods for test for aggregate for concrete
4. IS 383 – 1970 Indian Standard specification for coarse and fine aggregates from natural sources for concrete.

**OBJECTIVE :**

- At the end of the course the student will possess knowledge about Survey field techniques

**LIST OF EXPERIMENTS:****Chain Survey**

1. Study of chains and its accessories, Aligning, Ranging, Chaining and Marking  
Perpendicular offset
2. Setting out works - Foundation marking using tapes single Room and Double Room

### **Compass Survey**

3. Compass Traversing - Measuring Bearings & arriving included angles

### **Levelling - Study of levels and levelling staff**

4. Fly levelling using Dumpy level & Tilting level
5. Check levelling

### **Theodolite - Study of Theodolite**

6. Measurements of horizontal angles by reiteration and repetition and vertical angles
7. Determination of elevation of an object using single plane method when base is accessible/inaccessible.

### **Tacheometry – Tangential system – Stadia system**

8. Determination of Tacheometric Constants
9. Heights and distances by stadia Tacheometry
10. Heights and distances by Tangential Tacheometry

### **Total Station - Study of Total Station, Measuring Horizontal and vertical angles**

11. Traverse using Total station and Area of Traverse
12. Determination of distance and difference in elevation between two inaccessible points using Total station

**TOTAL: 60 PERIODS**

### **OUTCOME:**

- Students completing this course would have acquired practical knowledge on handling basic survey instruments including Theodolite, Tacheometry, Total Station and GPS and have adequate knowledge to carryout Triangulation and Astronomical surveying including general field marking for various engineering projects and Location of site etc.

### **LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS**

| <b>Sl.No.</b> | <b>Description of Equipment</b> | <b>Quantity</b>                |
|---------------|---------------------------------|--------------------------------|
| 1.            | Total Station                   | 3 Nos                          |
| 2.            | Theodolites                     | Atleast 1 for every 5 students |
| 3.            | Dumpy level / Filling level     | Atleast 1 for every 5 students |
| 4.            | Pocket stereoscope              | 1                              |
| 5.            | Ranging rods                    | 1 for a set of 5 students      |
| 6.            | Levelling staff                 |                                |
| 7.            | Cross staff                     |                                |
| 8.            | Chains                          |                                |
| 9.            | Tapes                           |                                |
| 10.           | Arrows                          |                                |
| 11.           | Prismatic Compass               | 10 nos                         |
| 12.           | Surveyor Compass                | 2 nos                          |
| 13.           | Survey grade or Hand held GPS   | 3 nos                          |

**OBJECTIVES:**

The Course will enable learners to:

- Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities.
- improve general and academic listening skills
- Make effective presentations.

**UNIT I**

Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.

**UNIT II**

Listen to a process information- give information, as part of a simple explanation - conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.

**UNIT III**

Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist- listen for detail

**UNIT IV**

Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures conversational speech listening to and participating in conversations - persuade.

**UNIT V**

Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.

**TOTAL : 30 PERIODS**

**OUTCOMES:**

At the end of the course Learners will be able to:

- Listen and respond appropriately.
- Participate in group discussions
- Make effective presentations
- Participate confidently and appropriately in conversations both formal and informal

**TEXTBOOKS:**

1. Brooks, Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.
2. Richards, C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010

**REFERENCES:**

1. Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.

3. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.
4. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
5. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014

**MA8491**

**NUMERICAL METHODS**

**L T P C**  
**4 0 0 4**

**OBJECTIVES :**

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

**UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12**  
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method - Pivoting - Gauss Jordan method - Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

**UNIT II INTERPOLATION AND APPROXIMATION 12**  
Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines - Difference operators and relations - Interpolation with equal intervals - Newton's forward and backward difference formulae.

**UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12**  
Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method - Two point and three point Gaussian quadrature formulae - Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

**UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12**  
Single step methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge - Kutta method for solving first order equations - Multi step methods - Milne's and Adams - Bash forth predictor corrector methods for solving first order equations.

**UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12**  
Finite difference methods for solving second order two - point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods - One dimensional wave equation by explicit method.

**TOTAL : 60 PERIODS**

**OUTCOMES :**

Upon successful completion of the course, students should be able to:

- Understand the basic concepts and techniques of solving algebraic and transcendental equations.



- Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.
- Apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

#### TEXTBOOKS :

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9<sup>th</sup> Edition, Cengage Learning, 2016.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10<sup>th</sup> Edition, New Delhi, 2015.

#### REFERENCES :

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
2. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6<sup>th</sup> Edition, New Delhi, 2006.
3. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2<sup>nd</sup> Edition, Prentice Hall, 1992.
4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3<sup>rd</sup> Edition, New Delhi, 2007.
5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5<sup>th</sup> Edition, 2015.

**CE8401**

**CONSTRUCTION TECHNIQUES AND PRACTICES**

**L T P C  
3 0 0 3**

#### OBJECTIVE:

- The main objective of this course is to make the student aware of the various construction techniques, practices and the equipment needed for different types of construction activities. At the end of this course the student shall have a reasonable knowledge about the various construction procedures for sub to super structure and also the equipment needed for construction of various types of structures from foundation to super structure.

#### UNIT I CONSTRUCTION TECHNIQUES

**9**

Structural systems - Load Bearing Structure - Framed Structure - Load transfer mechanism – floor system - Development of construction techniques - High rise Building Technology - Seismic effect - Environmental impact of materials – responsible sourcing - Eco Building (Green Building) - Material used - Construction methods - Natural Buildings - Passive buildings - Intelligent(Smart) buildings - Meaning - Building automation - Energy efficient buildings for various zones-Case studies of residential, office buildings and other buildings in each zones.

#### UNIT II CONSTRUCTION PRACTICES

**9**

Specifications, details and sequence of activities and construction co-ordination - Site Clearance - Marking - Earthwork - masonry - stone masonry - Bond in masonry - concrete hollow block masonry - flooring - damp proof courses - construction joints - movement and expansion joints - pre cast pavements - Building foundations - basements - temporary shed - centering and shuttering - slip forms - scaffoldings - de-shuttering forms - Fabrication and erection of steel trusses – frames – braced domes – laying brick – weather and water proof – roof finishes – acoustic and fire protection.

**UNIT III SUB STRUCTURE CONSTRUCTION 9**

Techniques of Box jacking – Pipe Jacking -under water construction of diaphragm walls and basement-Tunneling techniques - Piling techniques - well and caisson - sinking cofferdam - cable anchoring and grouting - driving diaphragm walls, sheet piles - shoring for deep cutting - well points -Dewatering and stand by Plant equipment for underground open excavation.

**UNIT IV SUPER STRUCTURE CONSTRUCTION 9**

Launching girders, bridge decks, off shore platforms – special forms for shells - techniques for heavy decks - in-situ pre-stressing in high rise structures, Material handling - erecting light weight components on tall structures - Support structure for heavy Equipment and conveyors - Erection of articulated structures, braced domes and space decks.

**UNIT V CONSTRUCTION EQUIPMENT 9**

Selection of equipment for earth work - earth moving operations - types of earthwork equipment - tractors, motor graders, scrapers, front end loaders, earth movers - Equipment for foundation and pile driving. Equipment for compaction, batching, mixing and concreting - Equipment for material handling and erection of structures – types of cranes - Equipment for dredging, trenching, tunneling,

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On successful completion of this course, students will be able to:

- know the different construction techniques and structural systems
- Understand various techniques and practices on masonry construction, flooring, and roofing.
- Plan the requirements for substructure construction.
- Know the methods and techniques involved in the construction of various types of super structures
- Select, maintain and operate hand and power tools and equipment used in the building construction sites.

**TEXTBOOKS :**

1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C., "Construction Planning, Equipment and Methods", 5<sup>th</sup> Edition, McGraw Hill, Singapore, 1995.
2. Arora S.P. and Bindra S.P., "Building Construction, Planning Techniques and Method of Construction", Dhanpat Rai and Sons, 1997.
3. Varghese, P.C. "Building construction", Prentice Hall of India Pvt. Ltd, New Delhi, 2007.

**REFERENCES:**

1. Jha J and Sinha S.K., "Construction and Foundation Engineering", Khanna Publishers, 1999.
2. Sharma S.C. "Construction Equipment and Management", Khanna Publishers New Delhi, 2002.
3. Deodhar, S.V. "Construction Equipment and Job Planning", Khanna Publishers, New Delhi, 2012.
4. Mahesh Varma, "Construction Equipment and its Planning and Application", Metropolitan Book Company, New Delhi, 1983.

**OBJECTIVES:**

- To know the method of finding slope and deflection of beams and trusses using energy theorems and to know the concept of analysing indeterminate beam
- To estimate the load carrying capacity of columns, stresses due to unsymmetrical bending and various theories for failure of material.

**UNIT I ENERGY PRINCIPLES****9**

Strain energy and strain energy density – strain energy due to axial load (gradual, sudden and impact loadings) , shear, flexure and torsion – Castigliano's theorems – Maxwell's reciprocal theorem - Principle of virtual work – unit load method - Application of energy theorems for computing deflections in determinate beams , plane frames and plane trusses – lack of fit and temperature effects - Williot Mohr's Diagram.

**UNIT II INDETERMINATE BEAMS****9**

Concept of Analysis - Propped cantilever and fixed beams - fixed end moments and reactions – sinking and rotation of supports - Theorem of three moments – analysis of continuous beams – shear force and bending moment diagrams.

**UNIT III COLUMNS AND CYLINDERS****9**

Euler's column theory - critical load for prismatic columns with different end conditions - Effective length - limitations - Rankine-Gordon formula - Eccentrically loaded columns - middle third rule - core of a section - Thin cylindrical and spherical shells - stresses and change in dimensions - Thick cylinders - Compound cylinders – shrinking on stresses.

**UNIT IV STATE OF STRESS IN THREE DIMENSIONS****9**

Stress tensor at a point - Stress invariants - Determination of principal stresses and principal planes - Volumetric strain. Theories of failure: Maximum Principal stress theory - Maximum Principal strain theory - Maximum shear stress theory - Total Strain energy theory - Maximum distortion energy theory - Application problems.

**UNIT V ADVANCED TOPICS****9**

Unsymmetrical bending of beams of symmetrical and unsymmetrical sections – Shear Centre - curved beams - Winkler Bach formula – stresses in hooks.

**TOTAL: 45 PERIODS****OUTCOMES:**

Students will be able to

- Determine the strain energy and compute the deflection of determinate beams, frames and trusses using energy principles.
- Analyze propped cantilever, fixed beams and continuous beams using theorem of three moment equation for external loadings and support settlements.
- find the load carrying capacity of columns and stresses induced in columns and cylinders
- Determine principal stresses and planes for an element in three dimensional state of stress and study various theories of failure
- Determine the stresses due to Unsymmetrical bending of beams, locate the shear center, and find the stresses in curved beams.

**TEXTBOOKS:**

1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 2015.
2. Rattan.S.S., "Strength of Materials", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2011.

3. Punmia B.C., Ashok Kumar Jain and Arun Kumar Jain, "Theory of Structures" (SMTS) Vol - II, Laxmi Publishing Pvt Ltd, New Delhi 2017.
4. Basavarajiah and Mahadevapa, Strength of Materials, University press, Hyderabad, 2016

#### REFERENCES:

1. Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co., New Delhi, 2003
2. William A .Nash, "Theory and Problems of Strength of Materials", Schaum's Outline Series, Tata McGraw Hill Publishing company, 2007.
3. Singh. D.K., " Strength of Materials", Ane Books Pvt. Ltd., New Delhi, 2016
4. Egor P Popov, "Engineering Mechanics of Solids", 2<sup>nd</sup> edition, PHI Learning Pvt. Ltd., New Delhi, 2012

**CE8403**

**APPLIED HYDRAULIC ENGINEERING**

**L T P C**  
**3 0 0 3**

#### OBJECTIVE:

- To introduce the students to various hydraulic engineering problems like open channel flows and hydraulic machines. At the completion of the course, the student should be able to relate the theory and practice of problems in hydraulic engineering.

#### UNIT I UNIFORM FLOW

**9**

Definition and differences between pipe flow and open channel flow - Types of Flow - Properties of open channel - Velocity distribution in open channel - Steady uniform flow: Chezy equation, Manning equation - Best hydraulic sections for uniform flow - Wide open channel - Specific energy and specific force – Critical flow .

#### UNIT II GRADUALLY VARIED FLOW

**9**

Dynamic equations of gradually varied flows - Types of flow profiles - Classifications: Computation by Direct step method and Standard step method – Control section – Break in Grade – Computation.

#### UNIT III RAPIDLY VARIED FLOW

**9**

Application of the momentum equation for RVF - Hydraulic jumps - Types - Energy dissipation – Celerity - Rapidly varied unsteady flows (positive and negative surges)

#### UNIT IV TURBINES

**9**

Impact of Jet on flat, curved plates, Stationary and Moving -Classification of Turbines - Pelton wheel - Francis turbine - Kaplan turbine - Specific speed - Characteristic Curves of Turbines- Draft tube and cavitation.

#### UNIT V PUMPS

**9**

Classification of Pumps - Centrifugal pumps – Work done - Minimum speed to start the pump - NPSH - Multistage pumps - Characteristics curve - Reciprocating pumps - Negative slip - Indicator diagrams and its variations – Air vessels - Savings in work done.

**TOTAL : 45 PERIODS**

#### OUTCOMES:

On completion of this course the students will be able to

- Apply their knowledge of fluid mechanics in addressing problems in open channels.
- Able to identify a effective section for flow in different cross sections.
- To solve problems in uniform, gradually and rapidly varied flows in steady state conditions.
- Understand the principles, working and application of turbines.
- Understand the principles, working and application of pumps.

**TEXTBOOKS:**

1. Subramanya.K, "Flow in open channels", Tata McGraw Hill, New Delhi, 2000.
2. Modi P.N and Seth.S.M "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House New Delhi, 2009.
3. Chandramouli P.N., "Applied Hydraulic Engineering", Yes Dee Publishing Pvt. Ltd., 2017.

**REFERENCES:**

1. Ven Te Chow, "Open Channel Hydraulics", McGraw Hill, New York, 2009.
2. Hanif Chaudhry.M., "Open Channel Flow", Second Edition, Springer, 2007.
3. Rajesh Srivastava, "Flow through open channels", Oxford University Press, New Delhi, 2008.
4. Jain.A.K., " Fluid Mechanics" (Including Hydraulic Machines), Khanna Publishers, Twelfth Edition, 2016.
5. Subramanya.K., " Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Education Private Limited, New Delhi, 2010.

**CE8404****CONCRETE TECHNOLOGY****L T P C  
3 0 0 3****OBJECTIVE:**

- To impart knowledge to the students on the properties of materials for concrete by suitable tests, mix design for concrete and special concretes.

**UNIT I            CONSTITUENT MATERIALS****9**

Cement - Different types - Chemical composition and Properties - Hydration of cement - Tests on cement - IS Specifications - Aggregates - Classification - Mechanical properties and tests as per BIS - Grading requirements - Water - Quality of water for use in concrete.

**UNIT II            CHEMICAL AND MINERAL ADMIXTURES****9**

Accelerators - Retarders - Plasticizers - Super plasticizers - Water proofers - Mineral Admixtures like Fly Ash, Silica Fume, Ground Granulated Blast Furnace Slag and Metakaoline - Effects on concrete properties.

**UNIT III           PROPORTIONING OF CONCRETE MIX****9**

Principles of Mix Proportioning - Properties of concrete related to Mix Design - Physical properties of materials required for Mix Design - Design Mix and Nominal Mix - BIS Method of Mix Design - Mix Design Examples

**UNIT IV           FRESH AND HARDENED PROPERTIES OF CONCRETE****9**

Workability - Tests for workability of concrete - Segregation and Bleeding - Determination of strength Properties of Hardened concrete - Compressive strength - split tensile strength - Flexural strength - Stress-strain curve for concrete - Modulus of elasticity - durability of concrete - water absorption - permeability - corrosion test - acid resistance.

**UNIT V            SPECIAL CONCRETES****9**

Light weight concretes - foam concrete- self compacting concrete - vacuum concrete - High strength concrete - Fibre reinforced concrete - Ferrocement - Ready mix concrete - SIFCON - Shotcrete - Polymer concrete - High performance concrete - Geopolymer Concrete

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Students will be able to understand

- The various requirements of cement, aggregates and water for making concrete
- The effect of admixtures on properties of concrete
- The concept and procedure of mix design as per IS method
- The properties of concrete at fresh and hardened state
- The importance and application of special concretes.

**TEXTBOOKS:**

1. Gupta.B.L., Amit Gupta, "Concrete Technology", Jain Book Agency, 2010.
2. Shetty,M.S, "Concrete Technology", S.Chand and Company Ltd, New Delhi, 2003
3. Bhavikatti.S.S, " Concrete Technology", I.K.International Publishing House Pvt. Ltd., New Delhi, 2015
4. Santhakumar. A.R., "Concrete Technology", Oxford University Press India, 2006.

**REFERENCES:**

1. Neville, A.M; "Properties of Concrete", Pitman Publishing Limited, London, 1995
2. Gambhir, M.L; "Concrete Technology", 3<sup>rd</sup> Edition, Tata McGraw Hill Publishing Co Ltd, New Delhi, 2007
3. IS10262-2009 Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, 1998.
4. Job Thomas, "Concrete Technology", Cengage Learning India Pvt. Ltd., Delhi, 2015
5. Kumar P Mehta., Paulo J M Monterio., "Concrete - Microstructure, Properties and Materials", McGraw Hill Education (India) Private Limited, New Delhi, 2016

**CE8491****SOIL MECHANICS****L T P C  
3 0 0 3****OBJECTIVE:**

- To impart knowledge to classify the soil based on index properties and to assess their engineering properties based on the classification. To familiarize the students about the fundamental concepts of compaction, flow through soil, stress transformation, stress distribution, consolidation and shear strength of soils. To impart knowledge of design of both finite and infinite slopes.

**UNIT I SOIL CLASSIFICATION AND COMPACTION****9**

History - formation and types of soil - composition - Index properties - clay mineralogy structural arrangement of grains - description - Classification - BIS - US - phase relationship - Compaction - theory - laboratory and field technology - field Compaction method - factors influencing compaction.

**UNIT II EFFECTIVE STRESS AND PERMEABILITY****9**

Soil - water - Static pressure in water - Effective stress concepts in soils - Capillary phenomena - Permeability - Darcy's law - Determination of Permeability - Laboratory Determination (Constant head and falling head methods) and field measurement pumping out in unconfined and confined aquifer - Factors influencing permeability of soils - Seepage - Two dimensional flow - Laplace's equation - Introduction to flow nets - Simple problems Sheet pile and wier.

**UNIT III STRESS DISTRIBUTION AND SETTLEMENT****9**

Stress distribution in homogeneous and isotropic medium - Boussines of theory - (Point load, Line load and udl) Use of Newmarks influence chart -Components of settlement - Immediate and consolidation settlement - Factors influencing settlement - Terzaghi's one dimensional consolidation theory - Computation of rate of settlement. -  $\sqrt{t}$  and log t methods. e-log p relationship consolidation settlement N-C clays - O.C clays - Computation.

**UNIT IV SHEAR STRENGTH****9**

Shear strength of cohesive and cohesion less soils - Mohr-Coulomb failure theory - shear strength - Direct shear, Triaxial compression, UCC and Vane shear tests - Pore pressure parameters - Factors influences shear strength of soil.

**UNIT V SLOPE STABILITY****9**

Infinite slopes and finite slopes – Friction circle method - Use of stability number -Guidelines for location of critical slope surface in cohesive and c  $\phi$  soil - Slope protection measures.

**TOTAL: 45 PERIODS****OUTCOMES:**

Students will be able to

- classify the soil and assess the engineering properties, based on index properties.
- Understand the stress concepts in soils
- Understand and identify the settlement in soils.
- Determine the shear strength of soil
- Analyze both finite and infinite slopes.

**TEXTBOOKS:**

1. Murthy, V.N.S., "Text book of Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2014
2. Arora, K.R., "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 7<sup>th</sup> Edition, 2017(Reprint).
3. Gopal Ranjan, A S R Rao, "Basic and Applied Soil Mechanics" New Age International Publication, 3<sup>rd</sup> Edition, 2016.
4. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 16<sup>th</sup> Edition, 2017.

**REFERENCES:**

1. McCarthy, D.F., "Essentials of Soil Mechanics and Foundations: Basic Geotechnics". Prentice-Hall, 2006.
2. Coduto, D.P., "Geotechnical Engineering - Principles and Practices", Prentice Hall of India Pvt. Ltd. New Delhi, 2010.
3. Braja M Das, "Principles of Geotechnical Engineering", Cengage Learning India Private Limited, 8<sup>th</sup> Edition, 2014.
4. Palanikumar.M., "Soil Mechanics", Prentice Hall of India Pvt. Ltd, Learning Private Limited Delhi, 2013.
5. Craig.R.F., "Soil Mechanics", E & FN Spon, London and New York, 2012.
6. Purushothama Raj. P., "Soil Mechanics and Foundations Engineering", 2<sup>nd</sup> Edition, Pearson Education, 2013.
7. Venkatramaiah.C., "Geotechnical Engineering", New Age International Pvt. Ltd., New Delhi, 2017

**CE8481****STRENGTH OF MATERIALS LABORATORY****L T P C  
0 0 4 2****OBJECTIVE:**

- To expose the students to the testing of different materials under the action of various forces and determination of their characteristics experimentally.

**LIST OF EXPERIMENTS**

1. Tension test on steel rod
2. Compression test on wood
3. Double shear test on metal
4. Torsion test on mild steel rod

5. Impact test on metal specimen (Izod and Charpy)
6. Hardness test on metals (Rockwell and Brinell Hardness Tests)
7. Deflection test on metal beam
8. Compression test on helical spring
9. Deflection test on carriage spring

**TOTAL: 60 PERIODS**

**OUTCOME:**

- The students will have the required knowledge in the area of testing of materials and components of structural elements experimentally.

**REFERENCES:**

1. Strength of Materials Laboratory Manual, Anna University, Chennai - 600 025.
2. IS1786-2008 (Fourth Revision, Reaffirmed 2013), 'High strength deformed bars and wires for concrete reinforcement - Specification', 2008.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

| Sl. No. | Description of Equipment  | Quantity |
|---------|---|----------|
| 1.      | UTM of minimum 400 kN capacity                                      | 1        |
| 2.      | Torsion testing machine   | 1        |
| 3.      | Izod impact testing machine   | 1        |
| 4.      | Hardness testing machine<br>Rockwell<br>Vicker's (any 2)<br>Brinell | 1 each   |
| 5.      | Beam deflection test apparatus                                      | 1        |
| 6.      | Extensometer  | 1        |
| 7.      | Compressometer  | 1        |
| 8.      | Dial gauges   | Few      |
| 9.      | Le Chatelier's apparatus  | 2        |
| 10.     | Vicat's apparatus   | 2        |
| 11.     | Mortar cube moulds  | 10       |

**CE8461**

**HYDRAULIC ENGINEERING LABORATORY**

**L T P C**  
**0 0 4 2**

**OBJECTIVE:**

- Students should be able to verify the principles studied in theory by performing the experiments in lab.

**LIST OF EXPERIMENTS**

**A. Flow Measurement**

1. Calibration of Rotameter
2. Calibration of Venturimeter / Orificemeter
3. Bernoulli's Experiment

**B. Losses in Pipes**

4. Determination of friction factor in pipes
5. Determination of min or losses



### C. Pumps

6. Characteristics of Centrifugal pumps
7. Characteristics of Gear pump
8. Characteristics of Submersible pump
9. Characteristics of Reciprocating pump

### D. Turbines

10. Characteristics of Pelton wheel turbine
11. Characteristics of Francis turbine/Kaplan turbine

### E. Determination of Metacentric height

12. Determination of Metacentric height of floating bodies

**TOTAL: 60 PERIODS**

### OUTCOMES:

- The students will be able to measure flow in pipes and determine frictional losses.
- The students will be able to develop characteristics of pumps and turbines.

### REFERENCES:

1. Sarbjit Singh."Experiments in Fluid Mechanics", Prentice Hall of India Pvt. Ltd, Learning Private Limited, Delhi, 2009.
2. "Hydraulic Laboratory Manual", Centre for Water Resources, Anna University, 2004.
3. Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi, 2000.
4. Subramanya K. "Flow in open channels", Tata McGraw Hill Publishing Company, 2001.

### LIST OF EQUIPMENTS

1. One set up of Rotometer
2. One set up of Venturimeter/Orifice meter
3. One Bernoulli's Experiment set up
4. One set up of Centrifugal Pump
5. One set up of Gear Pump
6. One set up of Submersible pump
7. One set up of Reciprocating Pump
8. One set up of Pelton Wheel turbine
9. One set up of Francis turbines/one set of kaplon turbine
10. One set up of equipment for determination of Metacentric height of floating bodies
11. One set up for determination of friction factor in pipes
12. One set up for determination of minor losses.

**HS8461**

**ADVANCED READING AND WRITING**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

### OBJECTIVES:

- Strengthen the reading skills of students of engineering.
- Enhance their writing skills with specific reference to technical writing.
- Develop students' critical thinking skills.
- Provide more opportunities to develop their project and proposal writing skills.

### UNIT I

Reading - Strategies for effective reading-Use glosses and footnotes to aid reading comprehension- Read and recognize different text types-Predicting content using photos and title  
Writing-Plan before writing- Develop a paragraph: topic sentence, supporting sentences, concluding sentence -Write a descriptive paragraph

## **UNIT II**

Reading-Read for details-Use of graphic organizers to review and aid comprehension Writing- State reasons and examples to support ideas in writing- Write a paragraph with reasons and examples- Write an opinion paragraph

## **UNIT III**

Reading- Understanding pronoun reference and use of connectors in a passage- speed reading techniques-Writing- Elements of a good essay-Types of essays- descriptive-narrative- issue-based-argumentative-analytical.

## **UNIT IV**

Reading- Genre and Organization of Ideas- Writing- Email writing- visumes – Job application-project writing-writing convincing proposals.

## **UNIT V**

Reading- Critical reading and thinking- understanding how the text positions the reader- identify Writing- Statement of Purpose- letter of recommendation- Vision statement

**TOTAL: 30 PERIODS**

### **OUTCOMES:**

At the end of the course Learners will be able to:

- Write different types of essays.
- Write winning job applications.
- Read and evaluate texts critically.
- Display critical thinking in various professional contexts.

### **TEXT BOOKS:**

1. Gramer F. Margot and Colin S. Ward Reading and Writing (Level 3) Oxford University Press: Oxford, 2011
2. Debra Daise, CharlNorloff, and Paul Carne Reading and Writing (Level 4) Oxford University Press: Oxford, 2011

### **REFERENCES**

1. Davis, Jason and Rhonda Llss.Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006
2. Suresh Kumar.E and et al. Enriching Speaking and Writing Skills. Second Edition. Orient Black swan: Hyderabad, 2012
3. Withrow, Jeans and et al. Inspired to Write. Readings and Tasks to develop writing skills. Cambridge University Press: Cambridge, 2004
4. Goatly, Andrew. Critical Reading and Writing. Routledge: United States of America, 2000
5. Petelin, Roslyn and Marsh Durham. The Professional Writing Guide: Knowing Well and Knowing Why. Business & Professional Publishing: Australia, 2004

**CE8501**

**DESIGN OF REINFORCED CEMENT CONCRETE ELEMENTS**

**L T P C**  
**3 2 0 4**

### **OBJECTIVES:**

- To introduce the different types of philosophies related to design of basic structural elements such as slab, beam, column and footing which form part of any structural system with reference to Indian standard code of practice.

**UNIT I INTRODUCTION 9+6**

Objective of structural design-Steps in RCC Structural Design Process- Type of Loads on Structures and Load combinations- Code of practices and Specifications - Concept of Working Stress Method, Ultimate Load Design and Limit State Design Methods for RCC -Properties of Concrete and Reinforcing Steel - Analysis and Design of Singly reinforced Rectangular beams by working stress method - Limit State philosophy as detailed in IS code - Advantages of Limit State Method over other methods - Analysis and design of singly and doubly reinforced rectangular beams by Limit State Method.

**UNIT II DESIGN OF BEAMS 9+6**

Analysis and design of Flanged beams for – Use of design aids for Flexure - Behaviour of RC members in Shear, Bond and Anchorage - Design requirements as per current code - Behaviour of rectangular RC beams in shear and torsion - Design of RC members for combined Bending, Shear and Torsion.

**UNIT III DESIGN OF SLABS AND STAIRCASE 9+6**

Analysis and design of cantilever, one way simply supported and continuous slabs and supporting beams-Two way slab- Design of simply supported and continuous slabs using IS code coefficients- Types of Staircases – Design of dog-legged Staircase.

**UNIT IV DESIGN OF COLUMNS 9+6**

Types of columns -Axially Loaded columns – Design of short Rectangular Square and circular columns -Design of Slender columns- Design for Uniaxial and Biaxial bending using Column Curves

**UNIT V DESIGN OF FOOTINGS 9+6**

Concepts of Proportioning footings and foundations based on soil properties-Design of wall footing – Design of axially and eccentrically loaded Square, Rectangular pad and sloped footings – Design of Combined Rectangular footing for two columns only.

**TOTAL: 75 PERIODS**

**OUTCOMES:**

Students will be able to

- Understand the various design methodologies for the design of RC elements.
- Know the analysis and design of flanged beams by limit state method and sign of beams for shear, bond and torsion.
- design the various types of slabs and staircase by limit state method.
- Design columns for axial, uniaxial and biaxial eccentric loadings.
- Design of footing by limit state method.

**TEXT BOOKS:**

1. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, Pvt. Ltd., New Delhi, 2002.
2. Gambhir. M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Private Limited, New Delhi, 2006.
3. Subramanian,N., "Design of Reinforced Concrete Structures",Oxford University Press, New Delhi, 2013.
4. Krishnaraju.N " Design of Reinforced Concrete Structures ", CBS Publishers & Distributors Pvt. Ltd., New Delhi.
5. Ramachandra, "Limit state Design of Concrete Structures" Standard Book House, New Delhi

**REFERENCES:**

1. Jain, A.K., "Limit State Design of RC Structures", Nemchand Publications, Roorkee, 1998
2. Sinha, S.N., "Reinforced Concrete Design", Tata McGraw Hill Publishing Company Ltd., New Delhi, 2002
3. Unnikrishna Pillai, S., Devdas Menon, "Reinforced Concrete Design", Tata McGraw Hill Publishing Company Ltd., 2009
4. Punmia. B.C., Ashok Kumar Jain, Arun Kumar Jain, "Limit State Design of Reinforced Concrete", Laxmi Publication Pvt. Ltd., New Delhi, 2007.
5. Bandyopadhyay. J.N., "Design of Concrete Structures"., Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
6. IS456:2000, Code of practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi, 2000
7. SP16, IS456:1978 "Design Aids for Reinforced Concrete to Bureau of Indian Standards, New Delhi, 1999
8. Shah V L Karve S R., "Limit State Theory and Design of Reinforced Concrete", Structures Publications, Pune, 2013

**CE8502****STRUCTURAL ANALYSIS I****L T P C  
3 0 0 3****OBJECTIVE:**

- To introduce the students to basic theory and concepts of classical methods of structural analysis

|   |                                   |          |
|---|-----------------------------------|----------|
| <b>UNIT I</b>   | <b>STRAIN ENERGY METHOD</b>       | <b>9</b> |
| Determination of Static and Kinematic Indeterminacies – Analysis of continuous beams, plane frames and indeterminate plane trusses by strain energy method (up to two degree of redundancy).  |                                   |          |
| <b>UNIT II</b>  | <b>SLOPE DEFLECTION METHOD</b>    | <b>9</b> |
| Slope deflection equations – Equilibrium conditions - Analysis of continuous beams and rigid frames – Rigid frames with inclined members - Support settlements- symmetric frames with symmetric and skew-symmetric loadings.          |                                   |          |
| <b>UNIT III</b>   | <b>MOMENT DISTRIBUTION METHOD</b> | <b>9</b> |
| Stiffness and carry over factors - Distribution and carryover of moments - Analysis of continuous Beams- Plane rigid frames with and without sway – Support settlement - symmetric frames with symmetric and skew-symmetric loadings. |                                   |          |
| <b>UNIT IV</b>  | <b>FLEXIBILITY METHOD</b>         | <b>9</b> |
| Primary structures - Compatibility conditions – Formation flexibility matrices - Analysis of indeterminate pin- jointed plane frames, continuous beams and rigid jointed plane frames by direct flexibility approach.                 |                                   |          |
| <b>UNIT V</b>   | <b>STIFFNESS METHOD</b>           | <b>9</b> |
| Restrained structure -Formation of stiffness matrices - equilibrium condition - Analysis of Continuous Beams, Pin-jointed plane frames and rigid frames by direct stiffness method.   |                                   |          |

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Students will be able to

- Analyze continuous beams, pin-jointed indeterminate plane frames and rigid plane frames by strain energy method
- Analyse the continuous beams and rigid frames by slope deflection method.
- Understand the concept of moment distribution and analysis of continuous beams and rigid frames with and without sway.
- Analyse the indeterminate pin jointed plane frames continuous beams and rigid frames using matrix flexibility method.
- Understand the concept of matrix stiffness method and analysis of continuous beams, pin jointed trusses and rigid plane frames.

**TEXTBOOKS:**

1. Bhavikatti, S.S, Structural Analysis, Vol.1, & 2, Vikas Publishing House Pvt.Ltd., New Delhi-4, 2014.
2. Bhavikatti, S.S, Matrix Method of Structural Analysis, I. K. International Publishing House Pvt.Ltd., New Delhi-4, 2014.
3. Vazrani.V.N And Ratwani, M.M, Analysis of Structures, Vol.II, Khanna Publishers, 2015.
4. Pandit G.S.and Gupta S.P., Structural Analysis-A Matrix Approach, Tata McGraw Hill Publishing Company Ltd., 2006

**REFERENCES:**

1. Punmia. B.C, Ashok Kumar Jain & Arun Kumar Jain, Theory of structures, Laxmi Publications, New Delhi, 2004.
2. William Weaver, Jrand James M.Gere, Matrix analysis of framed structures, CBS Publishers & Distributors, Delhi, 1995
3. Hibbeler, R.C., Structural Analysis, VII Edition, Prentice Hall, 2012.
4. Reddy.C.S, "Basic Structural Analysis", Tata McGraw Hill Publishing Company, 2005.
5. Rajasekaran. S, & G. Sankarasubramanian., "Computational Structural Mechanics", PHI Learning Pvt. Ltd, 2015
6. Negi L.S.and Jangid R.S., Structural Analysis, Tata McGraw Hill Publishing Co.Ltd. 2004.

**EN8491****WATER SUPPLY ENGINEERING****L T P C****3 0 0 3****OBJECTIVE:**

- To equip the students with the principles and design of water treatment units and distribution system.

**UNIT I SOURCES OF WATER****9**

Public water supply system - Planning, Objectives, Design period, Population forecasting; Water demand - Sources of water and their characteristics, Surface and Groundwater - Impounding Reservoir - Development and selection of source - Source Water quality - Characterization - Significance - Drinking Water quality standards.

**UNIT II CONVEYANCE FROM THE SOURCE****9**

Water supply - intake structures - Functions; Pipes and conduits for water - Pipe materials - Hydraulics of flow in pipes - Transmission main design - Laying, jointing and testing of pipes - appurtenances - Types and capacity of pumps - Selection of pumps and pipe materials.

**UNIT III WATER TREATMENT****9**

Objectives - Unit operations and processes - Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation -Clarifloccuator-Plate and tube settlers - Pulsator clarifier - sand filters - Disinfection - Residue Management -Construction, Operation and Maintenance aspects.

**UNIT IV ADVANCED WATER TREATMENT****9**

Water softening - Desalination- R.O. Plant - demineralization - Adsorption - Ion exchange- Membrane Systems - RO Reject Management - Iron and Manganese removal - Defluoridation - Construction and Operation & Maintenance aspects - Recent advances - MBR process

**UNIT V WATER DISTRIBUTION AND SUPPLY****9**

Requirements of water distribution - Components - Selection of pipe material - Service reservoirs - Functions - Network design - Economics - Analysis of distribution networks -Computer applications - Appurtenances - Leak detection.

Principles of design of water supply in buildings - House service connection - Fixtures and fittings, systems of plumbing and types of plumbing.

**TOTAL: 45 PERIODS****OUTCOMES:**

The students completing the course will have

- an insight into the structure of drinking water supply systems, including water transport, treatment and distribution
- the knowledge in various unit operations and processes in water treatment
- an ability to design the various functional units in water treatment
- an understanding of water quality criteria and standards, and their relation to public health
- the ability to design and evaluate water supply project alternatives on basis of chosen criteria.

**TEXTBOOKS:**

1. Garg, S.K. Environmental Engineering, Vol.I Khanna Publishers, New Delhi, 2010.
2. Modi, P.N., Water Supply Engineering, Vol.I Standard Book House, New Delhi, 2010.
3. Punmia, B.C., Ashok Jain and Arun Jain, Water Supply Engineering, Laxmi Publications (P) Ltd., New Delhi, 2014.

**REFERENCES:**

1. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
2. Syed R. Qasim and Edward M. Motley Guang Zhu, Water Works Engineering Planning, Design and Operation, Prentice Hall of India Learning Private Limited, New Delhi, 2009.

**CE8591****FOUNDATION ENGINEERING****L T P C  
3 0 0 3****OBJECTIVE:**

- To impart knowledge to plan and execute a detail site investigation programme, to select geotechnical design parameters and type of foundations. Also to familiarize the students for the geotechnical design of different type of foundations and retaining walls.

**UNIT I                    SITE INVESTIGATION AND SELECTION OF FOUNDATION                    9**

Scope and objectives - Methods of exploration - Auguring and boring - Wash boring and rotary drilling - Depth and spacing of bore holes - Soil samples - Representative and undisturbed - Sampling methods - Split spoon sampler, Thin wall sampler, Stationary piston sampler - Penetration tests (SPT and SCPT) - Data interpretation - Strength parameters - Bore log report and Selection of foundation.

**UNIT II                    SHALLOW FOUNDATION                    9**

Location and depth of foundation - Codal provisions - Bearing capacity of shallow foundation on homogeneous deposits - Terzaghi's formula and BIS formula - Factors affecting bearing capacity – Bearing capacity from in-situ tests (SPT, SCPT and plate load) - Allowable bearing pressure - Seismic considerations in bearing capacity evaluation. Determination of Settlement of foundations on granular and clay deposits - Total and differential settlement - Allowable settlements - Codal provision - Methods of minimizing total and differential settlements.

**UNIT III                    FOOTINGS AND RAFTS                    9**

Types of Isolated footing, Combined footing, Mat foundation - Contact pressure and settlement distribution - Proportioning of foundations for conventional rigid behaviour - Minimum thickness for rigid behaviour - Applications - Compensated foundation - Codal provision

**UNIT IV                    PILE FOUNDATION                    9**

Types of piles and their functions - Factors influencing the selection of pile - Carrying capacity of single pile in granular and cohesive soil - Static formula - Dynamic formulae (Engineering news and Hileys) - Capacity from insitu tests (SPT and SCPT) - Negative skin friction - Uplift capacity- Group capacity by different methods (Feld's rule, Converse - Labarra formula and block failure criterion) - Settlement of pile groups - Interpretation of pile load test (routine test only), Under reamed piles - Capacity under compression and uplift - Cohesive - expansive - non expansive - Cohesionless soils - Codal provisions.

**UNIT V                    RETAINING WALLS                    9**

Plastic equilibrium in soils - Active and passive states - Rankine's theory - Cohesionless and cohesive soil - Coulomb's wedge theory - Condition for critical failure plane - Earth pressure on retaining walls of simple configurations - Culmann's Graphical method - Pressure on the wall due to line load - Stability analysis of retaining walls - Codal provisions.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Students will be able to

- Understand the site investigation, methods and sampling.
- Get knowledge on bearing capacity and testing methods.
- Design shallow footings.
- Determine the load carrying capacity, settlement of pile foundation.
- Determine the earth pressure on retaining walls and analysis for stability.

**TEXTBOOKS:**

1. Murthy, V.N.S., "Text book of Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2014.
2. Arora, K.R., "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 7<sup>th</sup> Edition, 2017 (Reprint).
3. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 16<sup>th</sup> Edition 2017.

**REFERENCES:**

1. Braja M Das, "Principles of Foundation Engineering" (Eighth edition), Cengage Learning 2014.
2. Kaniraj, S.R. "Design aids in Soil Mechanics and Foundation Engineering", Tata McGraw Hill publishing company Ltd., New Delhi, 2014.
3. Joseph E bowles, "Foundation Analysis and design", McGraw Hill Education, 5<sup>th</sup> Edition, 28<sup>th</sup> August 2015.
4. IS Code 6403 : 1981 (Reaffirmed 1997) "Bearing capacity of shallow foundation", Bureau of Indian Standards, New Delhi.
5. IS Code 8009 (Part 1):1976 (Reaffirmed 1998) "Shallow foundations subjected to symmetrical static vertical loads", Bureau of Indian Standards, New Delhi.
6. IS Code 8009 (Part 2):1980 (Reaffirmed 1995) "Deep foundations subjected to symmetrical static vertical loading", Bureau of Indian Standards, New Delhi.
7. IS Code 2911 (Part 1): 1979 (Reaffirmed 1997) "Concrete Piles" Bureau of Indian Standards, New Delhi.
8. IS Code 2911 (Part 2): 1979 (Reaffirmed 1997) "Timber Piles", Bureau of Indian Standards, New Delhi.
9. IS Code 2911 (Part 3) : 1979 (Reaffirmed 1997) "Under Reamed Piles", Bureau of Indian Standards, New Delhi.
10. IS Code 2911 (Part 4) : 1979 (Reaffirmed 1997) "Load Test on Piles", Bureau of Indian Standards, New Delhi.
11. IS Code 1904: 1986 (Reaffirmed 1995) "Design and Construction of Foundations in Soils", Bureau of Indian Standards, New Delhi.
12. IS Code 2131: 1981 (Reaffirmed 1997) "Method for Standard Penetration test for Soils", Bureau of Indian Standards, New Delhi.
13. IS Code 2132: 1986 (Reaffirmed 1997) "Code of Practice for thin - walled tube sampling for soils", Bureau of Indian Standards, New Delhi.
14. IS Code 1892 (1979): Code of Practice for subsurface Investigation for Foundations. Bureau of Indian Standards, New Delhi.
15. IS Code 14458 (Part 1) : 1998 "Retaining Wall for Hill Area - Guidelines, Selection of Type of Wall" , Bureau of Indian Standards, New Delhi.
16. IS Code 14458 (Part 2) : 1998 "Retaining Wall for Hill Area – Guidelines, Design of Retaining/Breast Walls" , Bureau of Indian Standards, New Delhi.
17. IS Code 14458 (Part 3) : 1998 "Retaining Wall for Hill Area - Guidelines, Construction Of Dry Stone Walls" , Bureau of Indian Standards, New Delhi.

**CE8511****SOIL MECHANICS LABORATORY****L T P C  
0 0 4 2****OBJECTIVE:**

- To develop skills to test the soils for their index and engineering properties and to characterise the soil based on their properties.

**EXERCISES:****1. DETERMINATION OF INDEX PROPERTIES****20**

- a. Specific gravity of soil solids
- b. Grain size distribution - Sieve analysis
- c. Grain size distribution - Hydrometer analysis
- d. Liquid limit and Plastic limit tests
- e. Shrinkage limit and Differential free swell tests



- 2. DETERMINATION OF INSITU DENSITY AND COMPACTION CHARACTERISTICS**      **12**
- Field density Test ( Sand replacement method and core cutter method)
  - Determination of moisture - density relationship using standard Proctor compaction test.
  - Determination of relative density (Demonstration only)
- 3. DETERMINATION OF ENGINEERING PROPERTIES**      **28**
- Permeability determination (constant head and falling head methods)
  - One dimensional consolidation test (Determination of Co-efficient of consolidation only)
  - Direct shear test in cohesionless soil
  - Unconfined compression test in cohesive soil
  - Laboratory vane shear test in cohesive soil
  - Tri-axial compression test in cohesionless soil (Demonstration only)
  - California Bearing Ratio Test

**TOTAL: 60 PERIODS**

**OUTCOME:**

- Students are able to conduct tests to determine both the index and engineering properties of soils and to characterize the soil based on their properties.

**REFERENCES:**

- “Soil Engineering Laboratory Instruction Manual” published by Engineering College Cooperative Society, Anna University, Chennai, 2010.
- Lambe T.W., “Soil Testing for Engineers”, John Wiley and Sons, New York, 1951. Digitized 2008.
- Saibaba Reddy, E.Ramasastri, K. “Measurement of Engineering Properties of Soils” New age International (P) Limited Publishers, New Delhi, 2002.
- IS Code of Practice (2720) Relevant Parts, as amended from time to time, Bureau of Indian Standards, New Delhi.

**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS**

| Sl.No. | Description of Equipment   | Quantity |
|--------|--|----------|
| 1.     | Sieves   | 2 sets   |
| 2.     | Hydrometer   | 2 sets   |
| 3.     | Liquid and Plastic limit apparatus                                     | 2 sets   |
| 4.     | Shrinkage limit apparatus  | 3 sets   |
| 5.     | Proctor Compaction apparatus   | 2 sets   |
| 6.     | UTM of minimum of 20kN capacity  | 1        |
| 7.     | Direct Shear apparatus   | 1        |
| 8.     | Thermometer  | 2        |
| 9.     | Sand replacement method accessories and core cutter method accessories | 2        |
| 10.    | Tri-axial Shear apparatus  | 1        |
| 11.    | Three Gang Consolidation test device                                   | 1        |
| 12.    | Relative Density apparatus   | 1        |
| 13.    | Van Shear apparatus  | 1        |
| 14.    | Weighing machine - 20kg capacity                                       | 1 No     |
| 15.    | Weighing machine - 1kg capacity  | 3 No     |

**COURSE OBJECTIVES:**

- To analyse the physical, chemical and biological characteristics of water and wastewater
- To quantify the dosage requirement for coagulation process
- To study the growth of micro-organism and its quantification
- To quantify the sludge

**Course Content:**

1. Physical, Chemical and biological characteristics of water and wastewater
2. Jar test
3. Chlorine demand and residual test
4. Growth of micro-organism

**COURSE OUTCOME:**

On the completion of the course, the students will be able to:

- Quantify the pollutant concentration in water and wastewater
- Suggest the type of treatment required and amount of dosage required for the treatment
- Examine the conditions for the growth of micro-organisms

**TOTAL: 60 PERIODS****List of Experiments:**

1. Determination of pH, Turbidity and conductivity
2. Determination of Hardness
3. Determination of Alkalinity and Acidity
4. Determination of Chlorides
5. Determination of Phosphates and Sulphates
6. Determination of iron and fluoride
7. Determination of Optimum Coagulant dosage
8. Determination of residual chlorine and available chlorine in bleaching powder
9. Determination of Oil, and Grease
10. Determination of suspended, settleable, volatile and fixed solids
11. Determination Dissolved Oxygen and BOD for the given sample
12. Determination of COD for given sample
13. Determination of SVI of Biological sludge and microscopic examination
14. Determination of MPN index of given water sample

The objective of the survey camp is to enable the students to get practical training in the field work. Groups of not more than six members in a group will carry out each exercise in survey camp. The camp must involve work on a large area of not less than 40 acres outside the campus (Survey camp should not be conducted inside the campus). At the end of the camp, each student shall have mapped and contoured the area. The camp record shall include all original field observations, calculations and plots.

Two weeks Survey Camp will be conducted during summer vacation in the following activities:

1. Traverse - using Total station
2. Contouring
  - (i). Radial tachometric contouring - Radial Line at Every 45 Degree and Length not less than 60 Meter on each Radial Line

- (ii). Block Level/ By squares of size at least 100 Meter x 100 Meter atleast 20 Meter interval
- (III). L.S & C.S - Road and canal alignment for a Length of not less than 1 Kilo Meter atleast L.S at Every 30M and C.S at every 90 M
- 3. Offset of Buildings and Plotting the Location
- 4. Sun observation to determine azimuth (guidelines to be given to the students)
- 5. Use of GPS to determine latitude and longitude and locate the survey camp location
- 6. Traversing using GPS
- 7. Curve setting by deflection angle

Apart from above students may be given survey exercises in other area also based on site condition to give good exposure on survey.

**CE8601**

**DESIGN OF STEEL STRUCTURAL ELEMENTS**

**L T P C**  
**3 2 0 4**

**OBJECTIVE:**

- To introduce the students to limit state design of structural steel members subjected to compressive, tensile and bending loads, including connections. Design of structural systems such as roof trusses, gantry girders as per provisions of current code (IS 800 - 2007) of practice for working stress and Limit state Method.

**UNIT I INTRODUCTION AND ALLOWABLE STRESS DESIGN**

**9+6**

Structural steel types – Mechanical Properties of structural steel- Indian structural steel products- Steps involved in the Deign Process -Steel Structural systems and their Elements- -Type of Loads on Structures and Load combinations- Code of practices, Loading standards and Specifications - Concept of Allowable Stress Method, and Limit State Design Methods for Steel structures-Relative advantages and Limitations-Strengths and Serviceability Limit states.

Allowable stresses as per IS 800 section 11 -Concepts of Allowable stress design for bending and Shear -Check for Elastic deflection-Calculation of moment carrying capacity -Design of Laterally supported Solid Hot Rolled section beams-Allowable stress deign of Angle Tension and Compression Members and estimation of axial load carrying capacity.

**UNIT II CONNECTIONS IN STEEL STRUCTURES**

**9+6**

Type of Fasteners- Bolts Pins and welds- Types of simple bolted and welded connections Relative advantages and Limitations-Modes of failure-the concept of Shear lag-efficiency of joints- Axially loaded bolted connections for Plates and Angle Members using bearing type bolts -Prying forces and Hanger connection- Design of Slip critical connections with High strength Friction Grip bolts.- Design of joints for combined shear and Tension- Eccentrically Loaded Bolted Bracket Connections- Welds-symbols and specifications- Effective area of welds-Fillet and but Welded connections-Axially Loaded connections for Plate and angle truss members and Eccentrically Loaded bracket connections.

**UNIT III TENSION MEMBERS**

**9+6**

Tension Members - Types of Tension members and sections -Behaviour of Tension Members-modes of failure-Slenderness ratio- Net area - Net effective sections for Plates ,Angles and Tee in tension -Concepts of Shear Lag- Design of plate and angle tension members-design of built up tension Members-Connections in tension members - Use of lug angles - Design of tension splice.

**UNIT IV COMPRESSION MEMBERS**

**9+6**

Types of compression members and sections-Behaviour and types of failures-Short and slender columns- Current code provisions for compression members- Effective Length, Slenderness ratio -Column formula and column curves- Design of single section and compound Angles-Axially Loaded solid section Columns- Design of Built up Laced and Battened type columns - Design of column bases - Plate and Gusseted bases for Axially loaded columns- Splices for columns.

**UNIT V DESIGN OF FLEXURAL MEMBERS****9+6**

Types of steel Beam sections- Behaviour of Beams in flexure- Codal Provisions – Classification of cross sections- Flexural Strength and Lateral stability of Beams -Shear Strength-Web Buckling, Crippling and deflection of Beams- Design of laterally supported Beams- Design of solid rolled section Beams- Design of Plated beams with cover plates - Design Strength of Laterally unsupported Beams – Design of laterally unsupported rolled section Beams- Purlin in Roof Trusses-Design of Channel and I section Purlins.

**TOTAL: 75 PERIODS****OUTCOMES:**

Students will be able to

- Understand the concepts of various design philosophies
- Design common bolted and welded connections for steel structures
- Design tension members and understand the effect of shear lag.
- Understand the design concept of axially loaded columns and column base connections.
- Understand specific problems related to the design of laterally restrained and unrestrained steel beams.

**TEXTBOOKS:**

1. Subramanian.N, "Design of Steel Structures", Oxford University Press, New Delhi, 2013.
2. Gambhir. M.L., "Fundamentals of Structural Steel Design", McGraw Hill Education India Pvt. Ltd., 2013
3. Duggal. S.K, "Limit State Design of Steel Structures", Tata McGraw Hill Publishing Company, 2005

**REFERENCES:**

1. Narayanan.R.et.al. "Teaching Resource on Structural Steel Design", INSDAG, Ministry of Steel Publications, 2002
2. Sai Ram. K.S. "Design of Steel Structures " Dorling Kindersley (India) Pvt. Ltd., New Delhi, 2nd Edition, 2015, [www.pearsoned.co.in/kssairam](http://www.pearsoned.co.in/kssairam)
3. Shiyekar. M.R., "Limit State Design in Structural Steel", Prentice Hall of India Pvt. Ltd, Learning Pvt. Ltd., 2<sup>nd</sup> Edition, 2013
4. Bhavikatti.S.S, "Design of Steel Structures" By Limit State Method as per IS:800- 2007, IK International Publishing House Pvt. Ltd., 2009
5. Shah.V.L. and Veena Gore, "Limit State Design of Steel Structures", IS 800-2007, Structures Publications, 2009.
6. IS800 :2007, General Construction in Steel - Code of Practice, (Third Revision), Bureau of Indian Standards, New Delhi, 2007
7. SP 6(1) Hand book on structural Steel Sections

**CE8602****STRUCTURAL ANALYSIS II****L T P C  
3 0 0 3****OBJECTIVES :**

- To learn the method of drawing influence lines and its uses in various applications like beams and plane trusses.
- To analyse the arches, suspension bridges and space trusses.
- Also to learn Plastic analysis of beams and rigid frames.

|  |  |          |
|--|--|----------|
| <b>UNIT I</b>  | <b>INFLUENCE LINES FOR DETERMINATE BEAMS</b>   | <b>9</b> |
| Influence lines for reactions in statically determinate beams - Influence lines for shear force and bending moment – Calculation of critical stress resultants due to concentrated and distributed moving loads – absolute maximum bending moment - influence lines for member forces in pin jointed plane frames. |  |          |
| <b>UNIT II</b>   | <b>INFLUENCE LINES FOR INDETERMINATE BEAMS</b> | <b>9</b> |
| Muller Breslau's principle- Influence line for Shearing force, Bending Moment and support reaction components of propped cantilever, continuous beams (Redundancy restricted to one), and fixed beams.   |  |          |
| <b>UNIT III</b>  | <b>ARCHES</b>                                  | <b>9</b> |
| Arches - Types of arches - Analysis of three hinged, two hinged and fixed arches - Parabolic and circular arches – Settlement and temperature effects.   |  |          |
| <b>UNIT IV</b>   | <b>CABLES AND SUSPENSION BRIDGES</b>           | <b>9</b> |
| Equilibrium of cable - length of cable - anchorage of suspension cables - stiffening girders - cables with three hinged stiffening girders - Influence lines for three hinged stiffening girders.  |  |          |
| <b>UNIT V</b>  | <b>PLASTIC ANALYSIS</b>                        | <b>9</b> |
| Plastic theory - Statically indeterminate structures - Plastic moment of resistance - Plastic modulus - Shape factor - Load factor - Plastic hinge and mechanism - collapse load - Static and kinematic methods - Upper and lower bound theorems - Plastic analysis of indeterminate beams and frames.             |  |          |

**TOTAL:45 PERIODS**

**OUTCOMES:**

Students will be able to

- Draw influence lines for statically determinate structures and calculate critical stress resultants.
- Understand Muller Breslau principle and draw the influence lines for statically indeterminate beams.
- Analyse of three hinged, two hinged and fixed arches.
- Analyse the suspension bridges with stiffening girders
- Understand the concept of Plastic analysis and the method of analyzing beams and rigid frames.

**TEXTBOOKS:**

1. Bhavikatti,S.S, Structural Analysis,Vol.1 & 2, Vikas Publishing House Pvt.Ltd., NewDelhi-4, 2014.
2. Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain, Theory of structures, Laxmi, Publications,2004.
3. Vazrani.V.N And Ratwani,M.M, Analysis of Structures, Vol.II, Khanna Publishers,2015.

**REFERENCES:**

1. Negi.L.S and Jangid R.S., Structural Analysis, Tata McGraw-Hill Publishers, 2004.
2. Reddy C.S., Basic Structural Analysis, Tata McGraw Hill Publishing Co.Ltd.2002.
3. Gambhir.M.L., Fundamentals of Structural Mechanics and Analysis, PHIL earning Pvt. Ltd.,2011.
4. Prakash Rao D.S., Structural Analysis, Universities Press,1996.

**OBJECTIVE:**

- The student is exposed to different phases in irrigation practices and Planning and management of irrigation. Further they will be imparted required knowledge on Irrigation storage and distribution canal system and Irrigation management.

**UNIT I CROP WATER REQUIREMENT 9**

Need and classification of irrigation- historical development and merits and demerits of irrigation- types of crops-crop season-duty, delta and base period- consumptive use of crops- estimation of Evapotranspiration using experimental and theoretical methods

**UNIT II IRRIGATION METHODS 9**

Tank irrigation - Well irrigation - Irrigation methods: Surface and Sub-Surface and Micro Irrigation – design of drip and sprinkler irrigation - ridge and furrow irrigation-Irrigation scheduling - Water distribution system- Irrigation efficiencies.

**UNIT III DIVERSION AND IMPOUNDING STRUCTURES 9**

Types of Impounding structures - Gravity dam - Forces on a dam -Design of Gravity dams; Earth dams, Arch dams- Diversion Head works - Weirs and Barrages-

**UNIT IV CANAL IRRIGATION 9**

Canal regulations - direct sluice - Canal drop - Cross drainage works-Canal outlets - Design of prismatic canal-canal alignments-Canal lining - Kennedy's and Lacey's Regime theory-Design of unlined canal

**UNIT V WATER MANAGEMENT IN IRRIGATION 9**

Modernization techniques- Rehabilitation - Optimization of water use-Minimizing water losses- On farm development works-Participatory irrigation management- Water resources associations- Changing paradigms in water management-Performance evaluation-Economic aspects of irrigation

**TOTAL :45 PERIODS****OUTCOMES:**

Students will be able to

- Have knowledge and skills on crop water requirements.
- Understand the methods and management of irrigation.
- Gain knowledge on types of Impounding structures
- Understand methods of irrigation including canal irrigation.
- Get knowledge on water management on optimization of water use.

**TEXTBOOKS:**

1. Dilip Kumar Majumdar, "Irrigation Water Management", Prentice-Hall of India, New Delhi, 2008.
2. Punmia B.C., et. al; Irrigation and water power Engineering, Laxmi Publications, 16<sup>th</sup> Edition, New Delhi, 2009
3. Garg S. K., "Irrigation Engineering and Hydraulic structures", Khanna Publishers, 23<sup>rd</sup> Revised Edition, New Delhi, 2009

**REFERENCES:**

1. Duggal, K.N. and Soni, J.P., "Elements of Water Resources Engineering", New Age International Publishers, 2005
2. Linsley R.K. and Franzini J.B, "Water Resources Engineering", McGraw-Hill Inc, 2000
3. Chaturvedi M.C., "Water Resources Systems Planning and Management", Tata McGraw-Hill Inc., New Delhi, 1997.

4. Sharma R.K.. "Irrigation Engineering", S.Chand & Co. 2007.
5. Michael A.M., Irrigation Theory and Practice, 2nd Edition, Vikas Publishing House Pvt. Ltd., Noida, Up, 2008
6. Asawa, G.L., "Irrigation Engineering", NewAge International Publishers, New Delhi, 2000.
7. Basak, N.N, "Irrigation Engineering", Tata McGraw Hill Publishing Co. New Delhi, 1999

**CE8604**

**HIGHWAY ENGINEERING**

**L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- To give an overview about the highway engineering with respect to, planning, design, construction and maintenance of highways as per IRC standards, specifications and methods.

**UNIT I HIGHWAY PLANNING AND ALIGNMENT 9**

Significance of highway planning – Modal limitations towards sustainability - History of road development in India – factors influencing highway alignment – Soil suitability analysis - Road ecology - Engineering surveys for alignment, objectives, conventional and modern methods - Classification of highways – Locations and functions – Typical cross sections of Urban and Rural roads

**UNIT II GEOMETRIC DESIGN OF HIGHWAYS 9**

Cross sectional elements - Sight distances - Horizontal curves, Super elevation, transition curves, widening at curves – Vertical curves - Gradients, Special consideration for hill roads - Hairpin bends – Lateral and vertical clearance at underpasses.

**UNIT III DESIGN OF FLEXIBLE AND RIGID PAVEMENTS 9**

Pavement components and their role - Design principles -Design practice for flexible and rigid Pavements (IRC methods only) - Embankments- Problems in Flexible pavement design.

**UNIT IV HIGHWAY CONSTRUCTION MATERIALS AND PRACTICE 9**

Highway construction materials, properties, testing methods – CBR Test for subgrade - tests on aggregate & bitumen – Test on Bituminous mixes-Construction practice including modern materials and methods, Bituminous and Concrete road construction, Polymer modified bitumen, Recycling, Different materials - Glass, Fiber, Plastic, Geo-Textiles, Geo-Membrane (problem not included) – Quality control measures - Highway drainage – Construction machineries.

**UNIT V EVALUATION AND MAINTENANCE OF PAVEMENTS 9**

Pavement distress in flexible and rigid pavements – Types of maintenance – Pavement Management Systems - Pavement evaluation, roughness, present serviceability index, skid resistance, structural evaluation, evaluation by deflection measurements – Strengthening of pavements -Highway Project formulation.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Students will be able to

- Get knowledge on planning and aligning of highway.
- Geometric design of highways
- Design flexible and rigid pavements.
- Gain knowledge on Highway construction materials, properties, testing methods
- Understand the concept of pavement management system, evaluation of distress and maintenance of pavements.

**TEXTBOOKS:**

1. Khanna.S. K., Justo.C.E.G and Veeraragavan A. "Highway Engineering", Nemchand Publishers, 2014.
2. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications (India), Chennai, 2010
3. Kadiyali.L.R. "Principles and Practice of Highway Engineering", Khanna Technical Publications, 8th edition Delhi, 2013.

**REFERENCES:**

1. Indian Road Congress (IRC), Guidelines for the Design of Flexible Pavements, ( Third Revision), IRC: 37-2012
2. Indian Road Congress (IRC), Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, ( Third Revision), IRC: 58-2012
3. Yang H. Huang, "Pavement Analysis and Design", Pearson Education Inc, Nineth Impression, South Asia, 2012
4. Ian D. Walsh, "ICE manual of highway design and management", ICE Publishers, 1st Edition, USA, 2011
5. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, "Principles of Highway Engineering and Traffic Analysis", Wiley India Pvt. Ltd., New Delhi, 2011
6. Garber and Hoel, "Principles of Traffic and Highway Engineering", CENGAGE Learning, New Delhi, 2010
7. O'Flaherty.C.A "Highways, Butterworth - Heinemann, Oxford, 2006
8. IRC-37-2012, The Indian roads Congress, Guidelines for the Design of Flexible Pavements, New Delhi
9. IRC 58-2012. The Indian Road Congress, Guideline for the Design of Rigid Pavements for Highways, New Delhi

**EN8592****WASTEWATER ENGINEERING****L T P C  
3 0 0 3****OBJECTIVE:**

- The objectives of this course is to help students develop the ability to apply basic understanding of physical, chemical, and biological phenomena for successful design, operation and maintenance of sewage treatment plants.

**UNIT I PLANNING AND DESIGN OF SEWERAGE SYSTEM****9**

Characteristics and composition of sewage - population equivalent -Sanitary sewage flow estimation - Sewer materials - Hydraulics of flow in sanitary sewers - Sewer design - Storm drainage-Storm runoff estimation - sewer appurtenances - corrosion in sewers - prevention and control - sewage pumping-drainage in buildings-plumbing systems for drainage - Rain Water ting.

**UNIT II PRIMARY TREATMENT OF SEWAGE****9**

Objectives - Unit Operations and Processes - Selection of treatment processes -- Onsite sanitation - Septic tank- Grey water harvesting - Primary treatment - Principles, functions and design of sewage treatment units - screens - grit chamber-primary sedimentation tanks - Construction, Operation and Maintenance aspects.



**UNIT III SECONDARY TREATMENT OF SEWAGE 9**

Objectives - Selection of Treatment Methods - Principles, Functions, - Activated Sludge Process and Extended aeration systems -Trickling filters- Sequencing Batch Reactor(SBR) - Membrane Bioreactor - UASB - Waste Stabilization Ponds - - Other treatment methods -Reclamation and Reuse of sewage - Recent Advances in Sewage Treatment - Construction, Operation and Maintenance aspects.

**UNIT IV DISPOSAL OF SEWAGE 9**

Standards for- Disposal - Methods - dilution - Mass balance principle - Self purification of river- Oxygen sag curve - deoxygenation and reaeration - Streeter-Phelps model - Land disposal - Sewage farming - sodium hazards - Soil dispersion system.

**UNIT V SLUDGE TREATMENT AND DISPOSAL 9**

Objectives - Sludge characterization - Thickening - Design of gravity thickener- Sludge digestion – Standard rate and High rate digester design- Biogas recovery - Sludge Conditioning and Dewatering - Sludge drying beds- ultimate residue disposal - recent advances.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- An ability to estimate sewage generation and design sewer system including sewage pumping stations
- The required understanding on the characteristics and composition of sewage, self-purification of streams
- An ability to perform basic design of the unit operations and processes that are used in sewage treatment
- Understand the standard methods for disposal of sewage.
- Gain knowledge on sludge treatment and disposal.

**TEXTBOOKS:**

1. Garg, S.K., Environmental Engineering Vol. II, Khanna Publishers, New Delhi, 2015.
2. Duggal K.N., "Elements of Environmental Engineering" S.Chand and Co. Ltd., New Delhi, 2014.
- 3, Punmia, B.C., Jain, A.K., and Jain.A.K., Environmental Engineering, Vol.II, Laxmi Publications, 2010.

**REFERENCES:**

1. Manual on Sewerage and Sewage Treatment Systems Part A,B and C, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
2. Metcalf and Eddy- Wastewater Engineering-Treatment and Reuse, Tata Mc.Graw-Hill Company, New Delhi, 2010.
3. Syed R. Qasim "Wastewater Treatment Plants", CRC Press, Washington D.C.,2010
4. Gray N.F, "Water Technology", Elsevier India Pvt. Ltd., New Delhi, 2006.

**CE8611**

**HIGHWAY ENGINEERING LABORATORY**

**L T P C  
0 0 4 2**

**OBJECTIVE :**

- To learn the principles and procedures of testing of highway materials

**EXCERCISES :**

**I TEST ON AGGREGATES**

- a) Specific Gravity
- b) Los Angeles Abrasion Test
- c) Water Absorption of Aggregates

## II TEST ON BITUMEN

- a) Specific Gravity of Bitumen
- b) Penetration Test
- c) Viscosity Test
- d) Softening Point Test
- e) Ductility Test

## III TESTS ON BITUMINOUS MIXES

- a) Stripping Test
- b) Determination of Binder Content
- c) Marshall Stability and Flow Values

## IV DEMONSTRATION OF ANY ONE FIELD TESTING EQUIPMENT LIKE SKID RESISTANCE TESTER/ BENKELMAN BEAM ETC

**TOTAL: 60 PERIODS**

### OUTCOME:

- Student knows the techniques to characterize various pavement materials through relevant tests.

### REFERENCES:

1. Highway Materials and Pavement Testing, Nem Chand and Bros., Roorkee, Revised Fifth Edition, 2009
2. Methods for testing tar and bituminous materials, IS 1201-1978 to IS 1220- 1978, Bureau of Indian Standards
3. Methods of test for aggregates, IS 2386 - 1978, Bureau of Indian Standards
4. Mix Design Methods Asphalt Institute Manual Series No. 2, Sixth Edition, 1997, Lexington, KY, USA.

### LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

| Sl.No | Description of Equipment               | Quantity |
|-------|--|----------|
| 1.    | Concrete cube moulds                   | 6        |
| 2.    | Concrete cylinder moulds               | 3        |
| 3.    | Concrete Prism moulds                  | 3        |
| 4.    | Sieves                                 | 1set     |
| 5.    | Concrete Mixer                         | 1        |
| 6.    | Slump cone                             | 3        |
| 7.    | Flow table                             | 1        |
| 8.    | Vibrator                               | 1        |
| 9.    | Trowels and planers                    | 1 set    |
| 10.   | UTM - 400 kN capacity                  | 1        |
| 11.   | Vee Bee Consistometer                  | 1        |
| 12.   | Aggregate impact testing machine       | 1        |
| 13.   | CBR Apparatus                          | 1        |
| 14.   | Blains Apparatus                       | 1        |
| 15.   | Los - Angeles abrasion testing machine | 1        |
| 16.   | Marshall Stability Apparatus           | 1        |

**CE8612 IRRIGATION AND ENVIRONMENTAL ENGINEERING DRAWING**

**L T P C  
0 0 4 2**

### OBJECTIVE:

- At the end of the semester, the student shall conceive, design and draw the irrigation and environmental engineering structures in detail showing the plan, elevation and Sections.

## **PART A: IRRIGATION ENGINEERING**

### **1. TANK COMPONENTS**

**9**

Fundamentals of design - Tank surplus weir – Tank sluice with tower head - Drawings showing foundation details, plan and elevation

### **2. IMPOUNDING STRUCTURES**

**6**

Design principles - Earth dam - Profile of Gravity Dam

### **3. CROSS DRAINAGE WORKS**

**6**

General design principles - Aqueducts - Syphon aqueduct (Type III) - Canal drop (Notch Type) - Drawing showing plan, elevation and foundation details.

### **4. CANAL REGULATION STRUCTURES**

**9**

General Principles - Direct Sluice - Canal regulator - Drawing showing detailed plan, elevation and foundation details.

## **PART B: ENVIRONMENTAL ENGINEERING**

### **1. WATER SUPPLY AND TREATMENT**

**15**

Design and Drawing of flash mixer, flocculator, clarifier - Rapid sand filter - Service reservoirs - Pumping station - House service connection for water supply and drainage.

### **4. SEWAGE TREATMENT & DISPOSAL**

**15**

Design and Drawing of screen chamber - Grit channel - Primary clarifier - Activated sludge process - Aeration tank - Trickling filter - Sludge digester - Sludge drying beds - Septic tanks and disposal arrangements.

**TOTAL: 60 PERIODS**

### **OUTCOME:**

- The students after completing this course will be able to design and draw various units of Municipal water treatment plants and sewage treatment plants.

### **TEXTBOOKS:**

1. Satya Narayana Murthy Challa, "Water Resources Engineering: Principles and Practice", New Age International Publishers, New Delhi, 2002.
2. Garg, S.K., "Irrigation Engineering and Design of Structures", New Age International Publishers, New Delhi, 1997.
3. Manual on Water Supply and Treatment, CPHEEO, Government of India, New Delhi, 1999.
4. Manual on "Sewerage and Sewage Treatment Systems- Part A, B and C" CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.

### **REFERENCES:**

1. Mohanakrishnan. A, "A few Novel and Interesting Innovative Irrigation Structures: Conceived, Designed and Executed in the Plan Projects in Tamil Nadu", Publ. No. 44 and Water Resources Development & Management Publ.No.43, IMTI Thuvakudy, Trichy, 2011.
2. Raghunath, H.M. "Irrigation Engineering", Wiley India Pvt. Ltd., New Delhi, 2011.
3. Sharma R.K., "Irrigation Engineering and Hydraulic Structures", Oxford and IBH Publishing Co., New Delhi, 2002.
4. Peary, H.S., ROWE, D.R., Tchobanoglous, G., "Environmental Engineering", McGraw-HillBook Co., New Delhi, 1995.
5. Metcalf and Eddy, "Wastewater Engineering, Treatment and Reuse", Tata McGraw-Hill, New Delhi, 2010.
6. Qasim, S.R., Motley, E.M and Zhu.G. "Water works Engineering – Planning, Design and Operation", Prentice Hall, New Delhi, 2009.
7. Qasim, S. R. "Wastewater Treatment Plants, Planning, Design & Operation", CRC Press, New York, 2010

**OBJECTIVES: The course aims to:**

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

**UNIT I**

Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills--Grooming as a professional with values--Time Management--General awareness of Current Affairs

**UNIT II**

Self-Introduction-organizing the material - Introducing oneself to the audience - introducing the topic - answering questions - individual presentation practice-- presenting the visuals effectively - 5 minute presentations

**UNIT III**

Introduction to Group Discussion-- Participating in group discussions - understanding group dynamics - brainstorming the topic -- questioning and clarifying -GD strategies- activities to improve GD skills

**UNIT IV**

Interview etiquette - dress code - body language - attending job interviews- telephone/skype interview -one to one interview &panel interview - FAQs related to job interviews

**UNIT V**

Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes

**TOTAL :30 PERIODS****OUTCOMES: At the end of the course Learners will be able to:**

- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

**Recommended Software**

1. Open Source Software
2. Win English

**REFERENCES:**

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. Interact English Lab Manual for Undergraduate Students,. OrientBlackSwan: Hyderabad, 2016.
3. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
5. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010.

**OBJECTIVE:**

- The students will acquire knowledge in estimation, tender practices, contract procedures, and valuation and will be able to prepare estimates, call for tenders and execute works.

**UNIT I QUANTITY ESTIMATION****9**

Philosophy - Purpose - Methods of estimation - Types of estimates - Approximate estimates - Detailed estimate - Estimation of quantities for buildings, bituminous and cement concrete roads, septic tank, soak pit, retaining walls - culverts (additional practice in class room using computer softwares)

**UNIT II RATE ANALYSIS AND COSTING****9**

Standard Data – Observed Data – Schedule of rates – Market rates – Standard Data for Man Hours and Machineries for common civil works – Rate Analysis for all Building works, canals, and Roads- Cost Estimates (additional practice in class room using Computer softwares) - (Analysis of rates for the item of work asked, the data regarding labour, rates of material and rates of labour to be given in the Examination Question Paper)

**UNIT III SPECIFICATIONS, REPORTS AND TENDERS****9**

Specifications – Detailed and general specifications – Constructions – Sources – Types of specifications – Principles for report preparation – report on estimate of residential building – Culvert - Roads - TTT Act 2000 - Tender notices - types - tender procedures - Drafting model tenders , E-tendering-Digital signature certificates- Encrypting -Decrypting - Reverse auctions.

**UNIT IV CONTRACTS****9**

Contract – Types of contracts – Formation of contract – Contract conditions – Contract for labour, material, design, construction – Drafting of contract documents based on IBRD / MORTH Standard bidding documents – Construction contracts – Contract problems – Arbitration and legal requirements.

**UNIT V VALUATION****9**

Definitions - Various types of valuations - Valuation methods - Necessity - Capitalised value - Depreciation – Escalation – Valuation of land – Buildings – Calculation of Standard rent – Mortgage – Lease

**TOTAL: 45 PERIODS****OUTCOMES:**

The student will be able to

- Estimate the quantities for buildings,
- Rate Analysis for all Building works, canals, and Roads and Cost Estimate.
- Understand types of specifications, principles for report preparation, tender notices types.
- Gain knowledge on types of contracts
- Evaluate valuation for building and land.

**TEXTBOOKS:**

1. B.N Dutta 'Estimating and Costing in Civil Engineering', UBS Publishers & Distributors (P) Ltd, 2010.
2. B.S.Patil, 'Civil Engineering Contracts and Estimates', University Press, 2006
3. D.N. Banerjee, 'Principles and Practices of Valuation', V Edition, Eastern Law House, 1998

**REFERENCES:**

1. Hand Book of Consolidated Data - 8/2000, Vol.1, TNPWD
2. Tamil Nadu Transparencies in Tenders Act, 1998
3. Arbitration and Conciliation Act, 1996

4. Standard Bid Evaluation Form, Procurement of Good or Works, The World Bank, April 1996
5. Standard Data Book for Analysis and Rates, IRC, New Delhi, 2003

**CE8702                      RAILWAYS, AIRPORTS, DOCKS AND HARBOUR ENGINEERING                      L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- To introduce the students about Railways planning, design, construction and maintenance and planning design principles of airport and harbour

**UNIT I                      RAILWAY PLANNING AND CONSTRUCTION                      10**

Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, Selection of gauges - Track Stress, coning of wheels, creep in rails, defects in rails - Route alignment surveys, conventional and modern methods--Geometric design of railway, gradient, super elevation, widening of gauge on curves- Level Crossings. .

**UNIT II                      RAILWAY CONSTRUCTION AND MAINTENANCE                      8**

Earthwork - Stabilization of track on poor soil - Track drainage - Calculation of Materials required for track laying - Construction and maintenance of tracks – Railway Station and yards and passenger amenities-Signalling

**UNIT III                      AIRPORT PLANNING                      7**

Air transport characteristics - airport classification - ICAO - airport planning: Site selection typical Airport Layouts, Case Studies, parking and Circulation Area

**UNIT IV                      AIRPORT DESIGN                      10**

Runway Design: Orientation, Wind Rose Diagram, Problems on basic and Actual Length, Geometric Design - Elements of Taxiway Design - Airport Zones - Passenger Facilities and Services – Runway and Taxiway Markings.

**UNIT V                      HARBOUR ENGINEERING                      10**

Definition of Basic Terms: Harbour, Port, Satellite Port, Docks, Waves and Tides – Planning and Design of Harbours: Harbour Layout and Terminal Facilities – Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins and Floating Landing Stage - Inland Water Transport – Wave action on Coastal Structures and Coastal Protection Works – Coastal Regulation Zone, 2011

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Students who successfully complete this course will be able to:

- Understand the methods of route alignment and design elements in Railway Planning and Constructions.
- Understand the Construction techniques and Maintenance of Track laying and Railway stations.
- Gain an insight on the planning and site selection of Airport Planning and design.
- Analyze and design the elements for orientation of runways and passenger facility systems.
- Understand the various features in Harbours and Ports, their construction, coastal protection works and coastal Regulations to be adopted.

**TEXTBOOKS:**

1. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering, V Scitech Publications (India), Chennai, 2010
2. Saxena Subhash, C.and Satyapal Arora, A Course in Railway Engineering, Dhanapat Rai and Sons, Delhi, 1998
3. Khanna.S.K. Arora.M.G and Jain.S.S, Airport Planning and Design, Nemachand and Bros, Roorkee, 1994

**REFERENCES:**

1. Venkatramaiah. C., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels.,Universities Press (India) Private Limited, Hyderabad, 2015.
2. Mundrey J S, Railway Track Engineering, McGraw Hill Education ( India) Private Ltd, New Delhi, 2013

**CE8703****STRUCTURAL DESIGN AND DRAWING****L T P C  
3 0 2 4****OBJECTIVE:**

- This course aims at providing students with a solid background on the principles of structural engineering design. Students will be acquire the knowledge of liquid retaining structures, bridges components, retaining wall and industrial structures.

**UNIT I          RETAINING WALLS****9+6**

Reinforced concrete Cantilever and Counter fort Retaining Walls-Horizontal Backfill with Surcharge-Design of Shear Key-Design and Drawing.

**UNIT II          FLAT SLAB and BRIDGES****9+6**

Design of Flat Slabs with and without drops by Direct Design Method of IS code- Design and Drawing - IRC Specifications and Loading – RC Solid Slab Bridge – Steel Foot-over Bridge-Design and Drawing.

**UNIT III          LIQUID STORAGE STRUCTURES****9+6**

RCC Water Tanks - On ground, Elevated Circular, underground Rectangular Tanks-Hemispherical Bottomed Steel Water Tank –Design and Drawing

**UNIT IV          INDUSTRIAL STRUCTURES****9+6**

Structural steel Framing - Steel Roof Trusses - Roofing Elements - Beam columns - Codal provisions - Design and Drawing.

**UNIT V          GIRDERS AND CONNECTIONS****9+6**

Plate Girders – Behaviour of Components-Deign of Welded Plate Girder-Design of Industrial Gantry Girders - Design of Eccentric Shear and Moment Resisting connections.

**TOTAL: 75 PERIODS****Design and Drawing Exercises for practical component****Part A - RCC Structures**

1. Rectangular Column and Footing
2. Combined footing with Two columns
3. RCC one way &Two way Slab and beam system

4. Cantilever Retaining wall
5. RCC T beam bridge deck
6. Underground Rectangular Water Tank
7. Elevated circular water Tank

### **Part B- Steel Structures**

1. **Built up column, column base and Foundation**
2. **Simple Steel Roof Trusses**
3. **Industrial building Elements**
4. **Plate Girder (welded)**
5. **Framed Connections and Detailing**
6. **Gantry girder**
7. **Steel water Tank**

| STRUCTURAL DESIGN AND DRAWING  | Theory Examination   |   | Practicals  |   |
|--|--|---|---|---|
|  | Question paper Pattern   | Marks to awarded  | Question paper Pattern  | Marks to awarded  |
| This paper is a theory cum practical course weightage for theory 80% and for practical 20% | Five Either/Or type questions 5 x20 = 100 marks : covering all the five units<br>Total Duration of Examination will be 3 hours<br><br>Each Question include<br>Design - 12 Marks<br>Free hand Drawing (Not to scale) - 8 marks | Theoretical component<br>Marks will carry 80% weightage.<br>End Semester Examination will be conducted by COE | 2 Questions, one from Part A - RCC Structures & one from Part B- Steel Structures | Practical component<br>Marks will carry 20% weightage.<br>Practical Examination will be conducted by the respective institution as internal mode. |

### **OUTCOMES:**

At the end of the course the student will be able to

- Design and draw reinforced concrete Cantilever and Counterfort Retaining Walls
- Design and draw flat slab as per code provisions
- Design and draw reinforced concrete and steel bridges
- Design and draw reinforced concrete and steel water tanks
- Design and detail the various steel trusses and cantry girders

### **TEXTBOOKS:**

1. Krishnaraju N, Structural Design and Drawing, Universities Press, 2009.
2. Punmia B.C, Ashok Kumar Jain and Arun Kumar Jain, Comprehensive Design of Steel Structures, Laxmi Publications Pvt. Ltd., 2003.

### **REFERENCES:**

1. Krishnamurthy D, Structural Design and Drawing Voll, II and III, CBS Publishers, 2010.
2. Shah V L and Veena Gore, Limit State Design of Steel Structures
3. IS800-2007, Structures Publications, 2009.
4. IS 456(2000) Indian Standard Plain and Reinforced Concrete-Code of Practice, Bureau of Indian Standards, New Delhi.



5. SP34 Handbook on Concrete Reinforcement and Detailing, Bureau of Indian Standards, New Delhi.
6. IS 800 (2007) Indian Standard General Construction In Steel–Code of Practice, Bureau of Indian Standards, New Delhi.
7. IS 875 Part 1 (2003) Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures, Code of Practice-Dead Load, Bureau of Indian Standards, New Delhi.
8. IS 875 Part 2 (2003) Code of Practice for Design Loads (Other Than Earthquake) for Buildings and Structures, Code of Practice-Imposed Load, Bureau of Indian Standards, New Delhi.
9. IS 875 Part 3 (2003) Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures, Code of Practice-Wind Load, Bureau of Indian Standards, New Delhi.
10. IS 3370 Part 1 (2009) Indian Standard Concrete Structures for Storage of Liquids-Code of Practice-General Requirements, Code of Practice, Bureau of Indian Standards, New Delhi.
11. IS 3370 Part 2 (2009) Indian Standard Concrete Structures for Storage of Liquids-Code of Practice-Reinforced Concrete Structures, Code of Practice, Bureau of Indian Standards, New Delhi.
12. IS 3370-Part 4 (2008) Indian Standard Code of Practice for Concrete Structures for The Storage of Liquids-Design Tables, Code of Practice, Bureau of Indian Standards, New Delhi.
13. IS 804 (2008) Indian Standard Specification for Rectangular Pressed Steel Tanks, Code of Practice, Bureau of Indian Standards, New Delhi.
14. IS 805 (2006) Indian Standard Code of Practice for Use of Steel in Gravity Water Tanks, Code of Practice, Bureau of Indian Standards, New Delhi.
15. IRC 112-2011, Code of Practice for Concrete Road Bridges, The Indian Roads Congress, New Delhi.
16. IRC 6-2014, Standard Specifications and Code of Practice for Road Bridges Section: II- Loads and Stresses, The Indian Roads Congress, New Delhi.

**CE8711**

**CREATIVE AND INNOVATIVE PROJECT  
(Activity Based - Subject Related)**

**L T P C  
0 0 4 2**

**OBJECTIVE:**

- To use the knowledge acquired in Civil Engineering to do a mini project, which allows the students to come up with designs, fabrication or algorithms and programs expressing their ideas in a novel way.

**TOTAL: 60 PERIODS**

**STRATEGY**

To identify a topic of interest in consultation with Faculty/Supervisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design / fabrication or develop computer code. Demonstrate the novelty of the project through the results and outputs.

**CE8712**

**INDUSTRIAL TRAINING  
(4 Weeks During VI Semester – Summer)**

**L T P C  
0 0 0 2**

**OBJECTIVE:**

- To train the students in field work so as to have a firsthand knowledge of practical problems in carrying out engineering tasks. To develop skills in facing and solving the field problems.

**STRATEGY:**

The students individually undertake training in reputed civil engineering companies for the specified duration. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated through a viva-voce examination by a team of internal staff.

**OUTCOMES:**

At the end of the course the student will be able to understand

- The intricacies of implementation textbook knowledge into practice
- The concepts of developments and implementation of new techniques

**CE8811****PROJECT WORK****L T P C  
0 0 20 10****OBJECTIVE:**

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

**STRATEGY:**

The student works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction. The student will be evaluated based on the report and the viva voce examination by a team of examiners including one external examiner.

**TOTAL: 300 PERIODS****OUTCOME:**

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

**GI8012****DIGITAL CADASTRE****L T P C  
3 0 0 3****OBJECTIVE:**

- To introduce the students to the cadastral survey Methods and its applications in generation of Land information system.

**UNIT I INTRODUCTION****9**

History of cadastral survey - Types of survey - Tax - Real Property - Legal cadastre -Graphical and Numerical Cadastre, Legal Characteristics of Records, Torrens System.

**UNIT II CADASTRAL SURVEY METHODS****9**

Steps in survey of a village - Instruments used for cadastral survey & mapping - Orthogonal, Polar survey methods - Boundary survey - Rectangulation - Calculation of area of Land- GPS and Total Station in Cadastral survey.

**UNIT III PHOTOGRAMMETRIC METHODS****9**

Photogrammetry for cadastral surveying and mapping - Orthophoto map - Quality control measures - Organisation of cadastral offices - international scenario.

**UNIT IV CADASTRAL MAPPING AND LIS****9**

Cadastral map reproduction - Map projection for cadastral maps – Conventional symbols - map - reproduction processes - Automated cadastral map, Management of Digital Cadastral. Creation of Land Information System. Integrating LIS -Land administration.

**UNIT V MAINTENANCE AND MEASUREMENTS****9**

Cadastral survey maintenance - Resurveys - Measurement of sub-division - Measurement of obstructed lines - Survey of urban areas - Control requirement for Urban survey use of Satellite Imagery in boundary fixing.

**TOTAL: 45 PERIODS****OUTCOMES:**

On completion of this course students will be able to

- Gain knowledge about cadastre survey.
- Understand the methods of cadastral survey.
- Get the knowledge about photogrammetric methods.
- Understand Land Record System and computational procedure for modernization of the same.
- The students will be in position to understand the Government procedure in Land Record Management.

**TEXTBOOKS:**

1. Paul. R Wolf., Bon A. DeWitt, Elements of Photogrammetry with Application in GIS McGraw Hill International Book Co., 4th Edition, 2014
2. R.Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.

**REFERENCES:**

1. Karl Kraus, Photogrammetry: Geometry from Images and Laser Scans, Walter de Gruyter GmbH & Co. 2nd Edition, 2007.
2. E. M. Mikhail, J. S. Bethel, J. C. McGlone, Introduction to Modern Photogrammetry, Wiley Publisher, 2001.
3. James, M. Anderson and Edward N. Mikhail, Introduction to Surveying, McGraw Hill Book Co, 1985.

**GI8013****ADVANCED SURVEYING****L T P C  
3 0 0 3****OBJECTIVE :**

- To understand the use of Astronomy, Photogrammetry, Total Station and GPS

**UNIT I ASTRONOMICAL SURVEYING****9**

Astronomical terms and definition - Motion of sun and stars - Celestial co-ordinate System - Time system - Nautical Almanace - Apparent attitude and corrections - Field observations and determinations of time, longitude, latitude and azimuth by attitude and Hour angle method.

**UNIT II AERIAL SURVEYING****9**

Terrestrial Photogrammetry - Terrestrial stereo photogrammetry - Aerial photogrammetry - overlaps - scale of photographs - Vertical and titled photographs distortion in aerial photographs - stereostopic vision - photo interpretation - Applications.

**UNIT III TOTAL STATION SURVEYING 9**

Classification - basic measuring and working principles of an Electro - optical and Microwave total station- sources of errors in Electro – optical and Microwave total station – Care and Maintenance of total station - trilateration - Applications.

**UNIT IV GPS SURVEYING 9**

Basic concepts - Space, Control and User segments - Satellite configuration - Signal structure - Orbit determination and representation - Antispoofing and selective availability - hand held and geodetic receivers - Field work procedure - Data processing Applications.

**UNIT V MISCELLANEOUS 9**

Reconnaissance - Route surveys for highways, railways and waterways - simple, compound, reverse, transition and vertical curve - setting out methods - hydrographic surveying - tides - MSL - Sounding methods - measurement of current and discharge - Tunnel alignment and setting out - Settlement and Deformation studies.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On completion of this course, the student shall be able to

- know the astronomical surveying
- do the photogrammetric surveying and interpretation
- solve the field problems with Total station
- know the GPS surveying and the data processing
- understand the route surveys and tunnel alignments

**TEXT BOOKS:**

1. James M.Anderson and Edward M.Mikhail, “ Surveying, Theory and Practice”, 7<sup>th</sup> Edition, McGraw Hill, 2001.
2. Bannister and S.Raymond, “Surveying”, 7<sup>th</sup> Edition, Longman 2004.
3. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 3<sup>rd</sup> Edition, 2004.
4. Laurila, S.H. Electronic Surveying in Practice, John Wiley and Sons Inc, 1993.

**REFERENCES:**

1. Roy S.K., “Fundamentals of Surveying”, 2<sup>nd</sup> Edition, Prentice Hall of India, 2004.
2. Arora K.R. “Surveying Vol I & II”, Standard Book House, 10<sup>th</sup> Edition 2008.
3. Guocheng Xu, GPS Theory, Algorithms and Applications, Springer - Verlag, Berlin, 2003.
4. Seeber G, Satellite Geodesy, Water De Gruyter, Berlin, 1998.

**GI8014**

**GEOGRAPHIC INFORMATION SYSTEM**

**L T P C  
3 0 0 3**

**OBJECTIVES :**

- To introduce the fundamentals and components of Geographic Information System
- To provide details of spatial data structures and input, management and output processes.

**UNIT I FUNDAMENTALS OF GIS 9**

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems - Definitions - History of GIS - Components of a GIS - Hardware, Software, Data, People, Methods - Proprietary and open source Software - Types of data - Spatial, Attribute data- types of attributes - scales/ levels of measurements.

**UNIT II      SPATIAL DATA MODELS      9**  
Database Structures - Relational, Object Oriented - Entities - ER diagram - data models - conceptual, logical and physical models - spatial data models - Raster Data Structures - Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models.

**UNIT III      DATA INPUT AND TOPOLOGY      9**  
Scanner - Raster Data Input – Raster Data File Formats – Georeferencing – Vector Data Input -Digitiser - Datum Projection and reprojection -Coordinate Transformation - Topology - Adjacency, connectivity and containment - Topological Consistency - Non topological file formats - Attribute Data linking - Linking External Databases - GPS Data Integration

**UNIT IV      DATA QUALITY AND STANDARDS      9**  
Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards -Interoperability - OGC - Spatial Data Infrastructure

**UNIT V      DATA MANAGEMENT AND OUTPUT      9**  
Import/Export - Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation - Chart/Graphs - Multimedia - Enterprise Vs. Desktop GIS- distributed GIS.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

This course equips the student to

- Have basic idea about the fundamentals of GIS.
- Understand the types of data models.
- Get knowledge about data input and topology.
- Gain knowledge on data quality and standards.
- Understand data management functions and data output

**TEXT BOOKS:**

1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, "An Introduction Geographical Information Systems, Pearson Education, 2nd Edition,2007.

**REFERENCE:**

1. Lo.C.P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006

**GI8015      GEOINFORMATICS APPLICATIONS FOR CIVIL ENGINEERS      L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- To solve the Civil Engineering problems with the help of Geoinformatics technique.

**UNIT I      LAND RESOURCE MANAGEMENT      6**  
Total Station and GPS Surveys - Topographic and Bathymetric Surveys - Cadastral Information - Soil and Land Use Surveys - Land Information System (LIS) - Real Estate Information System

**UNIT II STRUCTURAL STUDIES 6**  
Deformation studies of deflection - Dam deformation - structural movement - Pavement yield - shifting sand-bank and shoreline - Landslide Risk Analysis

**UNIT III SOIL CONSERVATION AND MANAGEMENT 9**  
Soil survey interpretation and mapping - impact of agricultural and industrial activity on soil properties - soil erosion - factors influencing soil erosion - soil contamination using Hyper spectral Remote Sensing - mining pollution- EMR responses with contaminated soil - modeling soil characteristics using satellite data - soil degradation assessment using Remote Sensing and GIS - Land reclamation studies

**UNIT IV URBAN AND TRANSPORTATION MANAGEMENT 12**  
Monitoring Urban Growth through Remote Sensing - Geo-demographic Analysis – Property Market Analysis Urban Renewal - traffic analysis - accident analysis - site suitability analysis for transport infrastructure -transportation databases: creation and maintenance - Vehicle routing – Highway maintenance system - Intelligent Transportation System

**UNIT V WATER RESOURCES PLANNING AND MANAGEMENT 12**  
Location of storage/diversion works - capacity curve generation - sediment yield - modelling of catchments - Delineation of watershed - Watershed modelling for sustainable development - Rainfall – Runoff modelling -LiDAR Mapping for Urban area -Water quality mapping and monitoring - Flood Risk Zoning - Flood damage assessment - Flood Modelling - Assessment of droughts and mitigation

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On completion of this course students will be able to

- Get knowledge about the land resource management.
- Study structural deformation and movement.
- Model soil characteristics, soil degradation assessment and management.
- Monitor urban growth and management of transport infrastructure.
- Model catchments and management of water resources.

**TEXTBOOKS:**

1. Basudeb Bhatta, 'Remote Sensing and GIS', Second edition, Oxford University Press 2011.
2. Lo.C.P., Albert K.W.Yeung, Concepts and Techniques of Geographic Information Systems, Second edition, PHI Learning Private Limited, Delhi, 2014.

**REFERENCES:**

1. Andrew N. Rencz, Manual of Remote Sensing: Remote Sensing for Natural Resource Management and Environmental Monitoring, John Wiley & Sons Inc, April 2004
2. Rashed, Tarek; Jürgens, Carsten (Eds.), Remote Sensing of Urban and Suburban Areas, Springer, 1st Edition. 2010.
3. Harvey J. Miller, Shih-Lung Shaw, Geographic Information Systems for Transportation – Principles and Applications, Oxford University Press, 2001.
4. Gert A. Schulitz Edwin T. Engman, Remote Sensing in hydrology and Water Management, Springer - verlag Berlin Heidelberg Germany - 2000.

**OBJECTIVE :**

- To understand the working of Total Station equipment and solve the surveying problems.

**UNIT I FUNDAMENTALS OF TOTAL STATION AND ELECTROMAGNETIC WAVES 9**

Methods of Measuring Distance, Basic Principles of Total Station, Historical Development, Classifications, applications and comparison with conventional surveying. Classification - applications of Electromagnetic waves, Propagation properties, wave propagation at lower and higher frequencies- Refractive index (RI) - factors affecting RI-Computation of group for light and near infrared waves at standard and ambient conditions-Computation of RI for microwaves at ambient condition - Reference refractive index- Real time application of first velocity correction. Measurement of atmospheric parameters- Mean refractive index- Second velocity correction - Total atmospheric correction- Use of temperature - pressure transducers.

**UNIT II ELECTRO-OPTICAL AND MICROWAVE SYSTEM 9**

Electro-optical system: Measuring principle, Working principle, Sources of Error, Infrared and Laser Total Station instruments. Microwave system: Measuring principle, working principle, Sources of Error, Microwave Total Station instruments. Comparison between Electro-optical and Microwave system. Care and maintenance of Total Station instruments – Traversing and Trilateration-COGO functions, offsets and stake out-land survey applications.

**UNIT III SATELLITE SYSTEM 9**

Basic concepts of GPS - Historical perspective and development - applications - Geoid and Ellipsoid- satellite orbital motion - Keplerian motion – Kepler’s Law - Perturbing forces - Geodetic satellite - Doppler effect - Positioning concept -GNSS, IRNSS and GAGAN - Different segments - space, control and user segments - satellite configuration – GPS signal structure - Orbit determination and representation - Anti Spoofing and Selective Availability - Task of control segment - GPS receivers.

**UNIT IV GPS DATA PROCESSING 9**

GPS observables - code and carrier phase observation - linear combination and derived observables - concept of parameter estimation – downloading the data RINEX Format – Differential data processing - software modules -solutions of cycle slips, ambiguities, Concepts of rapid, static methods with GPS - semi Kinematic and pure Kinematic methods -satellite geometry & accuracy measures - applications- long baseline processing- use of different softwares available in the market.

**UNIT V HYDROGRAPHIC, MINE AND CADASTRAL SURVEYING 9**

Reconnaissance - Route surveys for highways, railways and waterways - Hydrographic survey- Tides – MSL – Sounding methods – Three point problem – River surveys – Measurement of current and discharge - Mine surveying Equipment - Weisbach triangle - Tunnel alignment and setting out - Transfer of azimuth - Gyro Theodolite - Shafts and audits - Cadastral survey- Legal - Real - Taxcadastre - Land record system - Settlement procedure - deformation studies.

**TOTAL : 45 PERIODS****OUTCOMES:**

At the end of the course the student will be able to understand

- Working principles of total station and GPS instruments
- Propagation of EMR through atmosphere and corrections for its effects
- The functioning various types total station and GPS equipments and their applications
- Various techniques available for surveying and mapping with total station and GPS.

**TEXTBOOKS:**

1. Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin, 1996
2. Satheesh Gopi, rasathishkumar, N.madhu, Advanced Surveying , Total Station GPS and Remote Sensing – Pearson education , 2007 isbn: 978-81317 00679

## REFERENCES :

1. R.Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
2. Laurila, S.H. Electronic Surveying in Practice, John Wiley and Sons Inc, 1993.
3. Guocheng Xu, GPS Theory, Algorithms and Applications, Springer - Verlag, Berlin, 2003.
4. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 3<sup>rd</sup> Edition, 2004.
5. Seeber G, Satellite Geodesy, Walter De Gruyter, Berlin, 1998

GE8071

DISASTER MANAGEMENT

L T P C  
3 0 0 3

## OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

### UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

### UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) - Early Warning System - Advisories from Appropriate Agencies.

### UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

### UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster - Disaster Damage Assessment.



**UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

**TEXTBOOKS:**

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IAS and Sage Publishers, New Delhi, 2010.

**REFERENCES:**

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

**GE8074**

**HUMAN RIGHTS**

**L T P C  
3 0 0 3**

**OBJECTIVE:**

- To sensitize the Engineering students to various aspects of Human Rights.

**UNIT I**

**9**

Human Rights - Meaning, origin and Development. Notion and classification of Rights - Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

**UNIT II**

**9**

Evolution of the concept of Human Rights Magna carta - Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

**UNIT III**

**9**

Theories and perspectives of UN Laws - UN Agencies to monitor and compliance.

**UNIT IV**

**9**

Human Rights in India - Constitutional Provisions / Guarantees.

**UNIT V****9**

Human Rights of Disadvantaged People - Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights - National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

**TOTAL : 45 PERIODS****OUTCOME :**

- Engineering students will acquire the basic knowledge of human rights.

**REFERENCES:**

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi

**CE8001****GROUND IMPROVEMENT TECHNIQUES****L T P C  
3 0 0 3****OBJECTIVE:**

- Students will be exposed to various problems associated with soil deposits and methods to evaluate them. The different techniques will be taught to them to improve the characteristics of difficult soils as well as design techniques required to implement various ground improvement methods.

**UNIT I PROBLEMATIC SOIL AND IMPROVEMENT TECHNIQUES****8**

Role of ground improvement in foundation engineering – Methods of ground improvement – Geotechnical problems in alluvial, lateritic and black cotton soils – Selection of suitable ground improvement techniques based on soil conditions.

**UNIT II DEWATERING****10**

Dewatering Techniques - Well points - Vacuum and electroosmotic methods - Seepage analysis for two dimensional flow for fully and partially penetrated slots in homogeneous deposits - Design for simple cases.

**UNIT III INSITU TREATMENT OF COHESIONLESS AND COHESIVE SOILS****10**

Insitu densification of cohesionless soils - Shallow as deep compaction - Dynamic compaction - Vibroflotation, Sand compaction piles and deep compaction. Consolidation of cohesionless soils - Preloading with sand drains, and fabric drains, Stabilization of soft clay ground using stone columns and Lime piles-Installation techniques – Simple design - Relative merits of above methods and their limitations.

**UNIT IV EARTH REINFORCEMENT****9**

Concept of reinforcement - Types of reinforcement material - Reinforced earth wall - Mechanism – Simple design - Applications of reinforced earth; Functions of Geotextiles in filtration, drainage, separation, road works and containment applications.

**UNIT V GROUTING TECHNIQUES****8**

Types of grouts - Grouting equipments and machinery - Injection methods - Grout monitoring - Stabilization with cement, lime and chemicals - Stabilization of expansive soil.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

At the end of the course the student will be able to

- Gain knowledge on methods and selection of ground improvement techniques.
- Understand dewatering techniques and design for simple cases.
- Get knowledge on insitu treatment of cohesionless and cohesive soils.
- Understand the concept of earth reinforcement and design of reinforced earth.
- Get to know types of grouts and grouting technique.

**TEXTBOOKS:**

1. Purushothama Raj. P, "Ground Improvement Techniques", Lakshmi Publications, 2<sup>nd</sup> Edition, 2016.
2. Koerner, R.M. "Construction and Geotechnical Methods in Foundation Engineering", McGraw Hill, 1994.
3. Nihar Ranjan Patra, "Ground Improvement Techniques", Vikas Publishing House, First Edition, 2012.
4. Mittal.S, "An Introduction to Ground Improvement Engineering", Medtech Publisher, First Edition, 2013.

**REFERENCES:**

1. Moseley, M.P., "Ground Improvement" Blockie Academic and Professional, 1992.
2. Moseley, M.P and Kirsch. K., 'Ground Improvement', Spon Press, Taylor and Francis Group, London, 2<sup>nd</sup> Edition, 2004.
3. Jones C.J.F.P. "Earth Reinforcement and Soil Structure", Thomas Telford Publishing, 1996.
4. Winterkorn, H.F. and Fang, H.Y. "Foundation Engineering Hand Book". Van Nostrand Reinhold, 1994.
5. Das, B.M., "Principles of Foundation Engineering" (seventh edition), Cengage learning, 2010.
6. Coduto, D.P., "Geotechnical Engineering - Principles and Practices", Prentice Hall of India Pvt.Ltd. New Delhi, 2011.
7. Koerner, R.M., "Designing with Geosynthetics" (Sixth Edition), Xlibris Corporation, U.S.A, 2012.
8. IS Code 9759 : 1981 (Reaffirmed 1998) "Guidelines for Dewatering During Construction", Bureau of Indian Standards, New Delhi.
9. IS Code 15284 (Part 1): 2003 "Design and Construction for Ground Improvement – Guidelines" (Stone Column), Bureau of Indian Standards, New Delhi.

**CE8002      INTRODUCTION TO SOIL DYNAMICS AND MACHINE FOUNDATIONS      L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- To understand the basics of soil dynamics – dynamic behaviour of soils – effects of dynamic loads and the various design methods.

**UNIT I      THEORY OF VIBRATION****9**

Introduction – Nature dynamic loads – Vibrations of single degree freedom system – Free vibrations of spring - mass systems - Forced vibrations - Viscous damping - Transmissibility - Principles of vibration measuring instruments - Effect of Transient and Pulsating loads.

|  |   |          |
|--|---|----------|
| <b>UNIT II</b>   | <b>WAVE PROPAGATION</b>                           | <b>9</b> |
| Elastic waves in rods of infinite length - Longitudinal and Torsional - Effect of end conditions - Longitudinal and torsional vibrations of rods of finite length - Wave Propagation in infinite, homogeneous isotropic and elastic medium - Wave propagation in elastic half space - Typical values of compressive wave and shear wave velocity - Wave propagation due to Machine foundation – Surface wave - Typical values - Particle movements and velocity. |   |          |
| <b>UNIT III</b>  | <b>DYNAMIC PROPERTIES OF SOILS</b>                | <b>9</b> |
| Dynamic stress - Strain characteristics - Principles of measuring dynamic properties - Laboratory Techniques - Field tests - Factors affecting dynamic properties - Typical values - Dynamic bearing capacity - Dynamic earth pressure.  |   |          |
| <b>UNIT IV</b>   | <b>FOUNDATION FOR DIFFERENT TYPES OF MACHINES</b> | <b>9</b> |
| Types of machines and foundation - General requirements - Modes of vibration of a rigid foundation - Method of analysis - Linear elastic weightless spring method - Elastic half space method - Analog Method - Design of block foundation - Special consideration for rotary, Impact type of machines – Codal Provisions.   |   |          |
| <b>UNIT V</b>  | <b>INFLUENCE OF VIBRATION AND REMEDIATION</b>     | <b>9</b> |
| Mechanism of Liquefaction - Influencing factors - Evaluation of Liquefaction potential based on SPT-Force Isolation - Motion Isolation - Use of spring and damping materials - Vibration control of existing machine foundation - Screening of vibration - Open trenches - Pile Barriers - Salient construction aspects of machine Foundations.  |   |          |

**TOTAL: 45 PERIODS**

**OUTCOMES:**

At the end of the course the student will be able to

- Understand the theory and measurement of vibration.
- Understand the concept of wave propagation in infinite medium and due to machine foundation.
- Get knowledge on dynamic properties of soils and laboratory and field testing.
- Design of foundation for different types of machines
- Understand liquefaction, motion isolation and vibration control.

**TEXT BOOKS:**

1. Swamisaran, "Soil Dynamics and Machine Foundations", Galgotia Publications Pvt.Ltd. New Delhi-110002, 3<sup>rd</sup> Edition 2016.
2. Kameswara Rao., "Dynamics Soil Tests and Applications", Wheeler Publishing, New Delhi, 2003.
3. P. Srinivasulu, and C.V. Vaidyanathan, "Handbook of Machine Foundations", Tata McGraw-Hill, 2007

**REFERENCES:**

1. Kamaswara Rao., "Vibration Analysis and Foundation Dynamics", Wheeler Publishing, New Delhi, 1998.
2. IS Code of Practice for Design and Construction of Machine Foundations, McGraw Hill, 1996.
3. Moore, P.J., "Analysis and Design of Foundation for Vibration", Oxford and IBH, 2005
4. Steven L. Kramer, "Geotechnical Earthquake Engineering", Prentice Hall, 1996.
5. IS Code 5249: 1992 (Reaffirmed 2006) "Determination of Dynamic Properties of Soil – Method of Test" Bureau of Indian Standards, New Delhi.
6. IS Code 2974: (Part 1) 1982 (Reaffirmed 2008) "Code of Practice for Design and Construction of Machine Foundations - Foundation for Reciprocating Type Machines" Bureau of Indian Standards, New Delhi.
7. IS Code 2974: (Part 2) 1980 (Reaffirmed 2008) "Code of Practice for Design and Construction of Machine Foundations - Foundations for Impact Type Machines (Hammer Foundations)" Bureau of Indian Standards, New Delhi.

8. IS Code 2974: (Part 3) 1992 (Reaffirmed 2006) "Code of Practice for Design and Construction of Machine Foundations - Foundations for Rotary Type Machines (Medium and High Frequency)" Bureau of Indian Standards, New Delhi.

**CE8003**

**ROCK ENGINEERING**

**L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- To impart knowledge on fundamentals of rock mechanics and its application in solving simple problems associated with rock slopes and underground openings. Student gains the knowledge on the mechanics of rock and its applications in underground structures and rock slope stability analysis.

**UNIT I CLASSIFICATION AND INDEX PROPERTIES OF ROCKS 6**

Geological classification - Index properties of rock systems - Classification of rock masses for engineering purpose - Rock Mass Rating and Q System.

**UNIT II ROCK STRENGTH AND FAILURE CRITERIA 12**

Modes of rock failure – Strength of rock – Laboratory measurement of shear, tensile and compressive strength. Stress - strain behaviour of rock under Hydrostatic compression and deviatoric loading - Mohr -Coulomb failure criteria and Hock and Brown empirical criteria

**UNIT III INITIAL STRESSES AND THEIR MEASUREMENTS 10**

Estimation of initial stresses in rocks - influence of joints and their orientation in distribution of stresses - measurements of in-situ stresses - Hydraulic fracturing - Flat jack method - Over coring method

**UNIT IV APPLICATION OF ROCK MECHANICS IN ENGINEERING 10**

Simple engineering application - Underground openings - Rock slopes - Foundations and mining subsidence.

**UNIT V ROCK STABILISATION 7**

Introduction - Rock support and Rock reinforcement - Principles - Support reaction curves - Shotcreting.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

At the end of the course the student will be able to

- Classify the rocks, study the index properties of rock systems.
- Understand the modes of rock failure, stress-strain characteristics, failure criteria.
- Estimate the stresses in rocks.
- Apply rock mechanics in engineering.
- Get knowledge on rock stabilization.

**TEXTBOOKS:**

1. Goodman, P.E. "Introduction to Rock Mechanics", John Wiley and Sons, 1999.
2. Stillborg B., "Professional User Handbook for rock Bolting", Tran Tech Publications, 1996.
3. Ramamurthy T., "Engineering in Rocks for Slopes Foundations and Tunnels", PHI Learning Pvt. Ltd., 3<sup>rd</sup> Edition, 2014.

**REFERENCES:**

1. Brown, E.T. "Rock Characterisation Testing and Monitoring". Pergaman Press 1991.
2. Arogyaswamy, R.N.P., "Geotechnical Application in Civil Engineering", Oxford and IBH, 1991.
3. Brady, B.H.G. and Brown, E.T., "Rock mechanics for underground mining (Third Edition)", Kluwer Academic Publishers, Dordrecht, 2006.

**CE8004****URBAN PLANNING AND DEVELOPMENT****L T P C  
3 0 0 3****OBJECTIVE:**

- To enable students to have the knowledge on planning process and to introduce to the students about the regulations and laws related to Urban Planning.

**UNIT I BASIC ISSUES****8**

Definition of Human settlement, Urban area, Town, City, Urbanisation, Suburbanisation, Urban sprawl, Peri - urban areas, Central Business District (CBD), Classification of urban areas – Trend of Urbanisation at International, National, Regional and State level.

**UNIT II PLANNING PROCESS****8**

Principles of Planning - Types and Level of Plan, Stages in Planning Process - Goals, Objectives, Delineation of Planning Areas, Surveys and Questionnaire Design.

**UNIT III DEVELOPMENT PLANS, PLAN FORMULATION AND EVALUATION****10**

Scope and Content of Regional Plan, Master Plan, Detailed Development Plan, Development Control Rules, Transfer of Development Rights , Special Economic Zones- Development of small town and smart cities-case studies

**UNIT IV PLANNING AND DESIGN OF URBAN DEVELOPMENT PROJECTS****9**

Site Analysis, Layout Design, Planning Standards, Project Formulation – Evaluation, Plan Implementation, Constraints and Implementation, Financing of Urban Development Projects.

**UNIT V LEGISLATION, DEVELOPMENT AND MANAGEMENT OF URBAN SYSTEM****10**

Town and Country Planning Act, Land Acquisition and Resettlement Act etc., Urban Planning Standards and Regulations, Involvement of Public, Private, NGO, CBO and Beneficiaries.

**TOTAL : 45 PERIODS****OUTCOMES:**

The students completing the course will have the ability to

- Describe basic issues in urban planning
- Formulate plans for urban and rural development and
- Plan and analyse socio economic aspects of urban and rural planning
- Design of urban development projects.
- Manage urban development projects.

**TEXTBOOKS:**

1. Goel, S.L Urban Development and Management, Deep and Deep publications, New Delhi 2002
2. George Chadwick, A Systems view of planning, Pergamon press, Oxford 1978
3. Singh V.B, Revitalised Urban Administration in India, Kalpaz publication, Delhi, 2001
4. Edwin S.Mills and Charles M.Becker, Studies in Urban development, A World Bank publication, 1986

**REFERENCES:**

1. Tamil Nadu Town and Country Planning Act 1971, Government of Tamil Nadu, Chennai
2. Goel S.L., Urban Development and Management, Deep and Deep Publications, New Delhi, 2002
3. Thooyavan, K.R., Human Settlements - A Planning Guide to Beginners, M.A Publications, Chennai, 2005
4. CMDA, Second Master Plan for Chennai, Chennai 2008

**CE8005****AIR POLLUTION AND CONTROL ENGINEERING****L T P C  
3 0 0 3****OBJECTIVE:**

- To impart knowledge on the principle and design of control of Indoor/ particulate/ gaseous air pollutant and its emerging trends.

**UNIT I INTRODUCTION****7**

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards -Ambient and stack sampling and Analysis of Particulate and Gaseous Pollutants.

**UNIT II METEOROLOGY****6**

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.

**UNIT III CONTROL OF PARTICULATE CONTAMINANTS****11**

Factors affecting Selection of Control Equipment - Gas Particle Interaction - Working principle, Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators - Operational Considerations.

**UNIT IV CONTROL OF GASEOUS CONTAMINANTS****11**

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations.

**UNIT V INDOOR AIR QUALITY MANAGEMENT****10**

Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness- Sources and Effects of Noise Pollution – Measurement – Standards -Control and Preventive measures.

**TOTAL: 45 PERIODS****OUTCOMES:**

The students completing the course will have

- an understanding of the nature and characteristics of air pollutants, noise pollution and basic concepts of air quality management
- ability to identify, formulate and solve air and noise pollution problems
- ability to design stacks and particulate air pollution control devices to meet applicable standards.
- Ability to select control equipments.
- Ability to ensure quality, control and preventive measures.

**TEXTBOOKS:**

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, springer science + science media LLC,2004.
2. Noel de Nevers, "Air Pollution Control Engineering", Waveland press,Inc 2017.
3. Anjaneyulu. Y, "Air Pollution and Control Technologies", Allied Publishers (P) Ltd., India 2002.

**REFERENCES:**

1. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.
2. Arthur C. Stern, "Air Pollution (Vol.I - Vol.VIII)", Academic Press, 2006.
3. Wayne T.Davis, "Air Pollution Engineering Manual", John Wiley & Sons, Inc, 2000.
4. M.N Rao and HVN Rao, "Air Pollution",Tata Mcgraw Hill Publishing Company limited,2007.
5. C.S.Rao, "Environmental Pollution Control Engineering",New Age International(P) Limited Publishers,2006.

**GE8075****INTELLECTUAL PROPERTY RIGHTS****L T P C  
3 0 0 3****OBJECTIVE:**

- To give an idea about IPR, registration and its enforcement.

**UNIT I INTRODUCTION****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 II REGISTRATION OF IPRs****10**

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

**UNIT III AGREEMENTS AND LEGISLATIONS****10**

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

**UNIT IV 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 V ENFORCEMENT OF IPRs****7**

Infringement of IPRs, Enforcement Measures, Emerging issues - Case Studies.

**TOTAL:45 PERIODS****OUTCOME:**

- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

**TEXTBOOKS:**

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002



**REFERENCES:**

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

**CE8006****PAVEMENT ENGINEERING****L T P C  
3 0 0 3****OBJECTIVE:**

- Student gains knowledge on various IRC guidelines for designing rigid and flexible pavements. Further, the student will be in a position to assess quality and serviceability conditions of roads.

**UNIT I TYPE OF PAVEMENT AND STRESS DISTRIBUTION ON LAYERED SYSTEM 8**

Introduction – Pavement as layered structure – Pavement types rigid and flexible. Resilient modulus - Stress and deflections in pavements under repeated loading.

**UNIT II DESIGN OF FLEXIBLE PAVEMENTS 10**

Flexible pavement design Factors influencing design of flexible pavement, Empirical - Mechanistic empirical and theoretical methods - Design procedure as per IRC guidelines - Design and specification of rural roads.

**UNIT III DESIGN OF RIGID PAVEMENTS 9**

Cement concrete pavements Factors influencing CC pavements - Modified Westergaard approach - Design procedure as per IRC guidelines - Concrete roads and their scope in India.

**UNIT IV PERFORMANCE EVALUATION AND MAINTENANCE 10**

Pavement Evaluation - Causes of distress in rigid and flexible pavements – Evaluation based on Surface Appearance, Cracks, Patches and Pot Holes, Undulations, Raveling, Roughness, Skid Resistance. Structural Evaluation by Deflection Measurements - Pavement Serviceability index, - Pavement maintenance (IRC Recommendations only).

**UNIT V STABILIZATION OF PAVEMENTS 8**

Stabilisation with special reference to highway pavements - Choice of stabilizers - Testing and field control - Stabilisation for rural roads in India - Use of Geosynthetics in roads.

**TOTAL: 45 PERIODS****OUTCOMES:**

The students completing the course will

- Get knowledge about types of rigid and flexible pavements.
- Able to design of rigid pavements.
- Able to design of flexible pavements.
- Determine the causes of distress in rigid and flexible pavements.
- Understand stabilisation of pavements, testing and field control.

**TEXTBOOKS:**

1. Khanna, S.K. and Justo C.E.G. and Veeraragavan, A, "Highway Engineering", New Chand and Brothers, Revised 10th Edition, 2014.
2. Kadiyali, L.R., "Principles and Practice of Highway Engineering", Khanna tech. Publications, New Delhi, 2005.

**REFERENCES:**

1. Yoder, R.J. and Witchak M.W. "Principles of Pavement Design", John Wiley 2000.
2. Guidelines for the Design of Flexible Pavements, IRC-37-2001, The Indian roads Congress, New Delhi.
3. Guideline for the Design of Rigid Pavements for Highways, IRC 58-1998, The Indian Road Congress, New Delhi.

**CE8007**

**TRAFFIC ENGINEERING AND MANAGEMENT**

**L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- To give an overview of Traffic engineering, traffic regulation, management and traffic safety with integrated approach in traffic planning as well.

**UNIT I TRAFFIC PLANNING AND CHARACTERISTICS**

**9**

Road Characteristics – Road user characteristics – PIEV theory – Vehicle – Performance characteristics - Fundamentals of Traffic Flow - Urban Traffic problems in India - Integrated planning of town ,country ,regional and all urban infrastructure - Towards Sustainable approach. - land use & transport and modal integration.

**UNIT II TRAFFIC SURVEYS**

**10**

Traffic Surveys - Speed, journey time and delay surveys - Vehicles Volume Survey including nonmotorized transports - Methods and interpretation - Origin Destination Survey - Methods and presentation - Parking Survey - Accident analyses -Methods, interpretation and presentation - Statistical applications in traffic studies and traffic forecasting - Level of service - Concept, applications and significance.

**UNIT III TRAFFIC DESIGN AND VISUAL AIDS**

**10**

Intersection Design - channelization, Rotary intersection design - Signal design - Coordination of signals – Grade separation - Traffic signs including VMS and road markings - Significant roles of traffic control personnel - Networking pedestrian facilities & cycle tracks.

**UNIT IV TRAFFIC SAFETY AND ENVIRONMENT**

**8**

Road accidents - Causes, effect, prevention, and cost - Street lighting - Traffic and environment hazards - Air and Noise Pollution, causes, abatement measures - Promotion and integration of public transportation - Promotion of non-motorized transport.

**UNIT V TRAFFIC MANAGEMENT**

**8**

Area Traffic Management System - Traffic System Management (TSM) with IRC standards – Traffic Regulatory Measures-Travel Demand Management (TDM) - Direct and indirect methods - Congestion and parking pricing - All segregation methods- Coordination among different agencies – Intelligent Transport System for traffic management, enforcement and education.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On completing this course, the Students will be able to

- Analyse traffic problems and plan for traffic systems various uses
- Design Channels, Intersections, signals and parking arrangements
- Develop Traffic management Systems

**TEXTBOOKS:**

1. Kadiyali.L.R. "Traffic Engineering and Transport Planning", Khanna Publishers, Delhi, 2013
2. Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management.
3. Salter. R.I and Hounsell N.B, "Highway Traffic Analysis and design", Macmillan Press Ltd. 1996.

**REFERENCES:**

1. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, Principles of Highway Engineering and Traffic Analysis, Wiley India Pvt. Ltd., New Delhi, 2011
2. Garber and Hoel, "Principles of Traffic and Highway Engineering", CENGAGE Learning, New Delhi, 2010
3. SP:43-1994, IRC Specification, "Guidelines on Low-cost Traffic Management Techniques" for Urban Areas, 1994
4. John E Tyworth, "Traffic Management Planning, Operations and control", Addison Wesley Publishing Company, 1996
5. Hobbs.F.D. "Traffic Planning and Engineering", University of Brimingham, Peragamon Press Ltd, 2005
6. Taylor MAP and Young W, "Traffic Analysis – New Technology and New Solutions", Hargreen Publishing Company, 1998.

**CE8008****TRANSPORT AND ENVIRONMENT****L T P C  
3 0 0 3****OBJECTIVE:**

- The objective of this course is to create an awareness / overview of the impact of Transportation Projects on the environment and society..

**UNIT I INTRODUCTION****8**

Environmental Inventory, Environmental Assessment, Environmental Impact Assessment (EIA), Environmental Impact of Transportation Projects, Need for EIA, EIA Guidelines for Transportation Project, Historical Development.

**UNIT II METHODOLOGIES****8**

Elements of EIA – Screening and Scoping – Methods of Impact Analysis – Applications – Appropriate methodology.

**UNIT III ENVIRONMENTAL IMPACT, PREDICTION AND ASSESSMENT****10**

Prediction and Assessment of Impact of Transportation Project at various stages on water, air, noise, land acquisition and resettlement, Socio economic impact, indigenous people, aesthetics, health and safety, energy studies, IRC guidelines.

**UNIT IV ENVIRONMENTAL MITIGATION AND MANAGEMENT PLAN****10**

Mitigation of the impact on Natural and Man-made Environment, Health, Water, Land, Noise, Air, Public participation, Environmental Management Plan, Energy Conservation, Methods to reduce Global Warming.

**UNIT V EIA CASE STUDIES****9**

EIA Case Studies on Highway, Railway, Airways and Waterways Projects

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Students will be able to

- Understood the impact of Transportation projects on the environment.
- Get knowledge on methods of impact analysis and their applications.
- Understand environmental Laws on Transportation Projects and the mitigative measures adopted in the planning stage.
- Predict and assess the impact of transportation projects.

**TEXTBOOKS:**

1. Canter, L.R., Environmental Impact Assessment, McGraw Hill, New Delhi, 1996.
2. Indian Road Congress (IRC), Environmental Impact of Highway Projects, IRC, Delhi, 1998.
3. P. Meenakshi, Elements of Environmental Science and Engineering, Prentice Hall of India, New Delhi, 2006
4. Thirumurthy A.M., Introduction to Environmental Science and Management, Shroff Publishers, Bombay, 2005

**REFERENCES:**

1. John G.Rau and David, C.Hooten, Environmental Impact Analysis Handbook, McGraw Hill Book Company, 1995
2. James H.Banks, Introduction to Transportation Engineering, McGraw Hill Book Company, 2000
3. World Bank, A Handbook on Roads and Environment, Vol.I and II, Washington DC, 1997
4. Priya Ranjan Trivedi, International Encyclopedia of Ecology and Environment - EIA, Indian Institute of Ecology and Environment, New Delhi, 1998

**CE8009****INDUSTRIAL STRUCTURES****L T P C****3 0 0 3****OBJECTIVE:**

- To learn the planning, layout, functional aspects of industries and design of major steel and R.C structures needed for industries.

**UNIT I PLANNING****9**

Classification of industries and industrial structures - Site Planning and Selection - Exterior and interior Layout for Industries and buildings - Guidelines from factories act

**UNIT II FUNCTIONAL REQUIREMENTS****9**

Lighting - Ventilation - Noise and Vibration control - Fire safety

**UNIT III DESIGN OF STEEL STRUCTURES****9**

Pre-engineered and Mill buildings - Transmission Lines Towers - plate girders. Bunkers and Silos - pipe/cable racks- Chimney.

**UNIT IV DESIGN OF R.C. STRUCTURES****9**

Corbels, Brackets and Nibs - Silos and bunkers -Chimney -Cooling Towers (Principles only)

**UNIT V PREFABRICATION****9**

Principles of prefabrication and pre cast construction - Prestressed precast roof trusses - Floor slabs - Wall panels- Handling and erection stresses-joints in precast structures.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Upon completion of this course, students will be able to

- Know the requirements of various industries and get an idea about the materials used and planning of various industrial components
- Understand the functional requirements for industrial structures.
- Design special steel structures like bunkers, silos, crane girders, chimneys and pre-engineered buildings.
- Design special RC structures like corbels, silos, bunkers, chimneys, plates and shells.
- Understand the principles of prefabrication and prestressing

**TEXTBOOKS:**

1. Ramamrutham.S., Design of Reinforced Concrete Structures, Dhanpat Rai Publishing Company, 2007.
2. Varghese.P.C., Advanced Reinforced Concrete Design, PHI, Eastern Economy Editions, Second Edition, 2005.
3. Subramanian, N., Design of Steel Structures, Oxford University Press, 2008.
4. Ramachandra and Virendra Gehlot, Design of steel structures -Vol. 2, Scientific Publishers, 2012.

**REFERENCES:**

1. Henn W. Buildings for Industry, Vol.I and II, London Hill Books, 1995
2. Handbook on Functional Requirements of Industrial buildings, SP32-1986, Bureau of Indian Standards, 1990.
3. Handbook of Industrial Lighting, Stanley L.Lyons, Butterworths, London.1981
4. Koncz, J., Manual of Precast Construction Vol. I and II, Bauverlay GMBH, 1971.
5. Handbook on Precast Construction, An Indian Concrete Institute Publication, 2016

**CE8010****ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT****L T P C  
3 0 0 3****OBJECTIVE:**

- To impart the knowledge and skills to identify, assess and mitigate the environmental and social impacts of developmental projects

**UNIT I INTRODUCTION****9**

Impacts of Development on Environment - Rio Principles of Sustainable Development- Environmental Impact Assessment (EIA) - Objectives - Historical development - EIA Types - EIA in project cycle -EIA Notification and Legal Framework-Stakeholders and their Role in EIA- Selection & Registration Criteria for EIA Consultants

**UNIT II ENVIRONMENTAL ASSESSMENT****9**

Screening and Scoping in EIA - Drafting of Terms of Reference, Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna - Matrices - Networks - Checklist Methods - Mathematical models for Impact prediction - Analysis of alternatives

**UNIT III ENVIRONMENTAL MANAGEMENT PLAN****9**

Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna - Environmental Monitoring Plan - EIA Report Preparation - Review of EIA Reports - Public Hearing-Environmental Clearance Post Project Monitoring

**UNIT IV SOCIO ECONOMIC ASSESSMENT****9**

Baseline monitoring of Socio economic environment - Identification of Project Affected Personal - Rehabilitation and Resettlement Plan- Economic valuation of Environmental impacts - Cost benefit Analysis-

**UNIT V CASE STUDIES****9**

EIA case studies pertaining to Infrastructure Projects - Real Estate Development - Roads and Bridges - Mass Rapid Transport Systems - Ports and Harbor - Airports - Dams and Irrigation projects - Power plants - CETPs- Waste Processing and Disposal facilities - Mining Projects.

**TOTAL: 45 PERIODS****OUTCOMES:**

The students completing the course will have ability to

- carry out scoping and screening of developmental projects for environmental and social assessments
- explain different methodologies for environmental impact prediction and assessment
- plan environmental impact assessments and environmental management plans
- evaluate environmental impact assessment reports

**TEXTBOOKS:**

1. Canter, R.L., "Environmental impact Assessment ", 2nd Edition, McGraw Hill Inc, New Delhi, 1995.
2. Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L. Tu, "Environmental Impact Assessment for Developing Countries in Asia", Volume 1 – Overview, Asian Development Bank, 1997.
3. Peter Morris, Riki Therivel "Methods of Environmental Impact Assessment", Routledge Publishers, 2009.

**REFERENCES:**

1. Becker H. A., Frank Vanclay, "The International handbook of social impact assessment" conceptual and methodological advances, Edward Elgar Publishing, 2003.
2. Barry Sadler and Mary McCabe, "Environmental Impact Assessment Training Resource Manual", United Nations Environment Programme, 2002.
3. Judith Petts, "Handbook of Environmental Impact Assessment Vol. I and II", Blackwell Science New York, 1998.
4. Ministry of Environment and Forests EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010.

**CE8011****DESIGN OF PRESTRESSED CONCRETE STRUCTURES****L T P C****3 0 0 3****OBJECTIVES:**

- To introduce the need for prestressing in a structure
- To explain the methods, types and advantages of prestressing to the students.
- To make the students to design a prestressed concrete structural elements and systems
- To introduce the students the effect of prestressing in the flexural and shear behaviour of structural elements.

**UNIT I INTRODUCTION – THEORY AND BEHAVIOUR****9**

Basic concepts - Advantages and disadvantages - Materials required - Systems and methods of prestressing - Analysis of sections - Stress concept - Strength concept - Load balancing concept – Effect of loading on the tensile stresses in tendons - Effect of tendon profile on deflections - Factors influencing deflections - Calculation of deflections - Short term and long term deflections - Losses of prestress - Estimation of crack width.

**UNIT II      DESIGN FOR FLEXURE AND SHEAR      9**

Basic assumptions of flexural design - Permissible stresses in steel and concrete as per I.S.1343 Code - Different Types of sections - Design of sections of Type I and Type II post-tensioned and pre tensioned beams - Check for flexural capacity based on I.S. 1343 Code - Influence of Layout of cables in post-tensioned beams - Location of wires in pre-tensioned beams - Design for shear based on I.S. 1343 Code.

**UNIT III      DEFLECTION AND DESIGN OF ANCHORAGE ZONE      9**

Factors influencing deflections - Short term deflections of uncracked members - Prediction of long term deflections due to creep and shrinkage - Check for serviceability limit states. Determination of anchorage zone stresses in post-tensioned beams - design of anchorage zone reinforcement - Check for transfer bond length in pre-tensioned beams.

**UNIT IV      COMPOSITE BEAMS AND CONTINUOUS BEAMS      9**

Analysis and design of composite beams - Methods of achieving continuity in continuous beams - Analysis for secondary moments - Concordant cable and linear transformation - Calculation of stresses - Principles of design.

**UNIT V      TENSION AND COMPRESSION MEMBERS      9**

Role of prestressing in members subjected to Tensile forces and compressive forces - Design of tension and compression members - Tanks, pipes and poles - Partial prestressing - Definition, methods of achieving partial prestressing, merits and demerits of partial prestressing.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On successful completion of this course, students will be able to:

- Understand the behaviour of prestressed concrete members and able to analyze the prestressed concrete beams.
- Design the prestressed concrete members for flexure and shear as per the relevant design code (IS 1343).
- Analyze for deflection of prestressed concrete members and design the anchorage zone.
- Analyze and design of composite beams and continuous beams.
- Design of prestressed concrete structures - sleepers, Tanks, pipes and poles.

**TEXTBOOKS:**

1. Krishna Raju N., "Prestressed concrete", 5<sup>th</sup> Edition, Tata McGraw Hill Company, New Delhi, 2012
2. Pandit.G.S. and Gupta.S.P., "Prestressed Concrete", CBS Publishers and Distributors Pvt. Ltd, 2012

**REFERENCES:**

1. Rajagopalan.N, "Prestressed Concrete", Narosa Publishing House, 2002.
2. Dayaratnam.P., "Prestressed Concrete Structures", Oxford and IBH, 2013
3. Lin T.Y. and Ned.H.Burns, "Design of prestressed Concrete Structures", Third Edition, Wiley India Pvt. Ltd., New Delhi, 2013.
4. IS1343:1980, Code of Practice for Prestressed Concrete, Bureau of Indian Standards, New Delhi, 2012
5. IS 3370- Part 4 (2008) Indian standard Code of practice for concrete structures for the storage of liquid- Design tables, code of practice, bureau of Indian standards, new Delhi.

**OBJECTIVE:**

- To make the students to learn about planning of construction projects, scheduling procedures and techniques, cost and quality control projects and use of project information as decision making tool.

**UNIT I CONSTRUCTION PLANNING****6**

Basic concepts in the development of construction plans-Choice of Technology and Construction method-Defining Work Tasks- Work breakdown structure- Definition- Precedence relationships among activities-Estimating Activity Durations-Estimating Resource Requirements for work activities-coding systems.

**UNIT II SCHEDULING PROCEDURES AND TECHNIQUES****12**

Relevance of construction schedules-Bar charts - The critical path method-Calculations for critical path scheduling-Activity float and schedules-Presenting project schedules-Critical path scheduling for Activity-on-node and with leads, Lags and Windows-Calculations for scheduling with leads,lags and windows-Resource oriented scheduling-Scheduling with resource constraints and precedences -Use of Advanced Scheduling Techniques-Scheduling with uncertain durations-Crashing and time/cost tradeoffs -Improving the Scheduling process – Introduction to application software.

**UNIT III COST CONTROL MONITORING AND ACCOUNTING****9**

The cost control problem-The project budget-Forecasting for Activity cost control - financial accounting systems and cost accounts-Control of project cash flows-Schedule control-Schedule and Budget updates-Relating cost and schedule information.

**UNIT IV QUALITY CONTROL AND SAFETY DURING CONSTRUCTION****9**

Quality and safety Concerns in Construction-Organizing for Quality and Safety-Work and Material Specifications-Total Quality control-Quality control by statistical methods -Statistical Quality control with Sampling by Attributes-Statistical Quality control by Sampling and Variables-Safety.

**UNIT V ORGANIZATION AND USE OF PROJECT INFORMATION****9**

Types of project information-Accuracy and Use of Information-Computerized organization and use of Information - Organizing information in databases-relational model of Data bases-Other conceptual Models of Databases-Centralized database Management systems-Databases and application programs-Information transfer and Flow.

**TOTAL: 45 PERIODS****OUTCOMES:**

The students completing the course will have ability to

- Understand basic concepts of construction planing.
- Schedule the construction activities.
- Forecast and control the cost in a construction.
- Understand the quality control and safety during construction.
- Organize information in Centralized database Management systems.

**TEXTBOOKS:**

1. Chitkara, K.K. "Construction Project Management Planning", Scheduling and Control, Tata McGraw Hill Publishing Co., New Delhi, 2009
2. Srinath,L.S., "Pert and CPM Principles and Applications", Affiliated East West Press, 2001



**REFERENCES:**

1. Chris Hendrickson and Tung Au, "Project Management for Construction - Fundamentals Concepts for Owners", Engineers, Architects and Builders, Prentice Hall, Pittsburgh, 2000.
2. Moder.J., Phillips. C. and Davis E, "Project Management with CPM", PERT and Precedence Diagramming, Van Nostrand Reinhold Co., 3<sup>rd</sup> Edition, 1985.
3. Willis., E.M., "Scheduling Construction projects", John Wiley and Sons, 1986.
4. Halpin,D.W., "Financial and Cost Concepts for Construction Management", John Wiley and Sons, New York, 1985.

**EN8591****MUNICIPAL SOLID WASTE MANAGEMENT****L T P C  
3 0 0 3****OBJECTIVE:**

- To make the students conversant with the types, sources, generation, storage, collection, transport, processing and disposal of municipal solid waste.

**UNIT I SOURCES AND CHARACTERISTICS 9**  
Sources and types of municipal solid wastes- Public health and environmental impacts of improper disposal of solid wastes- sampling and characterization of wastes - factors affecting waste generation rate and characteristics - Elements of integrated solid waste management – Requirements and salient features of Solid waste management rules (2016) – Role of public and NGO"s- Public Private participation - Elements of Municipal Solid Waste Management Plan.

**UNIT II SOURCE REDUCTION , WASTE STORAGE AND RECYCLING 8**  
Waste Management Hierarchy - Reduction, Reuse and Recycling - source reduction of waste - On-site storage methods - Effect of storage, materials used for containers - segregation of solid wastes - Public health and economic aspects of open storage - case studies under Indian conditions - Recycling of Plastics and Construction/Demolition wastes.

**UNIT III COLLECTION AND TRANSFER OF WASTES 8**  
Methods of Residential and commercial waste collection - Collection vehicles - Manpower - Collection routes - Analysis of waste collection systems; Transfer stations -location, operation and maintenance; options under Indian conditions - Field problems- solving.

**UNIT IV PROCESSING OF WASTES 12**  
Objectives of waste processing – Physical Processing techniques and Equipment; Resource recovery from solid waste composting and biomethanation; Thermal processing options - case studies under Indian conditions.

**UNIT V WASTE DISPOSAL 8**  
Land disposal of solid waste- Sanitary landfills - site selection, design and operation of sanitary landfills - Landfill liners - Management of leachate and landfill gas- Landfill bioreactor - Dumpsite Rehabilitation

**TOTAL: 45 PERIODS****OUTCOMES:**

The students completing the course will demonstrate

- understanding of the nature and characteristics of municipal solid wastes and the regulatory requirements regarding municipal solid waste management.
- Reduction, reuse and recycling of waste.

- ability to plan and design systems for storage, collection, transport, processing and disposal of municipal solid waste.
- knowledge on the issues on solid waste management from an integrated and holistic perspective, as well as in the local and international context.
- Design and operation of sanitary landfill.

#### TEXTBOOKS:

1. William A. Worrell, P. Aarne Vesilind (2012) Solid Waste Engineering, Cengage Learning, 2012.
2. John Pitchel (2014), Waste Management Practices-Municipal, Hazardous and industrial - CRC Press, Taylor and Francis, New York.

#### REFERENCES:

1. CPHEEO (2014), "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation , Government of India, New Delhi.
2. George Tchobanoglous and Frank Kreith (2002). Handbook of Solid waste management, McGraw Hill, New York.

GE8077

TOTAL QUALITY MANAGEMENT

LT PC  
3 0 0 3

#### OBJECTIVE:

- To facilitate the understanding of Quality Management principles and process.

#### UNIT I 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 - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

#### UNIT II TQM PRINCIPLES

9

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

#### UNIT III TQM TOOLS AND 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 IV TQM TOOLS AND TECHNIQUES II

9

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

#### UNIT V QUALITY MANAGEMENT SYSTEM

9

Introduction–Benefits of ISO Registration–ISO 9000 Series of Standards–Sector-Specific Standards–AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements–Implementation–Documentation–Internal Audits–Registration--**ENVIRONMENTAL MANAGEMENT SYSTEM:** Introduction–ISO 14000 Series Standards–Concepts of ISO 14001–Requirements of ISO 14001–Benefits of EMS.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

**TEXTBOOK:**

1. Dale H.Besterfield, Carol B.Michna,Glen H. Besterfield, Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

**REFERENCES:**

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8<sup>th</sup> Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO9001-2015 standards

|               |  |          |          |          |          |
|---------------|--|----------|----------|----------|----------|
| <b>GE8072</b> | <b>FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

**UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9**

**Global Trends Analysis and Product decision** - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - **Introduction to Product Development Methodologies and Management** - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle - Product Development Planning and Management.

**UNIT II REQUIREMENTS AND SYSTEM DESIGN 9**

**Requirement Engineering** - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - **System Design & Modeling** - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

**UNIT III DESIGN AND TESTING 9**

**Conceptualization** - Industrial Design and User Interface Design - Introduction to Concept generation Techniques - **Challenges in Integration of Engineering Disciplines** - Concept Screening & Evaluation - **Detailed Design** - Component Design and Verification – **Mechanical, Electronics and Software Subsystems** - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component

design, Layout and Hardware Testing - **Prototyping** - Introduction to Rapid Prototyping and Rapid Manufacturing - **System Integration, Testing, Certification and Documentation**

**UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9**

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - **Sustenance** -Maintenance and Repair - Enhancements - **Product EoL** - Obsolescence Management - Configuration Management - EoL Disposal

**UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9**

**The Industry** - Engineering Services Industry - Product Development in Industry versus Academia -**The IPD Essentials** - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the students will be able to:**

- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

**TEXTBOOKS:**

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

**REFERENCES:**

1. Hiriyaappa B, "Corporate Strategy - Managing the Business", Author House, 2013.
2. Peter F Drucker, "People and Performance", Butterworth - Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise Resource Planning – Concepts", Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

**CE8013**

**COASTAL ENGINEERING**

**L T P C**

**3 0 0 3**

**OBJECTIVES:**

- The main purpose of coastal engineering is to protect harbors and improve navigation.
- The students to the diverse topics as wave mechanics, wave climate, shoreline protection methods and laboratory investigations using model studies.

**UNIT I INTRODUCTION TO COASTAL ENGINEERING 9**

Indian Scenario - Classification of Harbours. Introduction - wind and waves - Sea and Swell - Introduction to small amplitude wave theory - use of wave tables- Mechanics of water waves - Linear (Airy) wave theory, Introduction to Tsunami

**UNIT II WAVE PROPERTIES AND ANALYSIS 9**

Behaviour of waves in shallow waters, Introduction to non-linear waves and their properties - Waves in shallow waters - Wave Refraction, Diffraction and Shoaling -Hindcast wave generation models, wave shoaling; wave refraction; wave breaking; wave diffraction random and 3D waves- Short term wave analysis - wave spectra and its utilities - Long term wave analysis- Statistics analysis of grouped wave data.

**UNIT III COASTAL SEDIMENT TRANSPORT 9**

Dynamic beach profile; cross-shore transport; along shore transport (Littoral transport), sediment movement

**UNIT IV COASTAL DEFENSE 9**

Field measurement; models, groins, sea walls, offshore breakwaters, artificial nourishment - planning of coast protection works - Design of shore defense structures

**UNIT V MODELING IN COASTAL ENGINEERING 9**

Physical modeling in Coastal Engineering - Limitations and advantages - Role of physical modeling in coastal engineering - Numerical modeling - Modeling aspects - limitations - Tsunami mitigation measures -

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students will be able to

- Understand coastal engineering aspects of harbors methods to improve navigation
- Understand the wave properties and analysis of wave.
- Understand the concepts of sediment transport.
- Design of shore defense structures.
- Gain knowledge in modeling in coastal engineering.

**REFERENCES:**

1. Mani J.S., Coastal Hydrodynamics. PHI Pvt. Ltd. New Delhi - 2012.
2. Dean, R.G. and Dalrymple, R.A., Water wave mechanics for Engineers and Scientists, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1994.
3. Ippen, A.T., Estuary and Coastline Hydrodynamics, McGraw-Hill, Inc., New York, 1978.
4. Sorenson, R.M., Basic Coastal Engineering, A Wiley-Interscience Pub. New York, 1978.
5. Coastal Engineering Manual, Vol. I-VI, Coastal Engineering Research Centre, Dept. of the Army, US Army Corps of Engineers, Washington DC, 2006.

**CE8014 PARTICIPATORY WATER RESOURCES MANAGEMENT LT P C  
3 0 0 3**

**OBJECTIVE:**

- To gain an insight on local and global perceptions and approaches on participatory water resource management

**UNIT I FUNDAMENTALS: SOCIOLOGY AND PARTICIPATORY APPROACH 6**

Sociology - Basic concepts - Perspectives- Social Stratification - Irrigation as a Socio technical Process - Participatory concepts- Objectives of participatory approach

**UNIT II UNDERSTANDING FARMERS PARTICIPATION 10**  
 Farmers participation -need and benefits - Comparisons of cost and benefit -Sustained system performance - Kinds of participation - Context of participation, factors in the environment - WUA - Constraints in organizing FA - Role of Community Organiser - Case Studies.

**UNIT III ISSUES IN WATER MANAGEMENT 9**  
 Multiple use of water - Issues in Inter-sectoral Water Allocation - domestic, irrigation, industrial sectors - modernization techniques - Rehabilitation - Command Area Development - Water delivery systems

**UNIT IV PARTICIPATORY WATER CONSERVATION 10**  
 Global Challenges -Social - Economic - Environmental - Solutions -Political - Water Marketing - Water Rights -Consumer education - Success Stories Case Studies

**UNIT V PARTICIPATORY WATERSHED DEVELOPMENT 10**  
 Concept and significance of watershed - Basic factors influencing watershed development – Principles of watershed management - Definition of watershed management – Identification of problems - Watershed approach in Government programmes – People’s participation – Entry point activities - Evaluation of watershed management measures.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students will be able to

- Gain knowledge on various processes involved in participatory water resource management.
- Understand farmers participation in water resources management.
- Aware of the issues related to water conservation and watershed Development
- Get knowledge in participatory water conservation
- Understand concept, principle , approach of watershed management.

**TEXTBOOKS:**

1. Sivasubramaniyan, K. Water Management, SIMRES Publication, Chennai, 2011
2. Uphoff.N., Improving International Irrigation management with Farmer Participation – Getting the process Right – Studies in water Policy and management, No.11, Westview press, Boulder,CO, 1986.
3. Tideman, E.M., “Watershed Management”, Omega Scientific Publishers, New Delhi, 1996.

**REFERENCE:**

1. Chambers Robert, Managing canal irrigation, Cambridge University Press, 1989

**CE8015 INTEGRATED WATER RESOURCES MANAGEMENT L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To introduce the students to the interdisciplinary analysis of water and conceptual design of intervention strategies.
- To develop a knowledge-base on capacity building on IWRM.

**UNIT I IWRM FRAMEWORK 9**  
 Definition - Objectives - Principles - Evolution of IWRM - IWRM relevance in water resources management - Paradigm shift : Processes and prospective outcomes

|   |  |          |
|---|--|----------|
| <b>UNIT II</b>  | <b>CONTEXTUALIZING IWRM</b>                          | <b>9</b> |
| UN formulations - SDG goals - IWRM in Global, Regional and Local water partnership – Institutional transformation - Bureaucratic reforms - Inclusive development              |  |          |
| <b>UNIT III</b>   | <b>EMERGING ISSUES IN WATER MANAGEMENT</b>           | <b>9</b> |
| Emerging Issues – Drinking water management in the context of climate change - IWRM and irrigation - Flood - Drought - Pollution - Linkages between water, health and poverty |  |          |
| <b>UNIT IV</b>  | <b>IWRM AND WATER RESOURCES DEVELOPMENT IN INDIA</b> | <b>9</b> |
| Rural Development - Ecological sustainability- -Watershed development and conservation - Ecosystem regeneration - Wastewater reuse - Sustainable livelihood - Food security   |  |          |
| <b>UNIT V</b>   | <b>ASPECTS OF INTEGRATED DEVELOPMENT</b>             | <b>9</b> |
| Capacity building - Conceptual framework of IWRM – Problems and policy issues - Solutions for effective integrated water management - Case studies                            |  |          |

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students will be able to

- Understand objectives, principles and evolution of integrated water resources management.
- Have an idea of contextualizing IWRM
- Gain knowledge in emerging issues in water management, flood, drought, pollution and poverty.
- Understand the water resources development in India and wastewater reuse.
- Gain knowledge on integrated development of water management.

**TEXTBOOKS:**

1. Mollinga P. *et al.* “Integrated Water Resources Management”, Water in South Asia Volume I, Sage Publications, 2006.
2. Sithamparanathan, Rangasamy, A., and Arunachalam, N., “Ecosystem Principles and Sustainable Agriculture”, Scitech Publications (India) Pvt.Lt, Chennai, 1999.

**REFERENCES:**

1. Cech Thomas V., Principles of Water Resources: History, Development, Management and Policy. John Wiley and Sons Inc., New York. 2003.
2. Murthy, J.V.S., “Watershed Management in India”, Wiley Eastern Ltd., New York, 1995.
3. Dalte, S.J.C., “Soil Conservation and Land Management”, International Book Distribution, India, 1986.

**CE8016**

**GROUNDWATER ENGINEERING**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To introduce the student to the principles of Groundwater governing Equations and Characteristics of different aquifers,
- To understand the techniques of development and management of groundwater.

|  |                                   |          |
|--|-----------------------------------|----------|
| <b>UNIT I</b>  | <b>HYDROGEOLOGICAL PARAMETERS</b> | <b>9</b> |
| Introduction – Water bearing Properties of Rock – Type of aquifers - Aquifer properties – permeability, specific yield, transmissivity and storage coefficient - Methods of Estimation - GEC |                                   |          |

norms - Steady state flow - Darcy's Law - Groundwater Velocity – Dupuit Forchheimer assumption - Steady Radial Flow into a Well

**UNIT II WELL HYDRAULICS 9**

Unsteady state flow - Theis method - Jacob method - Chow's method - Law of Times - Theis Recovery - Bailer method - Slug method - tests - Image well theory - Partial penetrations of wells – Well losses - Specific Capacity and Safe yield - Collector well and Infiltration gallery

**UNIT III GROUNDWATER MANAGEMENT 9**

Need for Management Model - Database for Groundwater Management - Groundwater balance study - Introduction to Mathematical model - Model Conceptualization - Initial and Boundary Condition - Calibration - Validation - Future Prediction - Sensitivity Analysis - Uncertainty - Development of a model

**UNIT IV GROUNDWATER QUALITY 9**

Ground water chemistry - Origin, movement and quality - Water quality standards - Drinking water – Industrial water – Irrigation water - Ground water Pollution and legislation - Environmental Regulatory requirements

**UNIT V GROUNDWATER CONSERVATION 9**

Artificial recharge techniques - Reclaimed wastewater recharge - Soil aquifer treatment (SAT) - Aquifer Storage and Recovery (ASR) Seawater Intrusion and Remediation - Ground water Basin management and Conjunctive use - Protection zone delineation, Contamination source inventory and remediation schemes

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students will be able to

- Understand aquifer properties and its dynamics
- Get an exposure towards well design and practical problems
- Develop a model for groundwater management.
- Students will be able to understand the importance of artificial recharge and groundwater quality concepts
- Gain knowledge on conservation of groundwater.

**TEXTBOOKS:**

1. Raghunath H.M., "Ground Water Hydrology", New Age International (P) Limited, New Delhi, 2010.
2. Todd D.K., "Ground Water Hydrology", John Wiley and Sons, New York, 2000.

**REFERENCES:**

1. Fitts R Charles, "Groundwater Science". Elsevier, Academic Press, 2002.
2. Ramakrishnan, S, Ground Water, K.J. Graph arts, Chennai, 1998.

**CE8017**

**WATER RESOURCES SYSTEMS ENGINEERING**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To introduce the student to the concept of Mathematical approaches for managing the water resources system.
- To make the students apply an appropriate system approach to optimally operate a water resource system.



|  |   |          |
|--|---|----------|
| <b>UNIT I</b>  | <b>SYSTEM APPROACH</b>                  | <b>9</b> |
| Definition, classification, and characteristics of systems - Philosophy of modelling - Goals and Objectives - Basics of system analysis concept - steps in systems engineering.  |   |          |
| <b>UNIT II</b>   | <b>LINEAR PROGRAMMING</b>               | <b>9</b> |
| Introduction to Operation research - Linear programming Problem Formulation-graphical solution-Simplex method -Sensitivity analysis - application to operation of single purpose reservoir   |   |          |
| <b>UNIT III</b>  | <b>DYNAMIC PROGRAMMING</b>              | <b>9</b> |
| Bellman's optimality criteria, problem formulation and solutions – Water Allocation for three state (user), Forward and Backward Recursion techniques in Dynamic Programming - Shortest pipe line route problem - Application to reservoirs capacity expansion |   |          |
| <b>UNIT IV</b>   | <b>SIMULATION</b>                       | <b>9</b> |
| Basic principles and concepts - Monte Carlo techniques - Model development - Inputs and outputs - Single and multipurpose reservoir simulation models - Deterministic simulation - Rule Curve development for reservoir  |   |          |
| <b>UNIT V</b>  | <b>ADVANCED OPTIMIZATION TECHNIQUES</b> | <b>9</b> |
| Integer and parametric linear programming - Goal programming types - Applications to reservoir release optimization - application of evolutionary algorithms like Genetic algorithm, Particle swarm, Simulated Annealing to reservoir release optimization     |   |          |

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students will be

- Exposed to the economic aspects and analysis of water resources systems by which they will get an idea of comprehensive and integrated planning of a water resources project.
- Understanding the concept of linear programming and apply in water resource system.
- Understanding the concept of dynamic programming and apply in water resource system.
- Develops simulation models.
- Ddeveloping skills in solving problems in operations research through LP, DP and Simulation techniques.

**TEXTBOOK:**

1. Vedula, S., and Majumdar, P.P. "Water Resources Systems" - Modeling Techniques and Analysis Tata McGraw Hill, 5th reprint, New Delhi, 2010.

**REFERENCES:**

1. Hall Warren, A. and John A. Dracup., "Water Resources System Engineering", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1998
2. Chadurvedi M.C., "Water resource Systems Planning and Management", Tata McGraw Hill inc., New Delhi, 1997
3. Taha H.A., "Operation Research", McMillan Publication Co., New York, 1995.
4. Maass A., Husfchimidt M.M., ,Dorfman R., ThomasH A., Marglin S.A and Fair G. M., "Design of Water Resources System", Hardward University Press, Cambridge, Mass., 1995.
5. Goodman Aluvin S., "Principles of Water Resources Planning", Prentice Hall of India, 1984

**OBJECTIVE:**

- The student acquires the knowledge on the Geotechnical engineering problems associated with soil contamination, safe disposal of waste and remediate the contaminated soils by different techniques thereby protecting environment.

**UNIT I GENERATION OF WASTES AND CONSEQUENCES OF SOIL POLLUTION 8**

Introduction to Geo environmental engineering - Environmental cycle - Sources, production and classification of waste - Causes of soil pollution - Factors governing soil pollution interaction clay minerals - Failures of foundation due to waste movement.

**UNIT II SITE SELECTION AND SAFE DISPOSAL OF WASTE 10**

Safe disposal of waste - Site selection for landfills - Characterization of land fill sites and waste - Risk assessment - Stability of landfills - Current practice of waste disposal - Monitoring facilities - Passive containment system - Application of geosynthetics in solid waste management - Rigid or flexible liners.

**UNIT III TRANSPORT OF CONTAMINANTS 8**

Contaminant transport in sub surface - Advection, Diffusion, Dispersion - Governing equations - Contaminant transformation - Sorption - Biodegradation - Ion exchange - Precipitation - Hydrological consideration in land fill design - Ground water pollution.

**UNIT IV WASTE STABILIZATION 10**

Stabilization - Solidification of wastes - Micro and macro encapsulation - Absorption, Adsorption, Precipitation - Detoxification - Mechanism of stabilization - Organic and inorganic stabilization - Utilization of solid waste for soil improvement - case studies.

**UNIT V REMEDIATION OF CONTAMINATED SOILS 9**

Exsitu and Insitu remediation-Solidification, bio-remediation, incineration, soil washing, phyto remediation, soil heating, vetrification, bio-venting.

**TOTAL: 45 PERIODS****OUTCOMES:**

The students will be able to

- Assess the contamination in the soil
- Understand the current practice of waste disposal
- To prepare the suitable disposal system for particular waste.
- Stabilize the waste and utilization of solid waste for soil improvement.
- Select suitable remediation methods based on contamination.

**TEXTBOOKS:**

1. Hari D. Sharma and Krishna R. Reddy, "Geo-Environmental Engineering" -John Wiley and Sons, INC, USA, 2004.
2. Daniel B.E., "Geotechnical Practice for waste disposal", Chapman & Hall, London 1993.
3. Manoj Datta," Waste Disposal in Engineered landfills", Narosa Publishing House, 1997.
4. Manoj Datta, B.P. Parida, B.K. Guha, "Industrial Solid Waste Management and Landfilling Practice", Narosa Publishing House, 1999.

**REFERENCES:**

1. Westlake, K, "Landfill Waste pollution and Control", Albion Publishing Ltd., England, 1995.
2. Wentz, C.A., "Hazardous Waste Management", McGraw Hill, Singapore, 1989



3. Linsley, R.K. and Franzini, J.B. "Water Resources Engineering", McGraw Hill International Book Company, 1995.

#### REFERENCES:

1. David Keith Todd. "Groundwater Hydrology", John Wiley & Sons, Inc. 2007
2. Ven Te Chow, Maidment, D.R. and Mays, L.W. "Applied Hydrology", McGraw Hill International Book Company, 1998.
3. Raghunath .H.M., "Hydrology", Wiley Eastern Ltd., 1998.

**GE8076**

**PROFESSIONAL ETHICS IN ENGINEERING**

**L T P C  
3 0 0 3**

#### OBJECTIVE:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

#### **UNIT I HUMAN VALUES**

**10**

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 - Introduction to Yoga and meditation for professional excellence and stress management.

#### **UNIT II ENGINEERING ETHICS**

**9**

Senses of 'Engineering Ethics' - Variety of moral issues - Types of inquiry - Moral dilemmas - Moral Autonomy - Kohlberg's theory - Gilligan's theory - Consensus and Controversy - Models of professional roles - Theories about right action - Self-interest - Customs and Religion - Uses of Ethical Theories.

#### **UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION**

**9**

Engineering as Experimentation - Engineers as responsible Experimenters - Codes of Ethics - A Balanced Outlook on Law.

#### **UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS**

**9**

Safety and Risk - Assessment of Safety and Risk - Risk Benefit Analysis and Reducing Risk - Respect for Authority - Collective Bargaining - Confidentiality - Conflicts of Interest - Occupational Crime - Professional Rights - Employee Rights - Intellectual Property Rights (IPR) - Discrimination.

#### **UNIT V GLOBAL ISSUES**

**8**

Multinational Corporations - Environmental Ethics - Computer Ethics - Weapons Development - Engineers as Managers - Consulting Engineers - Engineers as Expert Witnesses and Advisors - Moral Leadership - Code of Conduct - Corporate Social Responsibility.

**TOTAL: 45 PERIODS**

#### OUTCOME:

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

#### TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

**REFERENCES:**

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd., New Delhi, 2013.
6. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011.

**Web sources:**

1. [www.onlineethics.org](http://www.onlineethics.org)
2. [www.nspe.org](http://www.nspe.org)
3. [www.globalethics.org](http://www.globalethics.org)
4. [www.ethics.org](http://www.ethics.org)

**CE8019****COMPUTER AIDED DESIGN OF STRUCTURES****L T P C  
3 0 0 3****OBJECTIVES:**

- To introduce the students about computer graphics, structural analysis, design and optimization and expert systems, applications in analysis.

**UNIT I INTRODUCTION 9**

Fundamental reason for implementing CAD - Software requirements - Hardware components in CAD system - Design process - Applications and benefits.

**UNIT II COMPUTER GRAPHICS 9**

Graphic Software – Graphic primitives - Transformations - 2 Dimensional and 3 Dimensional transformations – Concatenation - Wire frame modeling - Solid modeling - Graphic standards - Drafting packages .

**UNIT III STRUCTURAL ANALYSIS 9**

Principles of structural analysis - Fundamentals of finite element analysis - Concepts of finite elements - Stiffness matrix formulation - Variational Method - Weighted residual method - Problems - Convergence criteria - Analysis packages and applications.

**UNIT IV DESIGN AND OPTIMIZATION 9**

Principles of design of steel and RC structures - Beams and Columns - Applications to simple design problems - Optimization techniques - Algorithms - Linear programming - Simplex Method

**UNIT V EXPERT SYSTEMS 9**

Introduction to artificial intelligence - Knowledge based expert systems – Applications of Knowledge Based Expert Systems - Rules and decision tables - Inference mechanisms - simple applications

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On successful completion of this course, students will be able to:

- Understand the concepts of Computer-Aided Design, Software requirements and Hardware components in CAD system.
- Acquire the knowledge in Computer Graphics and Computer aided drafting using Auto CAD software.
- Understand the fundamentals of finite element analysis and be able use software for modeling, analysis and design of structures.
- Understand the concepts of Optimization techniques and its practical applications to structural engineering.
- Acquire the knowledge in Artificial Intelligence and Knowledge based expert systems.

**TEXTBOOKS:**

1. Groover M.P. and Zimmers E.W. Jr., "CAD/CAM, Computer Aided Design and Manufacturing", Prentice Hall of India Ltd, New Delhi, 1993.
2. Krishnamoorthy C.S.Rajeev S., "Computer Aided Design", Narosa Publishing House, New Delhi, 2001.

**REFERENCES:**

1. Harrison H.B., "Structural Analysis and Design", Part I and II Pergamon Press, Oxford, 1990.
2. Rao S.S., "Optimisation Theory and Applications", Wiley Eastern Limited, New Delhi, 1984.
3. Richard Forsyth (Ed), "Expert System Principles and Case Studies", Chapman and Hall, London, 1989.

**CE8020      MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES      L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- To acquire the knowledge on Quality of concrete, durability aspects, causes of deterioration, assessment of distressed structures, repairing of structures and demolition procedures.

**UNIT I      MAINTENANCE AND REPAIR STRATEGIES      9**

Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating damaged structure, causes of deterioration.

**UNIT II      STRENGTH AND DURABILITY OF CONCRETE      9**

Quality assurance for concrete-Strength, Durability- Cracks, different types, causes-Effects due to climate, temperature, Sustained elevated temperature, Corrosion

**UNIT III      SPECIAL CONCRETES      9**

Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes.

**UNIT IV      TECHNIQUES FOR REPAIR AND PROTECTION METHODS      9**

Non-destructive Testing Techniques, Load Test for Stability-Epoxy injection, Shoring, Underpinning, Corrosion protection techniques-Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.

**UNIT V REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES 9**

Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, leakage, earthquake-Transportation of Structures from one place to other -Structural Health Monitoring- demolition techniques-Engineered demolition methods-Case studies

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Students will be able to understand

- the importance of maintenance and assessment method of distressed structures.
- the strength and durability properties ,their effects due to climate and temperature.
- recent development in concrete
- the techniques for repair and protection methods
- repair, rehabilitation and retrofitting of structures and demolition methods.

**TEXT BOOKS:**

1. Shetty.M.S.ConcreteTechnology-Theory and Practice,S.Chandand Company, 2008.
2. Vidivelli.B Rehabilitation of Concrete Structures Standard Publishes Distribution.1<sup>st</sup> edition 2009.
3. Varghese.P.C Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd 2014.
4. Dodge Woodson.R Concrete Structures, Protection, Repair and Rehabilitation, Butterworth- Heinemann,Elsevier,New Delhi 2012

**REFERENCES:**

1. DovKominetzky.M.S.,-Design and Construction Failures, Galgotia, Publications Pvt.Ltd.,2001
2. Ravishankar.K. Krishnamoorthy.T.S, Structural Health Monitoring, Repair And Rehabilitation of Concrete Structures, Allied Publishers, 2004.
3. Hand book onSeismic Retrofit of Buildings,CPWD and Indian Buildings Congress, Narosa Publishers, 2008.
4. 4.Hand Book on “Repair and Rehabilitation of RCC Buildings”-Director General works CPWD ,Govt of India , New Delhi-2002

**CE8021 STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING**

**L T P C  
3 0 0 3**

**OBJECTIVE:**

- To understand the behaviour of dynamic loading. Study the effect of earthquake loading on the behaviour of structures. Understand the codal provisions to design the structures as earthquake resistant.

**UNIT I SINGLE DEGREE OF FREEDOM SYSTEM 9**

Definition of degree of freedom - Idealization of structure as Single Degree of Freedom (SDOF) system - Formulation of equation of motion for various SDOF system - D' Alemberts Principles – Effect of damping - Free and forced vibration of damped and undamped structures - Response to harmonic forces and periodic forces.

**UNIT II MULTI DEGREE OF FREEDOM SYSTEM 9**

Formulation of equation of motion for multidegree of freedom (MDOF) system - Evaluation of natural frequencies and modes - Eigen values and Eigen vectors - Response to free and forced vibration of undamped and damped MDOF systems - Modal superposition methods.

**UNIT III INTRODUCTION TO EARTHQUAKE ENGINEERING 9**

Elements of Engineering Seismology - Definitions, Introduction to Seismic hazard, Earthquake phenomenon - Seismotectonics - Seismic Instrumentation - Characteristics of Strong Earthquake motion - Estimation of Earthquake Parameters.

**UNIT IV EARTHQUAKE EFFECTS ON STRUCTURES 9**

Effect of earthquake on different types of structures - Behaviour of RCC, Steel and prestressed Concrete Structures under earthquake loading - Pinching Effect - Bouchinger Effects - Evaluation of Earthquake forces - IS Code 1893: 2002 - Response Spectra - Lessons learnt from past earthquakes.

**UNIT V CONCEPTS OF EARTHQUAKE RESISTANT DESIGN 9**

Causes of damage - Planning considerations/Architectural concept (IS 4326-1993) - Guidelines for Earthquake resistant design - Earthquake resistant design of masonry buildings - Design consideration - Guidelines - Earthquake resistant design of R.C.C. buildings - Lateral load analysis - Design and detailing (IS 13920:1993).

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Student will develop knowledge in the simulation and mathematical model development.
- Students will be trained to identify, formulate and solve complicated problem.
- Students will be able to understand the role of natural calamity in the damage of structures.
- Students will be able to develop the skill to analyse data and to apply the same in the practical problems.
- Students will be able to apply the developed methodologies for the safe and stable design of structures.

**TEXTBOOKS:**

1. Mario Paz, Structural Dynamics – Theory and Computations, Fourth Edition, CBS publishers, 1997.
2. Agarwal.P and Shrikhande.M. Earthquake Resistant Design of Structures, Prentice Hall of India Pvt. Ltd. 2007.

**REFERENCES:**

1. Clough.R.W, and Penzien.J, Dynamics of Structures, Second Edition, McGraw Hill International Edition, 1995.
2. Jai Krishna, Chandrasekaran.A.R., and Brijesh Chandra, Elements of Earthquake Engineering, South Asia Publishers, 1994.
3. Minoru Wakabayashi, Design of Earthquake Resistant Buildings, Mc Graw – Hill Book Company, 1986
4. Humar.J.L, Dynamics of Structures, Prentice Hall Inc., 1990.
5. Anil K Chopra, Dynamics of structures – Theory and applications to Earthquake Engineering, Prentice Hall Inc., 2007.
6. Moorthy.C.V.R., Earthquake Tips, NICEE, IIT Kanpur,2002.
7. IS13920-1993 Ductile detailing of reinforced concrete structures subjected to seismic forces - Code of practice.
8. IS 1893 part 1 2002 Indian standard criteria for earthquake resistant design of structures.
9. IS 4326-1993 Earthquake Resistant Design and Construction of Buildings--Code of Practice (Second Revision)



**OBJECTIVE:**

- To impart knowledge to students on modular construction, industrialised construction and design of prefabricated elements and construction methods.

**UNIT I INTRODUCTION****9**

Need for prefabrication - Principles of prefabrication - Modular coordination - Standardization - Materials - Systems - Production - Transportation - Erection.

**UNIT II PREFABRICATED COMPONENTS****9**

Behaviour and types of structural components - Large panel systems - roof and floor slabs - Walls panels - Beams - Columns - Shear walls

**UNIT III DESIGN PRINCIPLES****9**

Design philosophy- Design of cross section based on efficiency of material used – Problems in design because of joint flexibility - Allowance for joint deformation - Demountable precast concrete systems.

**UNIT IV JOINTS AND CONNECTIONS IN STRUCTURAL MEMBERS****9**

Types of Joints – based on action of forces - compression joints - shear joints - tension joints - based on function - construction, contraction, expansion. Design of expansion joints - Dimensions and detailing - Types of sealants - Types of structural connections - Beam to Column - Column to Column - Beam to Beam - Column to foundation.

**UNIT V DESIGN FOR ABNORMAL LOADS****9**

Progressive collapse – Codal provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse.

**TOTAL: 45 PERIODS****OUTCOMES:**

- The student will have good knowledge about design principles, layout of factory and stages of loading in precast construction.
- Acquire knowledge about panel systems, slabs, connections used in precast construction and they will be in a position to design the elements.
- Acquire knowledge about types of floor systems, stairs and roofs used in precast construction.
- Acquire knowledge about types of walls used in precast construction, sealants, design of joints.
- Acquire knowledge about components in industrial building.

**TEXTBOOKS:**

1. Bruggeling A.S. G and Huyghe G.F. "Prefabrication with Concrete", A.A. Balkema Publishers, USA, 1991.
2. Lewitt, M. " Precast Concrete- Materials, Manufacture, Properties And Usage", Applied Science Publishers , London And New Jersey, 1982.
3. Bachmann, H. and Steinle, A. "Precast Concrete Structures", Ernst & Sohn, Berlin, 2011.

**REFERENCES:**

1. Koncz T., "Manual of precast concrete construction", Vol. I, II and III, Bauverlag, GMBH, 1976.
2. "Handbook on Precast Concrete Buildings", Indian Concrete Institute, 2016.
3. "Structural design manual", Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 2009.

**OBJECTIVE:**

- To make the student to know about various bridge structures, selection of appropriate bridge structures and its design for given site conditions.

**UNIT I INTRODUCTION****9**

History of bridges - Components of a bridge - Classification of road bridges - Selection of site and initial decision process - Survey and alignment; Geotechnical investigations and interpretations. River Bridge: Selection of Bridge site and planning - Collection of bridge design data - Hydrological calculation

Road Bridges - IRC codes - Standard Loading for Bridge Design - Influence lines for statically determinate and indeterminate structures - Transverse distribution of Live loads among deck longitudinal - Load combinations for different working state and limit state designs

Railway Bridges: Loadings for Railway Bridges; Railroad data. Pre-design considerations - Railroad vs. Highway bridges.

**UNIT II SUPERSTRUCTURES****9**

Bridge decks - Structural forms and behaviour - Choices of superstructure types - Behaviour and modeling of bridge decks - Simple beam model - Plate model - Grillage method - Finite Element method - Different types of superstructure (RCC and PSC); Longitudinal Analysis of Bridge.- Transverse Analysis of Bridge - Temperature Analysis - Distortional Analysis - Effects of Differential settlement of supports - Reinforced earth structures

**UNIT III DESIGN OF STEEL BRIDGES****9**

Design of Truss Bridges - Design of Plate girder bridges.

**UNIT IV DESIGN OF RC AND PSC BRIDGES****9**

Design of slab bridges - T beam bridges - PSC bridges

**UNIT V SUBSTRUCTURE, BEARINGS AND EXPANSION JOINTS, PARAPETS AND RAILINGS****9**

Substructure - Pier; Abutment - Wing walls- Importance of Soil-Structure Interaction - Types of foundations - Open foundation- Pile foundation- Well foundation- Simply supported bridge- Continuous Bridge - Bearings and Expansion Joints - Different types of bridge bearings and expansion joints - Parapets and Railings for Highway Bridges

**TOTAL: 45 PERIODS****OUTCOMES:**

On successful completion of this course, students will be able to:

- Identify loads on bridges and selection of type of bridge for the site condition
- Analyze the super structure by various methods.
- Design the trussed bridge and plate girder bridges
- Design reinforced concrete slab and T beam bridges and prestressed concrete bridges
- Decide the appropriate sub structural systems , bearings and expansion joints for the bridges.

**TEXTBOOKS:**

1. Johnson Victor D., "Essentials of Bridge Engineering", Oxford and IBH Publishing Co., New Delhi, 2009.
2. Jagadeesh. T.R. and Jayaram. M.A., "Design of Bridge Structures", Prentice Hall of India Pvt. Ltd, Learning Pvt. Ltd., 2013

**REFERENCES:**

1. Phatak D.R., "Bridge Engineering", Satya Prakashan, New Delhi, 1990.
2. Ponnuswamy S., "Bridge Engineering", Tata McGraw-Hill, New Delhi, 1996.
3. Rajagopalan. N. "Bridge Superstructure", Alpha Science International, 2006

**GE8073****FUNDAMENTALS OF NANOSCIENCE****L T P C****3 0 0 3****OBJECTIVE:**

- To learn about basis of nanomaterial science, preparation method, types and application

**UNIT I INTRODUCTION****8**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

**UNIT II GENERAL METHODS OF PREPARATION****9**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

**UNIT III NANOMATERIALS****12**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO<sub>2</sub>, MgO, ZrO<sub>2</sub>, NiO, nanoalumina, CaO, AgTiO<sub>2</sub>, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

**UNIT IV CHARACTERIZATION TECHNIQUES****9**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

**UNIT V APPLICATIONS****7**

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechnology: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

**TOTAL : 45 PERIODS****OUTCOMES:**

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

**TEXT BOOKS :**

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.

2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

**REFERENCES:**

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.



  
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**ANNA UNIVERSITY, CHENNAI**  
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**PROGRAM EDUCATIONAL OBJECTIVES (PEOs):**

1. To enable graduates to pursue higher education and research, or have a successful career in industries associated with Computer Science and Engineering, or as entrepreneurs. To ensure that graduates will have the ability and attitude to adapt to emerging technological changes.

**PROGRAM OUTCOMES POs:**

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### **PROGRAM SPECIFIC OBJECTIVES (PSOs)**

To analyze, design and develop computing solutions by applying foundational concepts of Computer Science and Engineering.

To apply software engineering principles and practices for developing quality software for scientific and business applications.

To adapt to emerging Information and Communication Technologies (ICT) to innovate ideas and solutions to existing/novel problems.

#### Mapping of POs/PSOs to PEOs

Contribution

1: Reasonable

2: Significant

3: Strong

|   | PEOs   |   |
|---|--|---|
| POs   | 1. Graduates will pursue higher education and research, or have a successful career in industries associated with Computer Science and Engineering, or as entrepreneurs. | 2. Graduates will have the ability and attitude to adapt to emerging technological changes. |
| 1. <b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.  | 3  | 1   |
| 2. <b>Problem analysis:</b> Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.   | 3  | 1   |
| 3. <b>Design/development of solutions:</b> Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. | 3  | 2   |
| 4. <b>Conduct investigations of complex problems:</b> Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.  | 3  | 2   |
| 5. <b>Modern tool usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.   | 2  | 3   |
| 6. <b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.   | 2  | 2   |

|   |   |   |
|---|---|---|
| <p><b>7. Environment and sustainability:</b><br/>Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.</p>  | 2 | 1 |
| <p><b>8. Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.</p>   | 3 | 1 |
| <p><b>9. Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.</p>  | 3 | 2 |
| <p><b>10. Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.</p> | 3 | 2 |
| <p><b>11. Project management and finance:</b><br/>Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.</p>   | 2 | 2 |
| <p><b>12. Life-long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.</p>   | 1 | 3 |
|   |   |   |

| <b>PSOs</b>   |   |   |
|---|---|---|
| 1. Analyze, design and develop computing solutions by applying foundational concepts of computer science and engineering.         | 3 | 1 |
| 2. Apply software engineering principles and practices for developing quality software for scientific and business applications.  | 3 | 1 |
| 3. Adapt to emerging information and communication technologies (ICT) to innovate ideas and solutions to existing/novel problems. | 1 | 3 |



### MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES

A broad relation between the Course Outcomes and Programme Outcomes is given in the following table

|                    | Course Title  | Programme Outcome (PO) |   |   |   |   |   |   |   |   |    |    |    |
|--------------------|---|------------------------|---|---|---|---|---|---|---|---|----|----|----|
|                    |   | 1                      | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| <b>SEMESTER I</b>  | Communicative English                                     |                        |   |   |   |   |   |   | √ | √ | √  |    | √  |
|                    | Engineering Mathematics - I                               | √                      | √ | √ |   |   |   |   |   | √ |    |    |    |
|                    | Engineering Physics                                       | √                      | √ | √ |   |   |   |   |   |   |    |    |    |
|                    | Engineering Chemistry                                     | √                      | √ | √ |   |   |   |   |   |   |    |    |    |
|                    | Problem Solving and Python Programming                    | √                      | √ | √ |   |   |   |   |   |   |    |    |    |
|                    | Engineering Graphics                                      | √                      | √ | √ |   | √ |   |   | √ | √ | √  |    | √  |
|                    | Problem Solving and Python Programming Laboratory         | √                      | √ | √ |   | √ |   |   | √ | √ | √  |    | √  |
|                    | Physics and Chemistry Laboratory                          | √                      | √ | √ |   |   |   |   | √ | √ | √  |    |    |
| <b>SEMESTER II</b> | Technical English   |                        |   |   |   |   |   |   | √ | √ | √  |    | √  |
|                    | Engineering Mathematics II                                | √                      | √ | √ |   |   |   |   |   | √ |    |    |    |
|                    | Physics for Information Science                           | √                      | √ | √ |   |   |   |   |   |   |    |    |    |
|                    | Basic Electrical, Electronics and Measurement Engineering | √                      | √ | √ |   |   |   |   |   |   |    |    |    |
|                    | Environmental Science and Engineering                     | √                      | √ | √ |   |   |   | √ | √ | √ | √  |    | √  |
|                    | Programming in C  | √                      | √ | √ |   |   |   |   | √ | √ | √  |    | √  |
|                    | Engineering Practices Laboratory                          | √                      | √ | √ | √ | √ | √ |   | √ | √ | √  |    | √  |
|                    | C Programming Laboratory                                  | √                      | √ | √ |   |   |   |   | √ | √ | √  |    | √  |

| PROGRAMME OUTCOME (PO)                 |              |   |                                 |   |   |   |   |   |   |   |   |    |    |    |  |   |
|--|--------------|---|---------------------------------|---|---|---|---|---|---|---|---|----|----|----|--|---|
| YEAR II                                | SEMESTER III | COURSE TITLE                              | 1                               | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |  |   |
|  |              | Discrete Mathematics                      | √                               | √ | √ |   |   |   |   |   |   |    | √  |    |  |   |
|  |              | Digital Principles and Design             | √                               | √ | √ |   |   |   |   |   |   |    |    |    |  |   |
|  |              | Data Structures                           | √                               | √ | √ |   |   |   |   |   |   |    |    |    |  |   |
|  |              | Object Oriented Programming               | √                               | √ | √ |   |   |   |   |   |   |    |    |    |  |   |
|  |              | Communication Engineering                 | √                               | √ | √ |   |   |   |   |   |   |    |    |    |  |   |
|  |              | Data Structures Laboratory                | √                               | √ | √ |   |   |   |   |   | √ | √  | √  |    |  | √ |
|  |              | Object Oriented Programming Laboratory    | √                               | √ | √ |   |   |   |   |   | √ | √  | √  |    |  | √ |
|  |              | Digital Systems Laboratory                | √                               | √ | √ |   |   |   | √ |   | √ | √  | √  |    |  | √ |
|  |              | Interpersonal Skills/Listening & Speaking |                                 |   |   |   |   |   |   |   |   | √  | √  | √  |  | √ |
|  |              | SEMESTER IV                               | Probability and Queueing Theory | √ | √ | √ |   |   |   |   |   |    | √  | √  |  | √ |
| Computer Architecture                  | √            |   | √                               | √ |   |   |   |   |   |   |   |    |    |    |  |   |
| Database Management Systems            | √            |   | √                               | √ |   |   |   |   |   |   |   |    |    |    |  |   |
| Design and Analysis of Algorithms      | √            |   | √                               | √ |   |   |   |   |   |   | √ | √  |    | √  |  |   |
| Operating Systems                      | √            |   | √                               | √ |   |   |   |   |   |   |   |    |    |    |  |   |
| Software Engineering                   | √            |   | √                               | √ |   | √ | √ |   |   | √ | √ | √  |    | √  |  |   |
| Database Management Systems Laboratory | √            |   | √                               | √ |   |   |   |   |   | √ | √ | √  |    | √  |  |   |
| Operating Systems Laboratory           | √            |   | √                               | √ |   |   |   |   |   | √ | √ | √  |    | √  |  |   |
| Advanced Reading and Writing           |              |   |                                 |   |   |   |   |   |   | √ | √ | √  |    | √  |  |   |

|          |              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|----------|--------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR III | SEMESTER V   | Algebra and Number Theory                       | √ | √ | √ |   |   |   |   |   | √ |   |   |   |   |
|          |              | Computer Networks                               | √ | √ | √ |   |   |   |   |   |   |   |   |   |   |
|          |              | Microprocessors and Microcontrollers            | √ | √ | √ |   |   |   |   |   |   |   |   |   |   |
|          |              | Theory of Computation                           | √ | √ | √ |   |   |   |   |   |   |   |   |   |   |
|          |              | Object Oriented Analysis and Design             | √ | √ | √ |   |   | √ |   |   |   |   |   |   |   |
|          |              | Open Elective I                                 |   |   |   |   |   |   |   |   |   |   |   |   |   |
|          |              | Microprocessors and Microcontrollers Laboratory | √ | √ | √ |   |   |   |   | √ | √ | √ |   |   | √ |
|          |              | Object Oriented Analysis and Design Laboratory  | √ | √ | √ |   | √ | √ |   | √ | √ | √ |   |   | √ |
|          |              | Networks Laboratory                             | √ | √ | √ |   |   |   |   | √ | √ | √ |   |   | √ |
|          |              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| YEAR IV  | SEMESTER VI  | Internet Programming                            | √ | √ | √ |   |   |   |   | √ | √ | √ |   | √ |   |
|          |              | Artificial Intelligence                         | √ | √ | √ |   |   |   |   |   |   |   |   |   |   |
|          |              | Mobile Computing                                | √ | √ | √ |   |   |   |   |   |   |   |   |   |   |
|          |              | Compiler Design                                 | √ | √ | √ |   |   |   |   | √ | √ | √ |   | √ |   |
|          |              | Distributed Systems                             | √ | √ | √ |   |   |   |   |   |   |   |   |   |   |
|          |              | Professional Elective I                         |   |   |   |   |   |   |   |   |   |   |   |   |   |
|          |              | Internet Programming Laboratory                 | √ | √ | √ |   | √ |   |   | √ | √ | √ |   | √ |   |
|          |              | Mobile Application Development Laboratory       | √ | √ | √ |   | √ | √ |   | √ | √ | √ |   | √ |   |
|          |              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|          |              | Mini Project                                    | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ |   |
|          |              | Professional Communication                      |   |   |   |   |   | √ |   |   | √ |   | √ |   |   |
|          |              |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| YEAR IV  | SEMESTER VII | Principles of Management                        | √ | √ | √ |   |   |   |   |   |   |   | √ |   |   |
|          |              | Cryptography and Network Security               | √ | √ | √ |   |   |   |   |   |   |   |   |   |   |
|          |              | Cloud Computing                                 | √ | √ | √ |   |   |   |   |   |   |   |   |   |   |
|          |              | Open Elective II                                |   |   |   |   |   |   |   |   |   |   |   |   |   |

|  |                      |                            |   |   |   |   |   |   |   |   |   |   |   |   |
|--|----------------------|----------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
|  |                      | Professional Elective II   |   |   |   |   |   |   |   |   |   |   |   |   |
|  |                      | Professional Elective III  |   |   |   |   |   |   |   |   |   |   |   |   |
|  |                      | Cloud Computing Laboratory | √ | √ | √ |   | √ |   |   | √ | √ | √ |   | √ |
|  |                      | Security Laboratory        | √ | √ | √ |   | √ |   |   | √ | √ | √ |   | √ |
|  |                      |                            |   |   |   |   |   |   |   |   |   |   |   |   |
|  | <b>SEMESTER VIII</b> | Professional Elective IV   |   |   |   |   |   |   |   |   |   |   |   |   |
|  |                      | Professional Elective V    |   |   |   |   |   |   |   |   |   |   |   |   |
|  |                      | Project Work               | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ |

## PROFESSIONAL ELECTIVES

| SEM                                | COURSE TITLE  | PROGRAMME OUTCOME (PO)   |   |   |   |   |   |   |   |   |    |    |    |
|------------------------------------|---|--------------------------|---|---|---|---|---|---|---|---|----|----|----|
|                                    |   | 1                        | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| VI                                 | Data Warehousing and Data Mining                            | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
|                                    | Software Testing  | √                        | √ | √ |   | √ |   |   |   | √ | √  |    |    |
|                                    | Embedded Systems  | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
|                                    | Agile Methodologies   | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
|                                    | Graph Theory and Applications- Intellectual Property Rights | √                        | √ | √ |   |   | √ | √ | √ | √ | √  | √  | √  |
|                                    | Digital Signal Processing                                   | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
| VII                                | Big Data Analytics  | √                        | √ | √ |   | √ |   |   |   | √ | √  |    |    |
|                                    | Machine Learning Techniques                                 | √                        | √ | √ |   | √ |   |   |   | √ | √  |    |    |
|                                    | Computer Graphics and Multimedia                            | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
|                                    | Software Project Management                                 | √                        | √ | √ |   |   | √ |   | √ | √ | √  | √  | √  |
|                                    | Internet of Things  | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
|                                    | Service Oriented Architecture                               | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
|                                    | Total Quality Management                                    | √                        | √ | √ |   |   |   |   |   |   |    |    | √  |
|                                    | Multi-core Architectures and Programming                    | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
|                                    | Human Computer Interaction                                  | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
|                                    | C# and .Net Programming                                     | √                        | √ | √ |   | √ |   |   |   | √ | √  |    |    |
|                                    | Wireless Adhoc and Sensor Networks                          | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
|                                    | Advanced Topics on Databases                                | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
|                                    | Foundation Skills in Integrated Product Development         | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
|                                    | Human Rights  | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
|                                    | Disaster Management   | √                        | √ | √ |   |   |   |   | √ |   |    |    |    |
|                                    | VIII  | Digital Image Processing | √ | √ | √ |   |   |   |   |   |    |    |    |
| Social Network Analysis            |   | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
| Information Security               |   | √                        | √ | √ |   |   |   |   | √ |   |    |    |    |
| Software Defined Networks          |   | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
| Cyber Forensics                    |   | √                        | √ | √ |   |   |   |   | √ |   |    |    |    |
| Soft Computing                     |   | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
| Professional Ethics in Engineering |   |                          |   |   |   |   | √ | √ | √ | √ | √  |    | √  |
| Information Retrieval Techniques   |   | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
| Green Computing                    |   | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
| GPU Architecture and Programming   |   | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
| Natural Language Processing        |   | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
| Parallel Algorithms                |   | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
| Speech Processing                  |   | √                        | √ | √ |   |   |   |   |   |   |    |    |    |
| Fundamentals of Nanoscience        | √   | √                        | √ |   |   |   |   |   |   |   |    |    |    |

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**I - VIII SEMESTERS CURRICULA AND SYLLABI**

**SEMESTER I**

| SI. No            | COURSE CODE | COURSE TITLE                                      | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |           |           |
| 1.                | HS8151      | Communicative English                             | HS       | 4               | 4         | 0        | 0         | 4         |
| 2.                | MA8151      | Engineering Mathematics - I                       | BS       | 4               | 4         | 0        | 0         | 4         |
| 3.                | PH8151      | Engineering Physics                               | BS       | 3               | 3         | 0        | 0         | 3         |
| 4.                | CY8151      | Engineering Chemistry                             | BS       | 3               | 3         | 0        | 0         | 3         |
| 5.                | GE8151      | Problem Solving and Python Programming            | ES       | 3               | 3         | 0        | 0         | 3         |
| 6.                | GE8152      | Engineering Graphics                              | ES       | 6               | 2         | 0        | 4         | 4         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |           |           |
| 7.                | GE8161      | Problem Solving and Python Programming Laboratory | ES       | 4               | 0         | 0        | 4         | 2         |
| 8.                | BS8161      | Physics and Chemistry Laboratory                  | BS       | 4               | 0         | 0        | 4         | 2         |
| <b>TOTAL</b>      |             |   |          | <b>31</b>       | <b>19</b> | <b>0</b> | <b>12</b> | <b>25</b> |

**SEMESTER II**

| SI.No             | COURSE CODE | COURSE TITLE  | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |          |           |
| 1.                | HS8251      | Technical English   | HS       | 4               | 4         | 0        | 0        | 4         |
| 2.                | MA8251      | Engineering Mathematics - II                              | BS       | 4               | 4         | 0        | 0        | 4         |
| 3.                | PH8252      | Physics for Information Science                           | BS       | 3               | 3         | 0        | 0        | 3         |
| 4.                | BE8255      | Basic Electrical, Electronics and Measurement Engineering | ES       | 3               | 3         | 0        | 0        | 3         |
| 5.                | GE8291      | Environmental Science and Engineering                     | HS       | 3               | 3         | 0        | 0        | 3         |
| 6.                | CS8251      | Programming in C  | PC       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |          |           |
| 7.                | GE8261      | Engineering Practices Laboratory                          | ES       | 4               | 0         | 0        | 4        | 2         |
| 8.                | CS8261      | C Programming Laboratory                                  | PC       | 4               | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>      |             |   |          | <b>28</b>       | <b>20</b> | <b>0</b> | <b>8</b> | <b>24</b> |

**SEMESTER III**

| SI.No             | COURSE CODE | COURSE TITLE                              | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |           |           |
| 1.                | MA8351      | Discrete Mathematics                      | BS       | 4               | 4         | 0        | 0         | 4         |
| 2.                | CS8351      | Digital Principles and System Design      | ES       | 4               | 4         | 0        | 0         | 4         |
| 3.                | CS8391      | Data Structures                           | PC       | 3               | 3         | 0        | 0         | 3         |
| 4.                | CS8392      | Object Oriented Programming               | PC       | 3               | 3         | 0        | 0         | 3         |
| 5.                | EC8395      | Communication Engineering                 | ES       | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |           |           |
| 6.                | CS8381      | Data Structures Laboratory                | PC       | 4               | 0         | 0        | 4         | 2         |
| 7.                | CS8383      | Object Oriented Programming Laboratory    | PC       | 4               | 0         | 0        | 4         | 2         |
| 8.                | CS8382      | Digital Systems Laboratory                | ES       | 4               | 0         | 0        | 4         | 2         |
| 9.                | HS8381      | Interpersonal Skills/Listening & Speaking | EEC      | 2               | 0         | 0        | 2         | 1         |
| <b>TOTAL</b>      |             |   |          | <b>31</b>       | <b>17</b> | <b>0</b> | <b>14</b> | <b>24</b> |

**SEMESTER IV**

| SI. No            | COURSE CODE | COURSE TITLE                           | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|--|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |  |          |                 |           |          |           |           |
| 1.                | MA8402      | Probability and Queueing Theory        | BS       | 4               | 4         | 0        | 0         | 4         |
| 2.                | CS8491      | Computer Architecture                  | PC       | 3               | 3         | 0        | 0         | 3         |
| 3.                | CS8492      | Database Management Systems            | PC       | 3               | 3         | 0        | 0         | 3         |
| 4.                | CS8451      | Design and Analysis of Algorithms      | PC       | 3               | 3         | 0        | 0         | 3         |
| 5.                | CS8493      | Operating Systems                      | PC       | 3               | 3         | 0        | 0         | 3         |
| 6.                | CS8494      | Software Engineering                   | PC       | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |  |          |                 |           |          |           |           |
| 7.                | CS8481      | Database Management Systems Laboratory | PC       | 4               | 0         | 0        | 4         | 2         |
| 8.                | CS8461      | Operating Systems Laboratory           | PC       | 4               | 0         | 0        | 4         | 2         |
| 9.                | HS8461      | Advanced Reading and Writing           | EEC      | 2               | 0         | 0        | 2         | 1         |
| <b>TOTAL</b>      |             |  |          | <b>29</b>       | <b>19</b> | <b>0</b> | <b>10</b> | <b>24</b> |

**SEMESTER V**

| SI. No            | COURSE CODE | COURSE TITLE                                    | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |           |           |
| 1.                | MA8551      | Algebra and Number Theory                       | BS       | 4               | 4         | 0        | 0         | 4         |
| 2.                | CS8591      | Computer Networks                               | PC       | 3               | 3         | 0        | 0         | 3         |
| 3.                | EC8691      | Microprocessors and Microcontrollers            | PC       | 3               | 3         | 0        | 0         | 3         |
| 4.                | CS8501      | Theory of Computation                           | PC       | 3               | 3         | 0        | 0         | 3         |
| 5.                | CS8592      | Object Oriented Analysis and Design             | PC       | 3               | 3         | 0        | 0         | 3         |
| 6.                |             | Open Elective I                                 | OE       | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |           |           |
| 7.                | EC8681      | Microprocessors and Microcontrollers Laboratory | PC       | 4               | 0         | 0        | 4         | 2         |
| 8.                | CS8582      | Object Oriented Analysis and Design Laboratory  | PC       | 4               | 0         | 0        | 4         | 2         |
| 9.                | CS8581      | Networks Laboratory                             | PC       | 4               | 0         | 0        | 4         | 2         |
| <b>TOTAL</b>      |             |   |          | <b>31</b>       | <b>19</b> | <b>0</b> | <b>12</b> | <b>25</b> |

**SEMESTER VI**

| SI. No            | COURSE CODE | COURSE TITLE                              | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |           |           |
| 1.                | CS8651      | Internet Programming                      | PC       | 3               | 3         | 0        | 0         | 3         |
| 2.                | CS8691      | Artificial Intelligence                   | PC       | 3               | 3         | 0        | 0         | 3         |
| 3.                | CS8601      | Mobile Computing                          | PC       | 3               | 3         | 0        | 0         | 3         |
| 4.                | CS8602      | Compiler Design                           | PC       | 5               | 3         | 0        | 2         | 4         |
| 5.                | CS8603      | Distributed Systems                       | PC       | 3               | 3         | 0        | 0         | 3         |
| 6.                |             | Professional Elective I                   | PE       | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |           |           |
| 7.                | CS8661      | Internet Programming Laboratory           | PC       | 4               | 0         | 0        | 4         | 2         |
| 8.                | CS8662      | Mobile Application Development Laboratory | PC       | 4               | 0         | 0        | 4         | 2         |
| 9.                | CS8611      | Mini Project                              | EEC      | 2               | 0         | 0        | 2         | 1         |
| 10.               | HS8581      | Professional Communication                | EEC      | 2               | 0         | 0        | 2         | 1         |
| <b>TOTAL</b>      |             |   |          | <b>32</b>       | <b>18</b> | <b>0</b> | <b>14</b> | <b>25</b> |



### SEMESTER VII

| SI. No            | COURSE CODE | COURSE TITLE                      | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|-----------------------------------|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |                                   |          |                 |           |          |          |           |
| 1.                | MG8591      | Principles of Management          | HS       | 3               | 3         | 0        | 0        | 3         |
| 2.                | CS8792      | Cryptography and Network Security | PC       | 3               | 3         | 0        | 0        | 3         |
| 3.                | CS8791      | Cloud Computing                   | PC       | 3               | 3         | 0        | 0        | 3         |
| 4.                |             | Open Elective II                  | OE       | 3               | 3         | 0        | 0        | 3         |
| 5.                |             | Professional Elective II          | PE       | 3               | 3         | 0        | 0        | 3         |
| 6.                |             | Professional Elective III         | PE       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |                                   |          |                 |           |          |          |           |
| 7.                | CS8711      | Cloud Computing Laboratory        | PC       | 4               | 0         | 0        | 4        | 2         |
| 8.                | IT8761      | Security Laboratory               | PC       | 4               | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>      |             |                                   |          | <b>26</b>       | <b>18</b> | <b>0</b> | <b>8</b> | <b>22</b> |

### SEMESTER VIII

| SI. No            | COURSE CODE | COURSE TITLE             | CATEGORY | CONTACT PERIODS | L        | T        | P         | C         |
|-------------------|-------------|--------------------------|----------|-----------------|----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |                          |          |                 |          |          |           |           |
| 1.                |             | Professional Elective IV | PE       | 3               | 3        | 0        | 0         | 3         |
| 2.                |             | Professional Elective V  | PE       | 3               | 3        | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |                          |          |                 |          |          |           |           |
| 3.                | CS8811      | Project Work             | EEC      | 20              | 0        | 0        | 20        | 10        |
| <b>TOTAL</b>      |             |                          |          | <b>26</b>       | <b>6</b> | <b>0</b> | <b>20</b> | <b>16</b> |

**TOTAL NO. OF CREDITS: 185**

### HUMANITIES AND SOCIAL SCIENCES (HS)

| SI. NO | COURSE CODE | COURSE TITLE                          | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|---------------------------------------|----------|-----------------|---|---|---|---|
| 1.     | HS8151      | Communicative English                 | HS       | 4               | 4 | 0 | 0 | 4 |
| 2.     | HS8251      | Technical English                     | HS       | 4               | 4 | 0 | 0 | 4 |
| 3.     | GE8291      | Environmental Science and Engineering | HS       | 3               | 3 | 0 | 0 | 3 |
| 4.     | MG8591      | Principles of Management              | HS       | 3               | 3 | 0 | 0 | 3 |

### BASIC SCIENCES (BS)

| SI. NO | COURSE CODE | COURSE TITLE                     | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|----------------------------------|----------|-----------------|---|---|---|---|
| 1.     | MA8151      | Engineering Mathematics I        | BS       | 4               | 4 | 0 | 0 | 4 |
| 2.     | PH8151      | Engineering Physics              | BS       | 3               | 3 | 0 | 0 | 3 |
| 3.     | CY8151      | Engineering Chemistry            | BS       | 3               | 3 | 0 | 0 | 3 |
| 4.     | BS8161      | Physics and Chemistry Laboratory | BS       | 4               | 0 | 0 | 4 | 2 |
| 5.     | MA8251      | Engineering Mathematics II       | BS       | 4               | 4 | 0 | 0 | 4 |
| 6.     | PH8252      | Physics for Information Science  | BS       | 3               | 3 | 0 | 0 | 3 |
| 7.     | MA8351      | Discrete Mathematics             | BS       | 4               | 4 | 0 | 0 | 4 |
| 8.     | MA8402      | Probability and Queueing Theory  | BS       | 4               | 4 | 0 | 0 | 4 |
| 9.     | MA8551      | Algebra and Number Theory        | BS       | 4               | 4 | 0 | 0 | 4 |

### ENGINEERING SCIENCES (ES)

| SI. NO | COURSE CODE | COURSE TITLE  | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|---|----------|-----------------|---|---|---|---|
| 1.     | GE8151      | Problem Solving and Python Programming                    | ES       | 3               | 3 | 0 | 0 | 3 |
| 2.     | GE8152      | Engineering Graphics                                      | ES       | 6               | 2 | 0 | 4 | 4 |
| 3.     | GE8161      | Problem Solving and Python Programming Laboratory         | ES       | 4               | 0 | 0 | 4 | 2 |
| 4.     | BE8255      | Basic Electrical, Electronics and Measurement Engineering | ES       | 3               | 3 | 0 | 0 | 3 |
| 5.     | GE8261      | Engineering Practices Laboratory                          | ES       | 4               | 0 | 0 | 4 | 2 |
| 6.     | CS8351      | Digital Principles and System Design                      | ES       | 4               | 4 | 0 | 0 | 4 |
| 7.     | EC8395      | Communication Engineering                                 | ES       | 3               | 3 | 0 | 0 | 3 |
| 8.     | CS8382      | Digital Systems Laboratory                                | ES       | 4               | 0 | 0 | 4 | 2 |

**PROFESSIONAL CORE (PC)**

| SI. NO | COURSE CODE | COURSE TITLE                                    | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|---|----------|-----------------|---|---|---|---|
| 1.     | CS8251      | Programming in C                                | PC       | 3               | 3 | 0 | 0 | 3 |
| 2.     | CS8261      | C Programming Laboratory                        | PC       | 4               | 0 | 0 | 4 | 2 |
| 3.     | CS8391      | Data Structures                                 | PC       | 3               | 3 | 0 | 0 | 3 |
| 4.     | CS8392      | Object Oriented Programming                     | PC       | 3               | 3 | 0 | 0 | 3 |
| 5.     | CS8381      | Data Structures Laboratory                      | PC       | 4               | 0 | 0 | 4 | 2 |
| 6.     | CS8383      | Object Oriented Programming Laboratory          | PC       | 4               | 0 | 0 | 4 | 2 |
| 7.     | CS8491      | Computer Architecture                           | PC       | 3               | 3 | 0 | 0 | 3 |
| 8.     | CS8492      | Database Management Systems                     | PC       | 3               | 3 | 0 | 0 | 3 |
| 9.     | CS8451      | Design and Analysis of Algorithms               | PC       | 3               | 3 | 0 | 0 | 3 |
| 10.    | CS8493      | Operating Systems                               | PC       | 3               | 3 | 0 | 0 | 3 |
| 11.    | CS8494      | Software Engineering                            | PC       | 3               | 3 | 0 | 0 | 3 |
| 12.    | CS8481      | Database Management Systems Laboratory          | PC       | 4               | 0 | 0 | 4 | 2 |
| 13.    | CS8461      | Operating Systems Laboratory                    | PC       | 4               | 0 | 0 | 4 | 2 |
| 14.    | CS8591      | Computer Networks                               | PC       | 3               | 3 | 0 | 0 | 3 |
| 15.    | EC8691      | Microprocessors and Microcontrollers            | PC       | 3               | 3 | 0 | 0 | 3 |
| 16.    | CS8501      | Theory of Computation                           | PC       | 3               | 3 | 0 | 0 | 3 |
| 17.    | CS8592      | Object Oriented Analysis and Design             | PC       | 3               | 3 | 0 | 0 | 3 |
| 18.    | EC8681      | Microprocessors and Microcontrollers Laboratory | PC       | 4               | 0 | 0 | 4 | 2 |
| 19.    | CS8582      | Object Oriented Analysis and Design Laboratory  | PC       | 4               | 0 | 0 | 4 | 2 |
| 20.    | CS8581      | Networks Laboratory                             | PC       | 4               | 0 | 0 | 4 | 2 |
| 21.    | CS8651      | Internet Programming                            | PC       | 3               | 3 | 0 | 0 | 3 |
| 22.    | CS8691      | Artificial Intelligence                         | PC       | 3               | 3 | 0 | 0 | 3 |
| 23.    | CS8601      | Mobile Computing                                | PC       | 3               | 3 | 0 | 0 | 3 |
| 24.    | CS8602      | Compiler Design                                 | PC       | 5               | 3 | 0 | 2 | 4 |
| 25.    | CS8603      | Distributed Systems                             | PC       | 3               | 3 | 0 | 0 | 3 |
| 26.    | CS8661      | Internet Programming Laboratory                 | PC       | 4               | 0 | 0 | 4 | 2 |
| 27.    | CS8662      | Mobile Application Development Laboratory       | PC       | 4               | 0 | 0 | 4 | 2 |
| 28.    | CS8792      | Cryptography and Network Security               | PC       | 3               | 3 | 0 | 0 | 3 |
| 29.    | CS8791      | Cloud Computing                                 | PC       | 3               | 3 | 0 | 0 | 3 |
| 30.    | CS8711      | Cloud Computing Laboratory                      | PC       | 4               | 0 | 0 | 4 | 2 |
| 31.    | IT8761      | Security Laboratory                             | PC       | 4               | 0 | 0 | 4 | 2 |

**PROFESSIONAL ELECTIVES (PE)****SEMESTER VI  
ELECTIVE - I**

| Sl. No | COURSE CODE | COURSE TITLE                     | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|----------------------------------|----------|-----------------|---|---|---|---|
| 1.     | CS8075      | Data Warehousing and Data Mining | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.     | IT8076      | Software Testing                 | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.     | IT8072      | Embedded Systems                 | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.     | CS8072      | Agile Methodologies              | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.     | CS8077      | Graph Theory and Applications-   | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.     | IT8071      | Digital Signal Processing        | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.     | GE8075      | Intellectual Property Rights     | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VII  
ELECTIVE - II**

| Sl. No | COURSE CODE | COURSE TITLE                     | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|----------------------------------|----------|-----------------|---|---|---|---|
| 1.     | CS8091      | Big Data Analytics               | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.     | CS8082      | Machine Learning Techniques      | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.     | CS8092      | Computer Graphics and Multimedia | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.     | IT8075      | Software Project Management      | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.     | CS8081      | Internet of Things               | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.     | IT8074      | Service Oriented Architecture    | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.     | GE8077      | Total Quality Management         | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VII  
ELECTIVE - III**

| Sl. No | COURSE CODE | COURSE TITLE  | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|---|----------|-----------------|---|---|---|---|
| 1.     | CS8083      | Multi-core Architectures and Programming            | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.     | CS8079      | Human Computer Interaction                          | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.     | CS8073      | C# and .Net Programming                             | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.     | CS8088      | Wireless Adhoc and Sensor Networks                  | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.     | CS8071      | Advanced Topics on Databases                        | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.     | GE8072      | Foundation Skills in Integrated Product Development | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.     | GE8074      | Human Rights  | PE       | 3               | 3 | 0 | 0 | 3 |
| 8.     | GE8071      | Disaster Management                                 | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VIII  
ELECTIVE - IV**

| SI. No | COURSE CODE | COURSE TITLE                       | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|------------------------------------|----------|-----------------|---|---|---|---|
| 1.     | EC8093      | Digital Image Processing           | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.     | CS8085      | Social Network Analysis            | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.     | IT8073      | Information Security               | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.     | CS8087      | Software Defined Networks          | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.     | CS8074      | Cyber Forensics                    | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.     | CS8086      | Soft Computing                     | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.     | GE8076      | Professional Ethics in Engineering | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VIII  
ELECTIVE - V**

| SI. No | COURSE CODE | COURSE TITLE                     | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|----------------------------------|----------|-----------------|---|---|---|---|
| 1.     | CS8080      | Information Retrieval Techniques | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.     | CS8078      | Green Computing                  | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.     | CS8076      | GPU Architecture and Programming | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.     | CS8084      | Natural Language Processing      | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.     | CS8001      | Parallel Algorithms              | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.     | IT8077      | Speech Processing                | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.     | GE8073      | Fundamentals of Nanoscience      | PE       | 3               | 3 | 0 | 0 | 3 |

**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

| SI. NO | COURSE CODE | COURSE TITLE                              | CATEGORY | CONTACT PERIODS | L | T | P  | C  |
|--------|-------------|---|----------|-----------------|---|---|----|----|
| 1.     | HS8381      | Interpersonal Skills/Listening & Speaking | EEC      | 2               | 0 | 0 | 2  | 1  |
| 2.     | HS8461      | Advanced Reading and Writing              | EEC      | 2               | 0 | 0 | 2  | 1  |
| 3.     | CS8611      | Mini Project                              | EEC      | 2               | 0 | 0 | 2  | 1  |
| 4.     | HS8581      | Professional Communication                | EEC      | 2               | 0 | 0 | 2  | 1  |
| 5.     | CS8811      | Project Work                              | EEC      | 20              | 0 | 0 | 20 | 10 |

## SUMMARY

| S.NO. | SUBJECT AREA                  | CREDITS AS PER SEMESTER |           |           |           |           |           |           |           | CREDITS TOTAL | Percentage |
|-------|-------------------------------|-------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------------|------------|
|       |                               | I                       | II        | III       | IV        | V         | VI        | VII       | VIII      |               |            |
| 1.    | HS                            | 4                       | 7         |           |           |           |           | 3         |           | 14            | 7.60%      |
| 2.    | BS                            | 12                      | 7         | 4         | 4         | 4         |           |           |           | 31            | 16.8%      |
| 3.    | ES                            | 9                       | 5         | 9         |           |           |           |           |           | 23            | 12.5%      |
| 4.    | PC                            |                         | 5         | 10        | 19        | 18        | 20        | 10        |           | 82            | 44.5%      |
| 5.    | PE                            |                         |           |           |           |           | 3         | 6         | 6         | 15            | 8.15%      |
| 6.    | OE                            |                         |           |           |           | 3         |           | 3         |           | 6             | 3.3%       |
| 7.    | EEC                           |                         |           | 1         | 1         |           | 2         |           | 10        | 14            | 7.65%      |
|       | <b>Total</b>                  | <b>25</b>               | <b>24</b> | <b>24</b> | <b>24</b> | <b>25</b> | <b>25</b> | <b>22</b> | <b>16</b> | <b>185</b>    |            |
| 8.    | <b>Non Credit / Mandatory</b> |                         |           |           |           |           |           |           |           |               |            |

**OBJECTIVES:**

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

**UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 12**

**Reading-** short comprehension passages, practice in skimming-scanning and predicting- **Writing-** completing sentences- - developing hints. **Listening-** short texts- short formal and informal conversations. **Speaking-** introducing oneself - exchanging personal information- **Language development-** Wh- Questions- asking and answering-yes or no questions- parts of speech. **Vocabulary development--** prefixes- suffixes- articles.- count/ uncount nouns.

**UNIT II GENERAL READING AND FREE WRITING 12**

**Reading** - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register- **Writing** – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –**Listening-** telephonic conversations. **Speaking** – sharing information of a personal kind—greeting – taking leave- **Language development** – prepositions, conjunctions **Vocabulary development-** guessing meanings of words in context.

**UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 12**

**Reading-** short texts and longer passages (close reading) **Writing-** understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences **Listening** – listening to longer texts and filling up the table- product description- narratives from different sources. **Speaking-** asking about routine actions and expressing opinions. **Language development-** degrees of comparison- pronouns- direct vs indirect questions- **Vocabulary development** – single word substitutes- adverbs.

**UNIT IV READING AND LANGUAGE DEVELOPMENT 12**

**Reading-** comprehension-reading longer texts- reading different types of texts- magazines **Writing-** letter writing, informal or personal letters-e-mails-conventions of personal email- **Listening-** listening to dialogues or conversations and completing exercises based on them. **Speaking-** speaking about oneself- speaking about one's friend- **Language development-** Tenses- simple present-simple past- present continuous and past continuous- **Vocabulary development-** synonyms-antonyms- phrasal verbs

**UNIT V EXTENDED WRITING****12**

**Reading**- longer texts- close reading –**Writing**- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing-**Listening** – listening to talks- conversations- **Speaking** – participating in conversations- short group conversations-**Language development**-modal verbs- present/ past perfect tense - **Vocabulary development**-collocations- fixed and semi-fixed expressions.

**TOTAL: 60 PERIODS****OUTCOMES:****AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English
- Write short essays of a general kind and personal letters and emails in English.

**TEXT BOOKS:**

1. Board of Editors. **Using English** A Coursebook for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015
2. Richards, C. Jack. **Interchange Students' Book-2** New Delhi: CUP, 2015.

**REFERENCES:**

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means,L. Thomas and Elaine Langlois. English & Communication For Colleges. CengageLearning ,USA: 2007
3. Redston, Chris & Gillies Cunningham Face2Face (Pre-intermediate Student's Book & Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013.

**MA8151****ENGINEERING MATHEMATICS – I**

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**OBJECTIVES :**

The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

**UNIT I DIFFERENTIAL CALCULUS****12**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.



**UNIT II      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 – Lagrange's method of undetermined multipliers.

**UNIT III      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 IV      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.

**UNIT V      DIFFERENTIAL EQUATIONS****12**

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

**TOTAL: 60 PERIODS****OUTCOMES:**

**After completing this course, students should demonstrate competency in the following skills:**

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Apply various techniques in solving differential equations.

**TEXT BOOKS :**

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7<sup>th</sup> Edition, New Delhi, 2015. [For Units I & III - 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].

**REFERENCES:**

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10<sup>th</sup> Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3<sup>rd</sup> Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, "Thomas Calculus", 12<sup>th</sup> Edition, Pearson India, 2016.

**OBJECTIVES:**

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

**UNIT I PROPERTIES OF MATTER 9**

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

**UNIT II WAVES AND FIBER OPTICS 9**

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers - fibre optic sensors: pressure and displacement.

**UNIT III THERMAL PHYSICS 9**

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

**UNIT IV QUANTUM PHYSICS 9**

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunnelling (qualitative) - scanning tunnelling microscope.

**UNIT V CRYSTAL PHYSICS 9**

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

**TOTAL :45 PERIODS****OUTCOMES:****Upon completion of this course,**

- The students will gain knowledge on the basics of properties of matter and its applications,
- The students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- The students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- The students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
- The students will understand the basics of crystals, their structures and different crystal growth techniques.

**TEXT BOOKS:**

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

**REFERENCES:**

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics". W.H. Freeman, 2007.

**CY8151****ENGINEERING CHEMISTRY****L T P C  
3 0 0 3****OBJECTIVES:**

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

**UNIT I WATER AND ITS TREATMENT****9**

Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – numerical problems – boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment – Ion exchange process, zeolite process – desalination of brackish water - Reverse Osmosis.

**UNIT II SURFACE CHEMISTRY AND CATALYSIS****9**

Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – contact theory – kinetics of surface reactions, unimolecular reactions, Langmuir - applications of adsorption on pollution abatement. Catalysis: Catalyst – types of catalysis – criteria – autocatalysis – catalytic poisoning and catalytic promoters - acid base catalysis – applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation.

**UNIT III ALLOYS AND PHASE RULE****9**

Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel. Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.

**UNIT IV FUELS AND COMBUSTION****9**

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel. Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

## **UNIT V ENERGY SOURCES AND STORAGE DEVICES**

**9**

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H<sub>2</sub>-O<sub>2</sub> fuel cell.

**TOTAL: 45 PERIODS**

### **OUTCOMES:**

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

### **TEXT BOOKS:**

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

### **REFERENCES:**

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

**GE8151**

## **PROBLEM SOLVING AND PYTHON PROGRAMMING**

**L T P C**  
**3 0 0 3**

### **OBJECTIVES:**

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures -- lists, tuples, dictionaries.
- To do input/output with files in Python.

## **UNIT I ALGORITHMIC PROBLEM SOLVING**

**9**

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

## **UNIT II DATA, EXPRESSIONS, STATEMENTS**

**9**

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

## **UNIT III CONTROL FLOW, FUNCTIONS**

**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,



dimensioning.

**UNIT I PLANE CURVES AND FREEHAND SKETCHING 7+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12**

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

**UNIT III PROJECTION OF SOLIDS 5+12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

**UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5+12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

**UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6 +12**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

**TOTAL: 90 PERIODS**

**OUTCOMES:**

**On successful completion of this course, the student will be able to:**

- Familiarize with the fundamentals and standards of Engineering graphics
- Perform freehand sketching of basic geometrical constructions and multiple views of objects.
- Project orthographic projections of lines and plane surfaces.
- Draw projections and solids and development of surfaces.
- Visualize and to project isometric and perspective sections of simple solids.

**TEXT BOOKS:**

1. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008.

**REFERENCES:**

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50<sup>th</sup> Edition, 2010.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2007.

4. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N. S. Parthasarathy and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2<sup>nd</sup> Edition, 2009.

**Publication of Bureau of Indian Standards:**

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

**Special points applicable to University Examinations on Engineering Graphics:**

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

**GE8161      PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY      L T P C  
0 0 4 2**

**OBJECTIVES:**

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

**LIST OF PROGRAMS:**

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

**PLATFORM NEEDED**

Python 3 interpreter for Windows/Linux

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**Upon completion of the course, students will be able to:**

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.

- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

**BS8161**

**PHYSICS AND CHEMISTRY LABORATORY**  
(Common to all branches of B.E. / B.Tech Programmes)

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**OBJECTIVES:**

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

**LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)**

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young’s modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser  
(b) Determination of acceptance angle in an optical fiber.
4. Determination of thermal conductivity of a bad conductor – Lee’s Disc method.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire – Air wedge method

**TOTAL: 30 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the students will be able to**

- Apply principles of elasticity, optics and thermal properties for engineering applications.

**CHEMISTRY LABORATORY: (Any seven experiments to be conducted)**

**OBJECTIVES:**

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by viscometry.

1. Estimation of HCl using Na<sub>2</sub>CO<sub>3</sub> as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler’s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Determination of CMC.
15. Phase change in a solid.



16. Conductometric titration of strong acid vs strong base.

**OUTCOMES:**

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

**TOTAL: 30 PERIODS**

**TEXTBOOK:**

1. Vogel's Textbook of Quantitative Chemical Analysis (8<sup>TH</sup> edition, 2014).

**HS8251**

**TECHNICAL ENGLISH**

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**OBJECTIVES:**

**The Course prepares second semester engineering and Technology students to:**

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

**UNIT I INTRODUCTION TECHNICAL ENGLISH 12**

**Listening-** Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- **Speaking** –Asking for and giving directions- **Reading** – reading short technical texts from journals- newspapers- **Writing-** purpose statements – extended definitions – issue- writing instructions – checklists-recommendations-**Vocabulary Development-** technical vocabulary **Language Development** –subject verb agreement - compound words.

**UNIT II READING AND STUDY SKILLS 12**

**Listening-** Listening to longer technical talks and completing exercises based on them-**Speaking** – describing a process-**Reading** – reading longer technical texts- identifying the various transitions in a text- paragraphing- **Writing-** interpreting charts, graphs- **Vocabulary Development-** vocabulary used in formal letters/emails and reports **Language Development-** impersonal passive voice, numerical adjectives.

**UNIT III TECHNICAL WRITING AND GRAMMAR 12**

**Listening-** Listening to classroom lectures/ talks on engineering/technology -**Speaking** – introduction to technical presentations- **Reading** – longer texts both general and technical, practice in speed reading; **Writing-**Describing a process, use of sequence words- **Vocabulary Development-** sequence words- Misspelled words. **Language Development-** embedded sentences

**UNIT IV REPORT WRITING 12**

**Listening-** Listening to documentaries and making notes. **Speaking** – mechanics of presentations- **Reading** – reading for detailed comprehension- **Writing-** email etiquette- job application – cover letter –Résumé preparation( via email and hard copy)- analytical essays and issue based essays--**Vocabulary Development-** finding suitable synonyms-paraphrasing-. **Language Development-** clauses- if conditionals.

**UNIT V GROUP DISCUSSION AND JOB APPLICATIONS****12**

**Listening-** TED/Ink talks; **Speaking** –participating in a group discussion **-Reading–** reading and understanding technical articles **Writing–** Writing reports- minutes of a meeting- accident and survey-**Vocabulary Development- verbal analogies Language Development-** reported speech.

**TOTAL :60 PERIODS****OUTCOMES:****At the end of the course learners will be able to:**

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

**TEXT BOOKS:**

1. Board of editors. **Fluency in English A Course book for Engineering and Technology.** Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. **English for Technical Communication.** Cambridge University Press: New Delhi, 2016.

**REFERENCES:**

1. Raman, Meenakshi and Sharma, Sangeetha- **Technical Communication Principles and Practice.**Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. **Engineering English.** Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, **Project Work,** Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, **English for Presentations,** Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, **English & Communication For Colleges.** Cengage Learning, USA: 2007

**Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading.**

**MA8251****ENGINEERING MATHEMATICS – II**

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**OBJECTIVES:**

This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

**UNIT I MATRICES****12**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

**UNIT II VECTOR CALCULUS****12**

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

**UNIT III ANALYTIC FUNCTIONS 12**

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions  $w = z + c, cz, \frac{1}{z}, z^2$  - Bilinear transformation.

**UNIT IV COMPLEX INTEGRATION 12**

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

**UNIT V LAPLACE TRANSFORMS 12**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

**TOTAL: 60 PERIODS**

**OUTCOMES :**

**After successfully completing the course, the student will have a good understanding of the following topics and their applications:**

- Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
- Gradient, divergence and curl of a vector point function and related identities.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Analytic functions, conformal mapping and complex integration.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

**TEXT BOOKS:**

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10<sup>th</sup> Edition, New Delhi, 2016.

**REFERENCES :**

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7<sup>th</sup> Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3<sup>rd</sup> Edition, 2007.
3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4<sup>th</sup> Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

**PH8252**

**PHYSICS FOR INFORMATION SCIENCE**  
(Common to CSE & IT)

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**OBJECTIVES:**

- To understand the essential principles of Physics of semiconductor device and Electron transport properties. Become proficient in magnetic and optical properties of materials and Nano-electronic devices.

**UNIT I ELECTRICAL PROPERTIES OF MATERIALS 9**

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Wiedemann-Franz law – Success and failures - electrons in metals – Particle in a three dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation - Electron effective mass – concept of hole.

**UNIT II SEMICONDUCTOR PHYSICS 9**

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – variation of Fermi level with temperature and impurity concentration – Carrier transport in Semiconductor: random motion, drift, mobility and diffusion – Hall effect and devices – Ohmic contacts – Schottky diode.

**UNIT III MAGNETIC PROPERTIES OF MATERIALS 9**

Magnetic dipole moment – atomic magnetic moments- magnetic permeability and susceptibility - Magnetic material classification: diamagnetism – paramagnetism – ferromagnetism – antiferromagnetism – ferrimagnetism – Ferromagnetism: origin and exchange interaction-saturation magnetization and Curie temperature – Domain Theory- M versus H behaviour – Hard and soft magnetic materials – examples and uses-- Magnetic principle in computer data storage – Magnetic hard disc (GMR sensor).

**UNIT IV OPTICAL PROPERTIES OF MATERIALS 9**

Classification of optical materials – carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and semiconductors (concepts only) - photo current in a P-N diode – solar cell - LED – Organic LED – Laser diodes – Optical data storage techniques.

**UNIT V NANO DEVICES 9**

Electron density in bulk material – Size dependence of Fermi energy – Quantum confinement – Quantum structures – Density of states in quantum well, quantum wire and quantum dot structure - Band gap of nanomaterials – Tunneling: single electron phenomena and single electron transistor – Quantum dot laser. Conductivity of metallic nanowires – Ballistic transport – Quantum resistance and conductance – Carbon nanotubes: Properties and applications .

**TOTAL :45 PERIODS**

**OUTCOMES:**

**At the end of the course, the students will be able to**

- Gain knowledge on classical and quantum electron theories, and energy band structures,
- Acquire knowledge on basics of semiconductor physics and its applications in various devices,
- Get knowledge on magnetic properties of materials and their applications in data storage,
- Have the necessary understanding on the functioning of optical materials for optoelectronics,
- Understand the basics of quantum structures and their applications in carbon electronics..

**TEXT BOOKS:**

1. Jasprit Singh, “Semiconductor Devices: Basic Principles”, Wiley 2012.
2. Kasap, S.O. “Principles of Electronic Materials and Devices”, McGraw-Hill Education, 2007.
3. Kittel, C. “Introduction to Solid State Physics”. Wiley, 2005.

## REFERENCES:

1. Garcia, N. & Damask, A. "Physics for Computer Science Students". Springer-Verlag, 2012.
2. Hanson, G.W. "Fundamentals of Nanoelectronics". Pearson Education, 2009.
3. Rogers, B., Adams, J. & Pennathur, S. "Nanotechnology: Understanding Small Systems". CRC Press, 2014.

**BE8255**

**BASIC ELECTRICAL, ELECTRONICS AND MEASUREMENT  
ENGINEERING**

**L T P C  
3 0 0 3**

## OBJECTIVES:

- To understand the fundamentals of electronic circuit constructions.
- To learn the fundamental laws, theorems of electrical circuits and also to analyze them
- To study the basic principles of electrical machines and their performance
- To study the different energy sources, protective devices and their field applications
- To understand the principles and operation of measuring instruments and transducers

### **UNIT I ELECTRICAL CIRCUITS ANALYSIS**

**9**

Ohms Law, Kirchhoff's Law-Instantaneous power- series and parallel circuit analysis with resistive, capacitive and inductive network - nodal analysis, mesh analysis- network theorems - Thevenins theorem, Norton theorem, maximum power transfer theorem and superposition theorem, three phase supply-Instantaneous, Reactive and apparent power-star delta conversion.

### **UNIT II ELECTRICAL MACHINES**

**9**

DC and AC ROTATING MACHINES:Types, Construction, principle, Emf and torque equation, application Speed Control- Basics of Stepper Motor – Brushless DC motors- Transformers-Introduction- types and construction, working principle of Ideal transformer-Emf equation- All day efficiency calculation.

### **UNIT III UTILIZATION OF ELECTRICAL POWER**

**9**

Renewable energy sources-wind and solar panels. Illumination by lamps- Sodium Vapour, Mercury vapour, Fluorescent tube. Domestic refrigerator and air conditioner-Electric circuit, construction and working principle. Batteries-NiCd, Pb Acid and Li ion-Charge and Discharge Characteristics. Protection-need for earthing, fuses and circuit breakers.Energy Tariff calculation for domestic loads.

### **UNIT IV ELECTRONIC CIRCUITS**

**9**

PN Junction-VI Characteristics of Diode, zener diode, Transistors configurations - amplifiers. Op amps- Amplifiers, oscillator,rectifiers, differentiator, integrator, ADC, DAC. Multi vibrator using 555 Timer IC . Voltage regulator IC using LM 723,LM 317.

### **UNIT V ELECTRICAL MEASUREMENT**

**9**

Characteristic of measurement-errors in measurement, torque in indicating instruments- moving coil and moving iron meters, Energy meter and watt meter. Transducers- classification-thermo electric, RTD, Strain gauge, LVDT, LDR and piezoelectric. Oscilloscope-CRO.

**TOTAL: 45 PERIODS**

## OUTCOMES:

**Upon completion of the course, the students will be able to:**

- Discuss the essentials of electric circuits and analysis.
- Discuss the basic operation of electric machines and transformers
- Introduction of renewable sources and common domestic loads.
- Introduction to measurement and metering for electric circuits.

**TEXT BOOKS:**

1. D.P. Kotharti and I.J. Nagarath, Basic Electrical and Electronics Engineering, Mc Graw Hill, 2016, Third Edition.
2. M.S. Sukhija and T.K. Nagsarkar, Basic Electrical and Electronic Engineering, Oxford, 2016.

**REFERENCES:**

1. S.B. Lal Seksen and Kaustuv Dasgupta, Fundamentals of Electrical Engineering, Cambridge, 2016
2. B.L. Theraja, Fundamentals of Electrical Engineering and Electronics. Chand & Co, 2008.
3. S.K. Sahdev, Basic of Electrical Engineering, Pearson, 2015
4. John Bird, —Electrical and Electronic Principles and Technology, Fourth Edition, Elsevier, 2010.
5. Mittle, Mittal, Basic Electrical Engineering, 2nd Edition, Tata McGraw-Hill Edition, 2016.
6. C.L. Wadhwa, "Generation, Distribution and Utilisation of Electrical Energy", New Age international pvt.ltd., 2003.

**GE8291****ENVIRONMENTAL SCIENCE AND ENGINEERING****L T P C  
3 0 0 3****OBJECTIVES:**

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

**UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY****14**

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

**UNIT II ENVIRONMENTAL POLLUTION****8**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

### **UNIT III NATURAL RESOURCES**

**10**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

### **UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT**

**7**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

### **UNIT V HUMAN POPULATION AND THE ENVIRONMENT**

**6**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

**TOTAL: 45 PERIODS**

#### **OUTCOMES:**

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

#### **TEXTBOOKS:**

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2<sup>nd</sup> edition, Pearson Education, 2004.

#### **REFERENCES :**

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hyderabad, 2015.
3. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
4. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.





3. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009.
4. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
5. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.

**GE8261**

**ENGINEERING PRACTICES LABORATORY**

**L T P C  
0 0 4 2**

**OBJECTIVES:**

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

**GROUP A (CIVIL & MECHANICAL)**

**I CIVIL ENGINEERING PRACTICE**

**13**

**BUILDINGS:**

- (a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

**PLUMBING WORKS:**

- (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
- (b) Study of pipe connections requirements for pumps and turbines.
- (c) Preparation of plumbing line sketches for water supply and sewage works.
- (d) Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

- (e) Demonstration of plumbing requirements of high-rise buildings.

**CARPENTRY USING POWER TOOLS ONLY:**

- (a) Study of the joints in roofs, doors, windows and furniture.
- (b) Hands-on-exercise:  
Wood work, joints by sawing, planing and cutting.

**II MECHANICAL ENGINEERING PRACTICE**

**18**

**WELDING:**

- (a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
- (b) Gas welding practice

**BASIC MACHINING:**

- (a) Simple Turning and Taper turning
- (b) Drilling Practice

**SHEET METAL WORK:**

- (a) Forming & Bending:
- (b) Model making – Trays and funnels.
- (c) Different type of joints.

**MACHINE ASSEMBLY PRACTICE:**

- (a) Study of centrifugal pump

- (b) Study of air conditioner

**DEMONSTRATION ON:**

- (a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
- (b) Foundry operations like mould preparation for gear and step cone pulley.
- (c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

**GROUP B (ELECTRICAL & ELECTRONICS)**

**III ELECTRICAL ENGINEERING PRACTICE 13**

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

**IV ELECTRONICS ENGINEERING PRACTICE 16**

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**On successful completion of this course, the student will be able to**

- Fabricate carpentry components and pipe connections including plumbing works.
- Use welding equipments to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundry and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

**CIVIL**

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. 15 Sets.
2. Carpentry vice (fitted to work bench) 15 Nos.
3. Standard woodworking tools 15 Sets.
4. Models of industrial trusses, door joints, furniture joints 5 each
5. Power Tools: (a) Rotary Hammer 2 Nos
- (b) Demolition Hammer 2 Nos
- (c) Circular Saw 2 Nos
- (d) Planer 2 Nos
- (e) Hand Drilling Machine 2 Nos
- (f) Jigsaw 2 Nos

**MECHANICAL**

1. Arc welding transformer with cables and holders 5 Nos.

- |   |           |
|---|-----------|
| 2. Welding booth with exhaust facility  | 5 Nos.    |
| 3. Welding accessories like welding shield, chipping hammer, wire brush, etc. | 5 Sets.   |
| 4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.    | 2 Nos.    |
| 5. Centre lathe   | 2 Nos.    |
| 6. Hearth furnace, anvil and smithy tools                                     | 2 Sets.   |
| 7. Moulding table, foundry tools  | 2 Sets.   |
| 8. Power Tool: Angle Grinder  | 2 Nos     |
| 9. Study-purpose items: centrifugal pump, air-conditioner                     | One each. |

### **ELECTRICAL**

- |   |         |
|---|---------|
| 1. Assorted electrical components for house wiring                  | 15 Sets |
| 2. Electrical measuring instruments                                 | 10 Sets |
| 3. Study purpose items: Iron box, fan and regulator, emergency lamp | 1 each  |
| 4. Megger (250V/500V)   | 1 No.   |
| 5. Power Tools: (a) Range Finder                                    | 2 Nos   |
| (b) Digital Live-wire detector                                      | 2 Nos   |

### **ELECTRONICS**

- |   |         |
|---|---------|
| 1. Soldering guns   | 10 Nos. |
| 2. Assorted electronic components for making circuits                 | 50 Nos. |
| 3. Small PCBs   | 10 Nos. |
| 4. Multimeters  | 10 Nos. |
| 5. Study purpose items: Telephone, FM radio, low-voltage power supply |         |

**CS8261**

**C PROGRAMMING LABORATORY**

**L T P C  
0 0 4 2**

#### **OBJECTIVES:**

- To develop programs in C using basic constructs.
- To develop applications in C using strings, pointers, functions, structures.
- To develop applications in C using file processing.

#### **LIST OF EXPERIMENTS:**

1. Programs using I/O statements and expressions.
2. Programs using decision-making constructs.
3. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
4. Design a calculator to perform the operations, namely, addition, subtraction, multiplication, division and square of a number.
5. Check whether a given number is Armstrong number or not?
6. Given a set of numbers like <10, 36, 54, 89, 12, 27>, find sum of weights based on the following conditions.
  - 5 if it is a perfect cube.
  - 4 if it is a multiple of 4 and divisible by 6.
  - 3 if it is a prime number.

Sort the numbers based on the weight in the increasing order as shown below  
<10,its weight>,<36,its weight><89,its weight>

7. Populate an array with height of persons and find how many persons are above the average height.
8. Populate a two dimensional array with height and weight of persons and compute the Body Mass Index of the individuals.
9. Given a string "a\$bcd.fg" find its reverse without changing the position of special characters.  
(Example input:a@gh%;j and output:j@hg%;a)

10. Convert the given decimal number into binary, octal and hexadecimal numbers using user defined functions.
11. From a given paragraph perform the following using built-in functions:
  - a. Find the total number of words.
  - b. Capitalize the first word of each sentence.
  - c. Replace a given word with another word.
12. Solve towers of Hanoi using recursion.
13. Sort the list of numbers using pass by reference.
14. Generate salary slip of employees using structures and pointers.
15. Compute internal marks of students for five different subjects using structures and functions.
16. Insert, update, delete and append telephone details of an individual or a company into a telephone directory using random access file.
17. Count the number of account holders whose balance is less than the minimum balance using sequential access file.

#### Mini project

18. Create a "Railway reservation system" with the following modules
  - Booking
  - Availability checking
  - Cancellation
  - Prepare chart

**TOTAL: 60 PERIODS**

#### OUTCOMES:

**Upon completion of the course, the students will be able to:**

- Develop C programs for simple applications making use of basic constructs, arrays and strings.
- Develop C programs involving functions, recursion, pointers, and structures.
- Design applications using sequential and random access file processing.

**MA8351**

**DISCRETE MATHEMATICS**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

#### OBJECTIVES:

- To extend student's logical and mathematical maturity and ability to deal with abstraction.
- To introduce most of the basic terminologies used in computer science courses and application of ideas to solve practical problems.
- To understand the basic concepts of combinatorics and graph theory.
- To familiarize the applications of algebraic structures.
- To understand the concepts and significance of lattices and boolean algebra which are widely used in computer science and engineering.

#### **UNIT I      LOGIC AND PROOFS**

**12**

Propositional logic – Propositional equivalences - Predicates and quantifiers – Nested quantifiers – Rules of inference - Introduction to proofs – Proof methods and strategy.

#### **UNIT II      COMBINATORICS**

**12**

Mathematical induction – Strong induction and well ordering – The basics of counting – The pigeonhole principle – Permutations and combinations – Recurrence relations – Solving linear recurrence relations – Generating functions – Inclusion and exclusion principle and its applications

#### **UNIT III      GRAPHS**

**12**

Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.

**UNIT IV ALGEBRAIC STRUCTURES****12**

Algebraic systems – Semi groups and monoids - Groups – Subgroups – Homomorphism's – Normal subgroup and cosets – Lagrange's theorem – Definitions and examples of Rings and Fields.

**UNIT V LATTICES AND BOOLEAN ALGEBRA****12**

Partial ordering – Posets – Lattices as posets – Properties of lattices - Lattices as algebraic systems – Sub lattices – Direct product and homomorphism – Some special lattices – Boolean algebra.

**TOTAL: 60 PERIODS****OUTCOMES:****At the end of the course, students would:**

- Have knowledge of the concepts needed to test the logic of a program.
- Have an understanding in identifying structures on many levels.
- Be aware of a class of functions which transform a finite set into another finite set which relates to input and output functions in computer science.
- Be aware of the counting principles.
- Be exposed to concepts and properties of algebraic structures such as groups, rings and fields.

**TEXTBOOKS:**

1. Rosen, K.H., "Discrete Mathematics and its Applications", 7<sup>th</sup> Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2011.
2. Tremblay, J.P. and Manohar.R, " Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30<sup>th</sup> Reprint, 2011.

**REFERENCES:**

1. Grimaldi, R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 4<sup>th</sup> Edition, Pearson Education Asia, Delhi, 2007.
2. Lipschutz, S. and Mark Lipson., "Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3<sup>rd</sup> Edition, 2010.
3. Koshy, T. "Discrete Mathematics with Applications", Elsevier Publications, 2006.

**CS8351****DIGITAL PRINCIPLES AND SYSTEM DESIGN**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

**OBJECTIVES:**

- To design digital circuits using simplified Boolean functions
- To analyze and design combinational circuits
- To analyze and design synchronous and asynchronous sequential circuits
- To understand Programmable Logic Devices
- To write HDL code for combinational and sequential circuits

**UNIT I BOOLEAN ALGEBRA AND LOGIC GATES****12**

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 II COMBINATIONAL LOGIC****12**

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.





interfaces - Object cloning -inner classes, Array Lists - Strings

**UNIT III EXCEPTION HANDLING AND I/O 9**

Exceptions - exception hierarchy - throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files

**UNIT IV MULTITHREADING AND GENERIC PROGRAMMING 8**

Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups. Generic Programming – Generic classes – generic methods – Bounded Types – Restrictions and Limitations.

**UNIT V EVENT DRIVEN PROGRAMMING 9**

Graphics programming - Frame – Components - working with 2D shapes - Using color, fonts, and images - Basics of event handling - event handlers - adapter classes - actions - mouse events - AWT event hierarchy - Introduction to Swing – layout management - Swing Components – Text Fields , Text Areas – Buttons- Check Boxes – Radio Buttons – Lists- choices- Scrollbars – Windows –Menus – Dialog Boxes.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, students will be able to:**

- Develop Java programs using OOP principles
- Develop Java programs with the concepts inheritance and interfaces
- Build Java applications using exceptions and I/O streams
- Develop Java applications with threads and generics classes
- Develop interactive Java programs using swings

**TEXT BOOKS:**

1. Herbert Schildt, “Java The complete reference”, 8<sup>th</sup> Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, “Core Java Volume –I Fundamentals”, 9<sup>th</sup> Edition, Prentice Hall, 2013.

**REFERENCES:**

1. Paul Deitel, Harvey Deitel, “Java SE 8 for programmers”, 3<sup>rd</sup> Edition, Pearson, 2015.
2. Steven Holzner, “Java 2 Black book”, Dreamtech press, 2011.
3. Timothy Budd, “Understanding Object-oriented programming with Java”, Updated Edition, Pearson Education, 2000.

**EC8395**

**COMMUNICATION ENGINEERING**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study the various analog and digital modulation techniques
- To study the principles behind information theory and coding
- To study the various digital communication techniques

**UNIT I ANALOG MODULATION 9**

Amplitude Modulation – AM, DSBSC, SSBSC, VSB – PSD, modulators and demodulators – Angle modulation – PM and FM – PSD, modulators and demodulators – Superheterodyne receivers



**UNIT II PULSE MODULATION 9**  
Low pass sampling theorem – Quantization – PAM – Line coding – PCM, DPCM, DM, and ADPCM And ADM, Channel Vocoder - Time Division Multiplexing, Frequency Division Multiplexing

**UNIT III DIGITAL MODULATION AND TRANSMISSION 9**  
Phase shift keying – BPSK, DPSK, QPSK – Principles of M-ary signaling M-ary PSK & QAM – Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers

**UNIT IV INFORMATION THEORY AND CODING 9**  
Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding, LZ Coding – Channel capacity – Shannon-Hartley law – Shannon's limit – Error control codes – Cyclic codes, Syndrome calculation – Convolution Coding, Sequential and Viterbi decoding

**UNIT V SPREAD SPECTRUM AND MULTIPLE ACCESS 9**  
PN sequences – properties – m-sequence – DSSS – Processing gain, Jamming – FHSS – Synchronisation and tracking – Multiple Access – FDMA, TDMA, CDMA,

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Apply analog and digital communication techniques.
- Use data and pulse communication techniques.
- Analyze Source and Error control coding.

**TEXT BOOKS:**

1. H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007
2. S. Haykin "Digital Communications" John Wiley 2005

**REFERENCES:**

1. B.P.Lathi, "Modern Digital and Analog Communication Systems", 3<sup>rd</sup> edition, Oxford University Press, 2007
2. H P Hsu, Schaum Outline Series – "Analog and Digital Communications" TMH 2006
3. B.Sklar, Digital Communications Fundamentals and Applications" 2/e Pearson Education 2007.

**CS8381**

**DATA STRUCTURES LABORATORY**

**L T P C  
0 0 4 2**

**OBJECTIVES**

- To implement linear and non-linear data structures
  - To understand the different operations of search trees
  - To implement graph traversal algorithms
  - To get familiarized to sorting and searching algorithms
1. Array implementation of Stack and Queue ADTs
  2. Array implementation of List ADT
  3. Linked list implementation of List, Stack and Queue ADTs
  4. Applications of List, Stack and Queue ADTs
  5. Implementation of Binary Trees and operations of Binary Trees
  6. Implementation of Binary Search Trees
  7. Implementation of AVL Trees
  8. Implementation of Heaps using Priority Queues.

9. Graph representation and Traversal algorithms
10. Applications of Graphs
11. Implementation of searching and sorting algorithms
12. Hashing – any two collision techniques

**TOTAL: 60 PERIODS**

### **OUTCOMES:**

**At the end of the course, the students will be able to:**

- Write functions to implement linear and non-linear data structure operations
- Suggest appropriate linear / non-linear data structure operations for solving a given problem
- Appropriately use the linear / non-linear data structure operations for a given problem
- Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval

**CS8383**

**OBJECT ORIENTED PROGRAMMING LABORATORY**

**L T P C  
0 0 4 2**

### **OBJECTIVES**

- To build software development skills using java programming for real-world applications.
- To understand and apply the concepts of classes, packages, interfaces, arraylist, exception handling and file processing.
- To develop applications using generic programming and event handling.

### **LIST OF EXPERIMENTS**

1. Develop a Java application to generate Electricity bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection (i.e domestic or commercial). Compute the bill amount using the following tariff.

If the type of the EB connection is domestic, calculate the amount to be paid as follows:

- First 100 units - Rs. 1 per unit
- 101-200 units - Rs. 2.50 per unit
- 201 -500 units - Rs. 4 per unit
- > 501 units - Rs. 6 per unit

If the type of the EB connection is commercial, calculate the amount to be paid as follows:

- First 100 units - Rs. 2 per unit
- 101-200 units - Rs. 4.50 per unit
- 201 -500 units - Rs. 6 per unit
- > 501 units - Rs. 7 per unit

2. Develop a java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa) , time converter (hours to minutes, seconds and vice versa) using packages.
3. Develop a java application with Employee class with Emp\_name, Emp\_id, Address, Mail\_id, Mobile\_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.
4. Design a Java interface for ADT Stack. Implement this interface using array. Provide necessary exception handling in both the implementations.

5. Write a program to perform string operations using ArrayList. Write functions for the following
  - a. Append - add at end
  - b. Insert – add at particular index
  - c. Search
  - d. List all string starts with given letter
6. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape.
7. Write a Java program to implement user defined exception handling.
8. Write a Java program that reads a file name from the user, displays information about whether the file exists, whether the file is readable, or writable, the type of file and the length of the file in bytes.
9. Write a java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.
10. Write a java program to find the maximum value from the given type of elements using a generic function.
11. Design a calculator using event-driven programming paradigm of Java with the following options.
  - a) Decimal manipulations
  - b) Scientific manipulations
12. Develop a mini project for any application using Java concepts.

**TOTAL : 60 PERIODS**

### **OUTCOMES**

**Upon completion of the course, the students will be able to**

- Develop and implement Java programs for simple applications that make use of classes, packages and interfaces.
- Develop and implement Java programs with arraylist, exception handling and multithreading .
- Design applications using file processing, generic programming and event handling.

**CS8382**

**DIGITAL SYSTEMS LABORATORY**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>0</b> | <b>0</b> | <b>4</b> | <b>2</b> |

### **OBJECTIVES:**

- To understand the various basic logic gates
- To design and implement the various combinational circuits
- To design and implement combinational circuits using MSI devices.
- To design and implement sequential circuits
- To understand and code with HDL programming

### **LIST OF EXPERIMENTS**

1. Verification of Boolean Theorems using basic gates.
2. Design and implementation of combinational circuits using basic gates for arbitrary

- functions, code converters.
3. Design and implement Half/Full Adder and Subtractor.
  4. Design and implement combinational circuits using MSI devices:
    - 4 – bit binary adder / subtractor
    - Parity generator / checker
    - Magnitude Comparator
    - Application using multiplexers
  5. Design and implement shift-registers.
  6. Design and implement synchronous counters.
  7. Design and implement asynchronous counters.
  8. Coding combinational circuits using HDL.
  9. Coding sequential circuits using HDL.
  10. Design and implementation of a simple digital system (Mini Project).

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**Upon Completion of the course, the students will be able to:**

- Implement simplified combinational circuits using basic logic gates
- Implement combinational circuits using MSI devices
- Implement sequential circuits like registers and counters
- Simulate combinational and sequential circuits using HDL

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

**LABORATORY REQUIREMENT FOR BATCH OF 30 STUDENTS HARDWARE:**

1. Digital trainer kits - 30
2. Digital ICs required for the experiments in sufficient numbers

**SOFTWARE:**

1. HDL simulator.

|               |  | L        | T        | P        | C        |
|---------------|--|----------|----------|----------|----------|
| <b>HS8381</b> | <b>INTERPERSONAL SKILLS/LISTENING&amp;SPEAKING</b> | <b>0</b> | <b>0</b> | <b>2</b> | <b>1</b> |

**OBJECTIVES:**

**The Course will enable learners to:**

- Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities.
- improve general and academic listening skills
- Make effective presentations.

**UNIT I**

Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.

**UNIT II**

Listen to a process information- give information, as part of a simple explanation - conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.

### UNIT III

Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist- listen for detail

### UNIT IV

Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures conversational speech listening to and participating in conversations - persuade.

### UNIT V

Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.

**TOTAL :30PERIODS**

### OUTCOMES:

**At the end of the course Learners will be able to:**

- Listen and respond appropriately.
- Participate in group discussions
- Make effective presentations
- Participate confidently and appropriately in conversations both formal and informal

### TEXT BOOKS:

1. Brooks, Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.
2. Richards, C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010

### REFERENCES:

1. Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
3. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.
4. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
5. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014

**MA8402**

**PROBABILITY AND QUEUING THEORY**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |

### OBJECTIVES:

- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in IT fields.
- To understand the concept of queueing models and apply in engineering.
- To understand the significance of advanced queueing models.
- To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.

|  |   |           |
|--|---|-----------|
| <b>UNIT I</b>  | <b>PROBABILITY AND RANDOM VARIABLES</b>   | <b>12</b> |
| Probability – Axioms of probability – Conditional probability – Baye’s theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions. |   |           |
| <b>UNIT II</b>   | <b>TWO - DIMENSIONAL RANDOM VARIABLES</b> | <b>12</b> |
| 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).       |   |           |
| <b>UNIT III</b>  | <b>RANDOM PROCESSES</b>                   | <b>12</b> |
| Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.  |   |           |
| <b>UNIT IV</b>   | <b>QUEUEING MODELS</b>                    | <b>12</b> |
| Markovian queues – Birth and death processes – Single and multiple server queueing models – Little’s formula - Queues with finite waiting rooms – Queues with impatient customers : Balking and renegeing.                                       |   |           |
| <b>UNIT V</b>  | <b>ADVANCED QUEUEING MODELS</b>           | <b>12</b> |
| Finite source models - M/G/1 queue – Pollaczek Khinchin formula - M/D/1 and M/E <sub>k</sub> /1 as special cases – Series queues – Open Jackson networks.  |   |           |

**TOTAL : 60 PERIODS**

**OUTCOMES:**

**Upon successful completion of the course, students should be able to:**

- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept of random processes in engineering disciplines.
- Acquire skills in analyzing queueing models.
- Understand and characterize phenomenon which evolve with respect to time in a probabilistic manner

**TEXTBOOKS:**

1. Gross, D., Shortle, J.F, Thompson, J.M and Harris. C.M., “Fundamentals of Queueing Theory”, Wiley Student 4<sup>th</sup> Edition, 2014.
2. Ibe, O.C., “Fundamentals of Applied Probability and Random Processes”, Elsevier, 1<sup>st</sup> Indian Reprint, 2007.

**REFERENCES :**

1. Hwei Hsu, "Schaum’s Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004.
2. Taha, H.A., "Operations Research", 9<sup>th</sup> Edition, Pearson India Education Services, Delhi, 2016.
3. Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2<sup>nd</sup> Edition, John Wiley and Sons, 2002.
4. Yates, R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2<sup>nd</sup> Edition, Wiley India Pvt. Ltd., Bangalore, 2012.

**OBJECTIVES:**

- To learn the basic structure and operations of a computer.
- To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit.
- To learn the basics of pipelined execution.
- To understand parallelism and multi-core processors.
- To understand the memory hierarchies, cache memories and virtual memories.
- To learn the different ways of communication with I/O devices.

**UNIT I BASIC STRUCTURE OF A COMPUTER SYSTEM 9**

Functional Units – Basic Operational Concepts – Performance – Instructions: Language of the Computer – Operations, Operands – Instruction representation – Logical operations – decision making – MIPS Addressing.

**UNIT II ARITHMETIC FOR COMPUTERS 9**

Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations – Subword Parallelism

**UNIT III PROCESSOR AND CONTROL UNIT 9**

A Basic MIPS implementation – Building a Datapath – Control Implementation Scheme – Pipelining – Pipelined datapath and control – Handling Data Hazards & Control Hazards – Exceptions.

**UNIT IV PARALLELISIM 9**

Parallel processing challenges – Flynn’s classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures - Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.

**UNIT V MEMORY & I/O SYSTEMS 9**

Memory Hierarchy - memory technologies – cache memory – measuring and improving cache performance – virtual memory, TLB’s – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits - USB.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**On Completion of the course, the students should be able to:**

- Understand the basics structure of computers, operations and instructions.
- Design arithmetic and logic unit.
- Understand pipelined execution and design control unit.
- Understand parallel processing architectures.
- Understand the various memory systems and I/O communication.

**TEXT BOOKS:**

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012.

**REFERENCES:**

1. William Stallings, Computer Organization and Architecture – Designing for Performance, Eighth Edition, Pearson Education, 2010.
2. John P. Hayes, Computer Architecture and Organization, Third Edition, Tata

- McGraw Hill, 2012.
- John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.

**CS8492**

**DATABASE MANAGEMENT SYSTEMS**

**L T P C  
3 0 0 3**

**OBJECTIVES**

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study SQL and relational database design.
- To understand the internal storage structures using different file and indexing techniques which will help in physical DB design.
- To understand the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures.
- To have an introductory knowledge about the Storage and Query processing Techniques

**UNIT I RELATIONAL DATABASES**

**10**

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL

**UNIT II DATABASE DESIGN**

**8**

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form

**UNIT III TRANSACTIONS**

**9**

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery - Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.

**UNIT IV IMPLEMENTATION TECHNIQUES**

**9**

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Algorithms for SELECT and JOIN operations – Query optimization using Heuristics and Cost Estimation.

**UNIT V ADVANCED TOPICS**

**9**

Distributed Databases: Architecture, Data Storage, Transaction Processing – Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL - XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery – Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the students will be able to:**

- Classify the modern and futuristic database applications based on size and complexity
- Map ER model to Relational model to perform database design effectively
- Write queries using normalization criteria and optimize queries
- Compare and contrast various indexing strategies in different database systems
- Appraise how advanced databases differ from traditional databases.



**TEXT BOOKS:**

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill, 2011.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Sixth Edition, Pearson Education, 2011.

**REFERENCES:**

1. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
2. Raghu Ramakrishnan, —Database Management SystemsII, Fourth Edition, McGraw-Hill College Publications, 2015.
3. G.K.Gupta, "Database Management Systems", Tata McGraw Hill, 2011.

**CS8451****DESIGN AND ANALYSIS OF ALGORITHMS****L T P C  
3 0 0 3****OBJECTIVES:**

- To understand and apply the algorithm analysis techniques.
- To critically analyze the efficiency of alternative algorithmic solutions for the same problem
- To understand different algorithm design techniques.
- To understand the limitations of Algorithmic power.

**UNIT I INTRODUCTION****9**

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – Fundamentals of the Analysis of Algorithmic Efficiency –Asymptotic Notations and their properties. Analysis Framework – Empirical analysis - Mathematical analysis for Recursive and Non-recursive algorithms - Visualization

**UNIT II BRUTE FORCE AND DIVIDE-AND-CONQUER****9**

Brute Force – Computing  $a^n$  – String Matching - Closest-Pair and Convex-Hull Problems - Exhaustive Search - Travelling Salesman Problem - Knapsack Problem - Assignment problem. Divide and Conquer Methodology – Binary Search – Merge sort – Quick sort – Heap Sort - Multiplication of Large Integers – Closest-Pair and Convex - Hull Problems.

**UNIT III DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE****9**

Dynamic programming – Principle of optimality - Coin changing problem, Computing a Binomial Coefficient – Floyd's algorithm – Multi stage graph - Optimal Binary Search Trees – Knapsack Problem and Memory functions.

Greedy Technique – Container loading problem - Prim's algorithm and Kruskal's Algorithm – 0/1 Knapsack problem, Optimal Merge pattern - Huffman Trees.

**UNIT IV ITERATIVE IMPROVEMENT****9**

The Simplex Method - The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs, Stable marriage Problem.

**UNIT V COPING WITH THE LIMITATIONS OF ALGORITHM POWER****9**

Lower - Bound Arguments - P, NP NP- Complete and NP Hard Problems. Backtracking – n-Queen problem - Hamiltonian Circuit Problem – Subset Sum Problem. Branch and Bound – LIFO Search and FIFO search - Assignment problem – Knapsack Problem – Travelling Salesman Problem - Approximation Algorithms for NP-Hard Problems – Travelling Salesman problem – Knapsack problem.

**TOTAL: 45 PERIODS**

**OUTCOMES:****At the end of the course, the students should be able to:**

- Design algorithms for various computing problems.
- Analyze the time and space complexity of algorithms.
- Critically analyze the different algorithm design techniques for a given problem.
- Modify existing algorithms to improve efficiency.

**TEXT BOOKS:**

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2007.

**REFERENCES:**

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.
3. Harsh Bhasin, "Algorithms Design and Analysis", Oxford university press, 2016.
4. S. Sridhar, "Design and Analysis of Algorithms", Oxford university press, 2014.
5. <http://nptel.ac.in/>

**CS8493****OPERATING SYSTEMS****L T P C  
3 0 0 3****OBJECTIVES:**

- To understand the basic concepts and functions of operating systems.
- To understand Processes and Threads
- To analyze Scheduling algorithms.
- To understand the concept of Deadlocks.
- To analyze various memory management schemes.
- To understand I/O management and File systems.
- To be familiar with the basics of Linux system and Mobile OS like iOS and Android.

**UNIT I OPERATING SYSTEM OVERVIEW****7**

Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of Operating System.- Computer System Organization Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.

**UNIT II PROCESS MANAGEMENT****11**

Processes - Process Concept, Process Scheduling, Operations on Processes, Inter-process Communication; CPU Scheduling - Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling, Real time scheduling; Threads- Overview, Multithreading models, Threading issues; Process Synchronization - The critical-section problem, Synchronization hardware, Mutex locks, Semaphores, Classic problems of synchronization, Critical regions, Monitors; Deadlock - System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

**UNIT III STORAGE MANAGEMENT****9**

Main Memory – Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, 32 and 64 bit architecture Examples; Virtual Memory – Background,

Demand Paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.

**UNIT IV FILE SYSTEMS AND I/O SYSTEMS 9**

Mass Storage system – Overview of Mass Storage Structure, Disk Structure, Disk Scheduling and Management, swap space management; File-System Interface - File concept, Access methods, Directory Structure, Directory organization, File system mounting, File Sharing and Protection; File System Implementation- File System Structure, Directory implementation, Allocation Methods, Free Space Management, Efficiency and Performance, Recovery; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem, Streams, Performance.

**UNIT V CASE STUDY 9**

Linux System - Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, Input-Output Management, File System, Inter-process Communication; Mobile OS - iOS and Android - Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer, File System.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the students should be able to:**

- Analyze various scheduling algorithms.
- Understand deadlock, prevention and avoidance algorithms.
- Compare and contrast various memory management schemes.
- Understand the functionality of file systems.
- Perform administrative tasks on Linux Servers.
- Compare iOS and Android Operating Systems.

**TEXT BOOK :**

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9<sup>th</sup> Edition, John Wiley and Sons Inc., 2012.

**REFERENCES :**

1. Ramaz Elmasri, A. Gil Carrick, David Levine, "Operating Systems – A Spiral Approach", Tata McGraw Hill Edition, 2010.
2. Achyut S.Godbole, Atul Kahate, "Operating Systems", McGraw Hill Education, 2016.
3. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Pearson Education, 2004.
4. Gary Nutt, "Operating Systems", Third Edition, Pearson Education, 2004.
5. Harvey M. Deitel, "Operating Systems", Third Edition, Pearson Education, 2004.
6. Daniel P Bovet and Marco Cesati, "Understanding the Linux kernel", 3rd edition, O'Reilly, 2005.
7. Neil Smyth, "iPhone iOS 4 Development Essentials – Xcode", Fourth Edition, Payload media, 2011.

**CS8494**

**SOFTWARE ENGINEERING**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To understand the phases in a software project
- To understand fundamental concepts of requirements engineering and Analysis Modeling.
- To understand the various software design methodologies
- To learn various testing and maintenance measures

**UNIT I 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.

**UNIT II                    REQUIREMENTS ANALYSIS AND SPECIFICATION                    9**

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management- Classical analysis: Structured system Analysis, Petri Nets- Data Dictionary.

**UNIT III                    SOFTWARE DESIGN                    9**

Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design - Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

**UNIT IV                    TESTING AND MAINTENANCE                    9**

Software testing fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging –Software Implementation Techniques: Coding practices-Refactoring-Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering.

**UNIT V                    PROJECT MANAGEMENT                    9**

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning – Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management-Risk Identification-RMMM Plan-CASE TOOLS

**TOTAL :45 PERIODS**

**OUTCOMES:**

**On Completion of the course, the students should be able to:**

- Identify the key activities in managing a software project.
- Compare different process models.
- Concepts of requirements engineering and Analysis Modeling.
- Apply systematic procedure for software design and deployment.
- Compare and contrast the various testing and maintenance.
- Manage project schedule, estimate project cost and effort required.

**TEXT BOOKS:**

1. Roger S. Pressman, “Software Engineering – A Practitioner’s Approach”, Seventh Edition, Mc Graw-Hill International Edition, 2010.
2. Ian Sommerville, “Software Engineering”, 9th Edition, Pearson Education Asia, 2011.

**REFERENCES:**

1. Rajib Mall, “Fundamentals of Software Engineering”, Third Edition, PHI Learning Private Limited, 2009.
2. Pankaj Jalote, “Software Engineering, A Precise Approach”, Wiley India, 2010.
3. Kelkar S.A., “Software Engineering”, Prentice Hall of India Pvt Ltd, 2007.
4. Stephen R.Schach, “Software Engineering”, Tata McGraw-Hill Publishing Company Limited,2007.
5. <http://nptel.ac.in/>.

**CS8481                    DATABASE MANAGEMENT SYSTEMS LABORATORY                    L T P C  
0 0 4 2**

**AIM:**

The aim of this laboratory is to inculcate the abilities of applying the principles of the database management systems. This course aims to prepare the students for projects where a proper implementation of databases will be required.

**OBJECTIVES:**

- To understand data definitions and data manipulation commands
  - To learn the use of nested and join queries
  - To understand functions, procedures and procedural extensions of data bases
  - To be familiar with the use of a front end tool
  - To understand design and implementation of typical database applications
1. Data Definition Commands, Data Manipulation Commands for inserting, deleting, updating and retrieving Tables and Transaction Control statements
  2. Database Querying – Simple queries, Nested queries, Sub queries and Joins
  3. Views, Sequences, Synonyms
  4. Database Programming: Implicit and Explicit Cursors
  5. Procedures and Functions
  6. Triggers
  7. Exception Handling
  8. Database Design using ER modeling, normalization and Implementation for any application
  9. Database Connectivity with Front End Tools
  10. Case Study using real life database applications

**TOTAL: 60 PERIODS****OUTCOMES:****Upon completion of the course, the students will be able to:**

- Use typical data definitions and manipulation commands.
- Design applications to test Nested and Join Queries
- Implement simple applications that use Views
- Implement applications that require a Front-end Tool
- Critically analyze the use of Tables, Views, Functions and Procedures

**CS8461****OPERATING SYSTEMS LABORATORY****L T P C  
0 0 4 2****OBJECTIVES**

- To learn Unix commands and shell programming
- To implement various CPU Scheduling Algorithms
- To implement Process Creation and Inter Process Communication.
- To implement Deadlock Avoidance and Deadlock Detection Algorithms
- To implement Page Replacement Algorithms
- To implement File Organization and File Allocation Strategies

**LIST OF EXPERIMENTS**

1. Basics of UNIX commands
2. Write programs using the following system calls of UNIX operating system  
fork, exec, getpid, exit, wait, close, stat, opendir, readdir
3. Write C programs to simulate UNIX commands like cp, ls, grep, etc.
4. Shell Programming
5. Write C programs to implement the various CPU Scheduling Algorithms
6. Implementation of Semaphores
7. Implementation of Shared memory and IPC
8. Bankers Algorithm for Deadlock Avoidance
9. Implementation of Deadlock Detection Algorithm
10. Write C program to implement Threading & Synchronization Applications
11. Implementation of the following Memory Allocation Methods for fixed partition
  - a) First Fit
  - b) Worst Fit
  - c) Best Fit
12. Implementation of Paging Technique of Memory Management
13. Implementation of the following Page Replacement Algorithms
  - a) FIFO
  - b) LRU
  - c) LFU

14. Implementation of the various File Organization Techniques  
 15. Implementation of the following File Allocation Strategies  
     a) Sequential                      b) Indexed                      c) Linked

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to**

- Compare the performance of various CPU Scheduling Algorithms
- Implement Deadlock avoidance and Detection Algorithms
- Implement Semaphores
- Create processes and implement IPC
- Analyze the performance of the various Page Replacement Algorithms
- Implement File Organization and File Allocation Strategies

**HS8461**

**ADVANCED READING AND WRITING**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**OBJECTIVES:**

- Strengthen the reading skills of students of engineering.
- Enhance their writing skills with specific reference to technical writing.
- Develop students' critical thinking skills.
- Provide more opportunities to develop their project and proposal writing skills.

**UNIT I**

**Reading** - Strategies for effective reading-Use glosses and footnotes to aid reading comprehension- Read and recognize different text types-Predicting content using photos and title  
**Writing**-Plan before writing- Develop a paragraph: topic sentence, supporting sentences, concluding sentence –Write a descriptive paragraph

**UNIT II**

**Reading**-Read for details-Use of graphic organizers to review and aid comprehension **Writing**- State reasons and examples to support ideas in writing- Write a paragraph with reasons and examples- Write an opinion paragraph

**UNIT III**

**Reading**- Understanding pronoun reference and use of connectors in a passage- speed reading techniques-**Writing**- Elements of a good essay-Types of essays- descriptive-narrative- issue-based-argumentative-analytical.

**UNIT IV**

**Reading**- Genre and Organization of Ideas- **Writing**- Email writing- visumes – Job application- project writing-writing convincing proposals.

**UNIT V**

**Reading**- Critical reading and thinking- understanding how the text positions the reader- identify  
**Writing**- Statement of Purpose- letter of recommendation- Vision statement

**TOTAL: 30 PERIODS**

**OUTCOMES:**

**At the end of the course Learners will be able to:**

- Write different types of essays.
- Write winning job applications.

- Read and evaluate texts critically.
- Display critical thinking in various professional contexts.

#### TEXT BOOKS:

1. Gramer F. Margot and Colin S. Ward **Reading and Writing (Level 3)** Oxford University Press: Oxford, 2011
2. Debra Daise, CharlNorloff, and Paul Carne **Reading and Writing (Level 4)** Oxford University Press: Oxford, 2011

#### REFERENCES:

1. Davis, Jason and Rhonda Liss. **Effective Academic Writing (Level 3)** Oxford University Press: Oxford, 2006
2. E. Suresh Kumar and et al. **Enriching Speaking and Writing Skills**. Second Edition. Orient Black swan: Hyderabad, 2012
3. Withrow, Jeans and et al. **Inspired to Write. Readings and Tasks to develop writing skills**. Cambridge University Press: Cambridge, 2004
4. Goatly, Andrew. **Critical Reading and Writing**. Routledge: United States of America, 2000
5. Petelin, Roslyn and Marsh Durham. **The Professional Writing Guide: Knowing Well and Knowing Why**. Business & Professional Publishing: Australia, 2004

MA8551

ALGEBRA AND NUMBER THEORY

L T P C  
4 0 0 4

#### OBJECTIVES:

- To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
- To introduce and apply the concepts of rings, finite fields and polynomials.
- To understand the basic concepts in number theory
- To examine the key questions in the Theory of Numbers.
- To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

#### UNIT I GROUPS AND RINGS 12

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 12

Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields.

#### UNIT III DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS 12

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 12

Linear Diophantine equations – Congruence's – Linear Congruence's - Applications: Divisibility tests - Modular exponentiation-Chinese remainder theorem – 2 x 2 linear systems.

#### UNIT V CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS 12

Wilson's theorem – Fermat's little theorem – Euler's theorem – Euler's Phi functions – Tau and Sigma functions.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**Upon successful completion of the course, students should be able to:**

- Apply the basic notions of groups, rings, fields which will then be used to solve related problems.
- Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
- Demonstrate accurate and efficient use of advanced algebraic techniques.
- Demonstrate their mastery by solving non - trivial problems related to the concepts, and by proving simple theorems about the, statements proven by the text.
- Apply integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

**TEXTBOOKS:**

1. Grimaldi, R.P and Ramana, B.V., "Discrete and Combinatorial Mathematics", Pearson Education, 5<sup>th</sup> Edition, New Delhi, 2007.
2. Koshy, T., "Elementary Number Theory with Applications", Elsevier Publications, New Delhi, 2002.

**REFERENCES:**

1. Lidl, R. and Pitz, G, "Applied Abstract Algebra", Springer Verlag, New Delhi, 2<sup>nd</sup> Edition, 2006.
2. Niven, I., Zuckerman.H.S., and Montgomery, H.L., "An Introduction to Theory of Numbers", John Wiley and Sons , Singapore, 2004.
3. San Ling and Chaoping Xing, "Coding Theory – A first Course", Cambridge Publications, Cambridge, 2004.

**CS8591****COMPUTER NETWORKS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To understand the protocol layering and physical level communication.
- To analyze the performance of a network.
- To understand the various components required to build different networks.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the Transport layer.

**UNIT I INTRODUCTION AND PHYSICAL LAYER 9**

Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.

**UNIT II DATA-LINK LAYER & MEDIA ACCESS 9**

Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC – PPP - Media Access Control - Wired LANs: Ethernet - Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.

**UNIT III NETWORK LAYER 9**

Network Layer Services – Packet switching – Performance – IPV4 Addresses – Forwarding of IP Packets - Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.

**UNIT IV TRANSPORT LAYER 9**

Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol – SCTP.

**UNIT V APPLICATION LAYER 9**

WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP.



**OUTCOMES:**

**On Completion of the course, the students should be able to:**

- Understand the basic layers and its functions in computer networks.
- Evaluate the performance of a network.
- Understand the basics of how data flows from one node to another.
- Analyze and design routing algorithms.
- Design protocols for various functions in the network.
- Understand the working of various application layer protocols.

**TEXT BOOK:**

1. Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013.

**REFERENCES**

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.
3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open Source Approach, McGraw Hill Publisher, 2011.
5. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Sixth Edition, Pearson Education, 2013.

**EC8691**

**MICROPROCESSORS AND MICROCONTROLLERS**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To understand the Architecture of 8086 microprocessor.
- To learn the design aspects of I/O and Memory Interfacing circuits.
- To interface microprocessors with supporting chips.
- To study the Architecture of 8051 microcontroller.
- To design a microcontroller based system

**UNIT I THE 8086 MICROPROCESSOR**

**9**

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

**UNIT II 8086 SYSTEM BUS STRUCTURE**

**9**

8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

**UNIT III I/O INTERFACING**

**9**

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

**UNIT IV MICROCONTROLLER**

**9**

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

**UNIT V INTERFACING MICROCONTROLLER****9**

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors

**TOTAL: 45 PERIODS****OUTCOMES:****At the end of the course, the students should be able to:**

- Understand and execute programs based on 8086 microprocessor.
- Design Memory Interfacing circuits.
- Design and interface I/O circuits.
- Design and implement 8051 microcontroller based systems.

**TEXT BOOKS:**

1. Yu-Cheng Liu, Glenn A.Gibson, “Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design”, Second Edition, Prentice Hall of India, 2007. (UNIT I- III)
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson education, 2011. (UNIT IV-V)

**REFERENCES:**

1. Douglas V.Hall, “Microprocessors and Interfacing, Programming and Hardware”,TMH,2012
2. A.K.Ray,K.M.Bhurchandi,”Advanced Microprocessors and Peripherals “3<sup>rd</sup> edition, Tata McGrawHill,2012

**CS8501****THEORY OF COMPUTATION****L T P C****3 0 0 3****OBJECTIVES:**

- To understand the language hierarchy
- To construct automata for any given pattern and find its equivalent regular expressions
- To design a context free grammar for any given language
- To understand Turing machines and their capability
- To understand undecidable problems and NP class problems

**UNIT I AUTOMATA FUNDAMENTALS****9**

Introduction to formal proof – Additional forms of Proof – Inductive Proofs –Finite Automata – Deterministic Finite Automata – Non-deterministic Finite Automata – Finite Automata with Epsilon Transitions

**UNIT II REGULAR EXPRESSIONS AND LANGUAGES****9**

Regular Expressions – FA and Regular Expressions – Proving Languages not to be regular – Closure Properties of Regular Languages – Equivalence and Minimization of Automata.

**UNIT III CONTEXT FREE GRAMMAR AND LANGUAGES****9**

CFG – Parse Trees – Ambiguity in Grammars and Languages – Definition of the Pushdown Automata – Languages of a Pushdown Automata – Equivalence of Pushdown Automata and CFG, Deterministic Pushdown Automata.



**Implementation Diagrams** - UML package diagram - When to use package diagrams - Component and Deployment Diagrams – When to use Component and Deployment diagrams

**UNIT IV DESIGN PATTERNS 9**

**GRASP:** Designing objects with responsibilities – Creator – Information expert – Low Coupling – High Cohesion – Controller

**Design Patterns – creational** – factory method – **structural** – Bridge – Adapter – **behavioural** – Strategy – observer –Applying GoF design patterns – Mapping design to code

**UNIT V TESTING 9**

Object Oriented Methodologies – Software Quality Assurance – Impact of object orientation on Testing – Develop Test Cases and Test Plans

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the students will be able to:**

- Express software design with UML diagrams
- Design software applications using OO concepts.
- Identify various scenarios based on software requirements
- Transform UML based software design into pattern based design using design patterns
- Understand the various testing methodologies for OO software

**TEXT BOOKS:**

1. Craig Larman, “Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development”, Third Edition, Pearson Education, 2005.
2. Ali Bahrami - Object Oriented Systems Development - McGraw Hill International Edition - 1999

**REFERENCES:**

1. Erich Gamma, and Richard Helm, Ralph Johnson, John Vlissides, “Design patterns: Elements of Reusable Object-Oriented Software”, Addison-Wesley, 1995.
2. Martin Fowler, “UML Distilled: A Brief Guide to the Standard Object Modeling Language”, Third edition, Addison Wesley, 2003.

**EC8681 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY L T P C  
0 0 4 2**

**OBJECTIVES:**

- To Introduce ALP concepts, features and Coding methods
- Write ALP for arithmetic and logical operations in 8086 and 8051
- Differentiate Serial and Parallel Interface
- Interface different I/Os with Microprocessors
- Be familiar with MASM

**LIST OF EXPERIMENTS:**

**8086 Programs using kits and MASM**

1. Basic arithmetic and Logical operations
2. Move a data block without overlap
3. Code conversion, decimal arithmetic and Matrix operations.
4. Floating point operations, string manipulations, sorting and searching
5. Password checking, Print RAM size and system date
6. Counters and Time Delay

**Peripherals and Interfacing Experiments**

7. Traffic light controller
8. Stepper motor control

9. Digital clock
10. Key board and Display
11. Printer status
12. Serial interface and Parallel interface
13. A/D and D/A interface and Waveform Generation

#### **8051 Experiments using kits and MASM**

14. Basic arithmetic and Logical operations
15. Square and Cube program, Find 2's complement of a number
16. Unpacked BCD to ASCII

**TOTAL: 60 PERIODS**

#### **OUTCOMES:**

**At the end of the course, the student should be able to:**

- Write ALP Programmes for fixed and Floating Point and Arithmetic operations
- Interface different I/Os with processor
- Generate waveforms using Microprocessors
- Execute Programs in 8051
- Explain the difference between simulator and Emulator

#### **LAB EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

##### **HARDWARE:**

8086 development kits - 30 nos  
 Interfacing Units - Each 10 nos  
 Microcontroller - 30 nos

##### **SOFTWARE:**

Intel Desktop Systems with MASM - 30 nos  
 8086 Assembler  
 8051 Cross Assembler

#### **CS8582 OBJECT ORIENTED ANALYSIS AND DESIGN LABORATORY**

**L T P C**  
**0 0 4 2**

#### **OBJECTIVES:**

- To capture the requirements specification for an intended software system
- To draw the UML diagrams for the given specification
- To map the design properly to code
- To test the software system thoroughly for all scenarios
- To improve the design by applying appropriate design patterns.

Draw standard UML diagrams using an UML modeling tool for a given case study and map design to code and implement a 3 layered architecture. Test the developed code and validate whether the SRS is satisfied.

1. Identify a software system that needs to be developed.
2. Document the Software Requirements Specification (SRS) for the identified system.
3. Identify use cases and develop the Use Case model.
4. Identify the conceptual classes and develop a Domain Model and also derive a Class Diagram from that.
5. Using the identified scenarios, find the interaction between objects and represent them using UML Sequence and Collaboration Diagrams
6. Draw relevant State Chart and Activity Diagrams for the same system.
7. Implement the system as per the detailed design
8. Test the software system for all the scenarios identified as per the usecase diagram
9. Improve the reusability and maintainability of the software system by applying appropriate

design patterns.  
10. Implement the modified system and test it for various scenarios

**SUGGESTED DOMAINS FOR MINI-PROJECT:**

1. Passport automation system.
2. Book bank
3. Exam registration
4. Stock maintenance system.
5. Online course reservation system
6. Airline/Railway reservation system
7. Software personnel management system
8. Credit card processing
9. e-book management system
10. Recruitment system
11. Foreign trading system
12. Conference management system
13. BPO management system
14. Library management system
15. Student information system

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**Upon completion of this course, the students will be able to:**

- Perform OO analysis and design for a given problem specification.
- Identify and map basic software requirements in UML mapping.
- Improve the software quality using design patterns and to explain the rationale behind applying specific design patterns
- Test the compliance of the software with the SRS.

**HARDWARE REQUIREMENTS**

Standard PC

**SOFTWARE REQUIREMENTS**

1. Windows 7 or higher
2. ArgoUML that supports UML 1.4 and higher
3. Selenium, JUnit or Apache JMeter

**CS8581**

**NETWORKS LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

**OBJECTIVES:**

- To learn and use network commands.
- To learn socket programming.
- To implement and analyze various network protocols.
- To learn and use simulation tools.
- To use simulation tools to analyze the performance of various network protocols.

**LIST OF EXPERIMENTS**

1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and traceroute PDUs using a network protocol analyzer and examine.
2. Write a HTTP web client program to download a web page using TCP sockets.
3. Applications using TCP sockets like:
  - Echo client and echo server
  - Chat
  - File Transfer

4. Simulation of DNS using UDP sockets.
5. Write a code simulating ARP /RARP protocols.
6. Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS.
7. Study of TCP/UDP performance using Simulation tool.
8. Simulation of Distance Vector/ Link State Routing algorithm.
9. Performance evaluation of Routing protocols using Simulation tool.
10. Simulation of error correction code (like CRC).

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**Upon Completion of the course, the students will be able to:**

- Implement various protocols using TCP and UDP.
- Compare the performance of different transport layer protocols.
- Use simulation tools to analyze the performance of various network protocols.
- Analyze various routing algorithms.
- Implement error correction codes.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

**LABORATORY REQUIREMENT FOR BATCH OF 30 STUDENTS:**

**HARDWARE:**

- |                        |        |
|------------------------|--------|
| 1. Standalone desktops | 30 Nos |
|------------------------|--------|

**SOFTWARE:**

- |  |    |
|--|----|
| 1. C / C++ / Java / Python / Equivalent Compiler                         | 30 |
| 2. Network simulator like NS2/Glomosim/OPNET/ Packet Tracer / Equivalent |    |

|               |                             |          |          |          |          |
|---------------|-----------------------------|----------|----------|----------|----------|
| <b>CS8651</b> | <b>INTERNET PROGRAMMING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                             | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To understand different Internet Technologies.
- To learn java-specific web services architecture

**UNIT I WEBSITE BASICS, HTML 5, CSS 3, WEB 2.0 9**

Web Essentials: Clients, Servers and Communication – The Internet – Basic Internet protocols – World wide web – HTTP Request Message – HTTP Response Message – Web Clients – Web Servers – HTML5 – Tables – Lists – Image – HTML5 control elements – Semantic elements – Drag and Drop – Audio – Video controls - CSS3 – Inline, embedded and external style sheets – Rule cascading – Inheritance – Backgrounds – Border Images – Colors – Shadows – Text – Transformations – Transitions – Animations.

**UNIT II CLIENT SIDE PROGRAMMING 9**

Java Script: An introduction to JavaScript–JavaScript DOM Model-Date and Objects,- Regular Expressions- Exception Handling-Validation-Built-in objects-Event Handling-DHTML with JavaScript- JSON introduction – Syntax – Function Files – Http Request – SQL.

**UNIT III SERVER SIDE PROGRAMMING 9**

Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- Installing and Configuring Apache Tomcat Web Server- DATABASE CONNECTIVITY: JDBC perspectives, JDBC program example - JSP: Understanding Java Server Pages-JSP Standard Tag Library (JSTL)-Creating HTML forms by embedding JSP code.

**UNIT IV PHP and XML 9**

An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions- Form Validation- Regular Expressions - File handling – Cookies - Connecting to Database. XML: Basic XML- Document Type Definition- XML Schema DOM and Presenting XML, XML Parsers and Validation, XSL and XSLT Transformation, News Feed (RSS and ATOM).

**UNIT V INTRODUCTION TO AJAX and WEB SERVICES 9**

AJAX: Ajax Client Server Architecture-XML Http Request Object-Call Back Methods; Web Services: Introduction- Java web services Basics – Creating, Publishing, Testing and Describing a Web services (WSDL)-Consuming a web service, Database Driven web service from an application –SOAP.

**TOTAL 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the students should be able to:**

- Construct a basic website using HTML and Cascading Style Sheets.
- Build dynamic web page with validation using Java Script objects and by applying different event handling mechanisms.
- Develop server side programs using Servlets and JSP.
- Construct simple web pages in PHP and to represent data in XML format.
- Use AJAX and web services to develop interactive web applications

**TEXT BOOK:**

1. Deitel and Deitel and Nieto, “Internet and World Wide Web - How to Program”, Prentice Hall, 5th Edition, 2011.

**REFERENCES:**

1. Stephen Wynkoop and John Burke “Running a Perfect Website”, QUE, 2nd Edition, 1999.
2. Chris Bates, Web Programming – Building Intranet Applications, 3rd Edition, Wiley Publications, 2009.
3. Jeffrey C and Jackson, “Web Technologies A Computer Science Perspective”, Pearson Education, 2011.
4. Gopalan N.P. and Akilandeswari J., “Web Technology”, Prentice Hall of India, 2011.
5. UttamK.Roy, “Web Technologies”, Oxford University Press, 2011.

**CS8691**

**ARTIFICIAL INTELLIGENCE**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To understand the various characteristics of Intelligent agents
- To learn the different search strategies in AI
- To learn to represent knowledge in solving AI problems
- To understand the different ways of designing software agents
- To know about the various applications of AI.

**UNIT I INTRODUCTION**

**9**

Introduction–Definition - Future of Artificial Intelligence – Characteristics of Intelligent Agents– Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.



**UNIT II      PROBLEM SOLVING METHODS      9**

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing - Optimal Decisions in Games – Alpha - Beta Pruning - Stochastic Games

**UNIT III      KNOWLEDGE REPRESENTATION      9**

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation - Ontological Engineering-Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information

**UNIT IV      SOFTWARE AGENTS      9**

Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.

**UNIT V      APPLICATIONS      9**

AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing - Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving

**TOTAL :45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the students will be able to:**

- Use appropriate search algorithms for any AI problem
- Represent a problem using first order and predicate logic
- Provide the apt agent strategy to solve a given problem
- Design software agents to solve a problem
- Design applications for NLP that use Artificial Intelligence.

**TEXT BOOKS:**

- 1 S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Third Edition, 2009.
- 2 I. Bratko, "Prolog: Programming for Artificial Intelligence", Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.

**REFERENCES:**

1. M. Tim Jones, "Artificial Intelligence: A Systems Approach(Computer Science)", Jones and Bartlett Publishers, Inc.; First Edition, 2008
2. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press, 2009.
3. William F. Clocksin and Christopher S. Mellish," Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003.
4. Gerhard Weiss, "Multi Agent Systems", Second Edition, MIT Press, 2013.
5. David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Cambridge University Press, 2010.

**OBJECTIVES:**

- To understand the basic concepts of mobile computing.
- To learn the basics of mobile telecommunication system .
- To be familiar with the network layer protocols and Ad-Hoc networks.
- To know the basis of transport and application layer protocols.
- To gain knowledge about different mobile platforms and application development.

**UNIT I INTRODUCTION 9**  
Introduction to Mobile Computing – Applications of Mobile Computing- Generations of Mobile Communication Technologies- Multiplexing – Spread spectrum -MAC Protocols – SDMA- TDMA- FDMA- CDMA

**UNIT II MOBILE TELECOMMUNICATION SYSTEM 9**  
Introduction to Cellular Systems - GSM – Services & Architecture – Protocols – Connection Establishment – Frequency Allocation – Routing – Mobility Management – Security – GPRS-UMTS – Architecture – Handover - Security

**UNIT III MOBILE NETWORK LAYER 9**  
Mobile IP – DHCP – AdHoc– Proactive protocol-DSDV, Reactive Routing Protocols – DSR, AODV , Hybrid routing –ZRP, Multicast Routing- ODMRP, Vehicular Ad Hoc networks ( VANET) –MANET Vs VANET – Security.

**UNIT IV MOBILE TRANSPORT AND APPLICATION LAYER 9**  
Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture – WML

**UNIT V MOBILE PLATFORMS AND APPLICATIONS 9**  
Mobile Device Operating Systems – Special Constraints & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – MCommerce – Structure – Pros & Cons – Mobile Payment System – Security Issues

**TOTAL 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the students should be able to:**

- Explain the basics of mobile telecommunication systems
- Illustrate the generations of telecommunication systems in wireless networks
- Determine the functionality of MAC, network layer and Identify a routing protocol for a given Ad hoc network
- Explain the functionality of Transport and Application layers
- Develop a mobile application using android/blackberry/ios/Windows SDK

**TEXT BOOKS:**

1. Jochen Schiller, "Mobile Communications", PHI, Second Edition, 2003.
2. Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI Learning Pvt.Ltd, New Delhi – 2012

**REFERENCES**

1. Dharma Prakash Agarval, Qing and An Zeng, "Introduction to Wireless and Mobile systems", Thomson Asia Pvt Ltd, 2005.
2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, 2003.
3. William.C.Y.Lee, "Mobile Cellular Telecommunications-Analog and Digital Systems", Second Edition, TataMcGraw Hill Edition ,2006.
4. C.K.Toth, "AdHoc Mobile Wireless Networks", First Edition, Pearson Education, 2002.

5. Android Developers : <http://developer.android.com/index.html>
6. Apple Developer : <https://developer.apple.com/>
7. Windows Phone DevCenter : <http://developer.windowsphone.com>
8. BlackBerry Developer : <http://developer.blackberry.com>

**CS8602**

**COMPILER DESIGN**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>2</b> | <b>4</b> |

**OBJECTIVES:**

- To learn the various phases of compiler.
- To learn the various parsing techniques.
- To understand intermediate code generation and run-time environment.
- To learn to implement front-end of the compiler.
- To learn to implement code generator.

**UNIT I INTRODUCTION TO COMPILERS 9**

Structure of a compiler – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens – Lex – Finite Automata – Regular Expressions to Automata – Minimizing DFA.

**UNIT II SYNTAX ANALYSIS 12**

Role of Parser – Grammars – Error Handling – Context-free grammars – Writing a grammar – Top Down Parsing - General Strategies Recursive Descent Parser Predictive Parser-LL(1) Parser-Shift Reduce Parser-LR Parser-LR (0)Item Construction of SLR Parsing Table - Introduction to LALR Parser - Error Handling and Recovery in Syntax Analyzer-YACC.

**UNIT III INTERMEDIATE CODE GENERATION 8**

Syntax Directed Definitions, Evaluation Orders for Syntax Directed Definitions, Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking.

**UNIT IV RUN-TIME ENVIRONMENT AND CODE GENERATION 8**

Storage Organization, Stack Allocation Space, Access to Non-local Data on the Stack, Heap Management - Issues in Code Generation - Design of a simple Code Generator.

**UNIT V CODE OPTIMIZATION 8**

Principal Sources of Optimization – Peep-hole optimization - DAG- Optimization of Basic Blocks- Global Data Flow Analysis - Efficient Data Flow Algorithm.

**LIST OF EXPERIMENTS:**

1. Develop a lexical analyzer to recognize a few patterns in C. (Ex. identifiers, constants, comments, operators etc.). Create a symbol table, while recognizing identifiers.
2. Implement a Lexical Analyzer using Lex Tool
3. Implement an Arithmetic Calculator using LEX and YACC
4. Generate three address code for a simple program using LEX and YACC.
5. Implement simple code optimization techniques (Constant folding, Strength reduction and Algebraic transformation)
6. Implement back-end of the compiler for which the three address code is given as input and the 8086 assembly language code is produced as output.

|                   |           |                |
|-------------------|-----------|----------------|
| <b>PRACTICALS</b> | <b>30</b> | <b>PERIODS</b> |
| <b>THEORY</b>     | <b>45</b> | <b>PERIODS</b> |
| <b>TOTAL :</b>    | <b>75</b> | <b>PERIODS</b> |

**OUTCOMES:**

**On Completion of the course, the students should be able to:**

- Understand the different phases of compiler.
- Design a lexical analyzer for a sample language.

- Apply different parsing algorithms to develop the parsers for a given grammar.
- Understand syntax-directed translation and run-time environment.
- Learn to implement code optimization techniques and a simple code generator.
- Design and implement a scanner and a parser using LEX and YACC tools.

#### TEXT BOOK:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles, Techniques and Tools, Second Edition, Pearson Education, 2009.

#### REFERENCES

1. Randy Allen, Ken Kennedy, Optimizing Compilers for Modern Architectures: A Dependence based Approach, Morgan Kaufmann Publishers, 2002.
2. Steven S. Muchnick, Advanced Compiler Design and Implementation, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003.
3. Keith D Cooper and Linda Torczon, Engineering a Compiler, Morgan Kaufmann Publishers Elsevier Science, 2004.
4. V. Raghavan, Principles of Compiler Design, Tata McGraw Hill Education Publishers, 2010.
5. Allen I. Holub, Compiler Design in C, Prentice-Hall Software Series, 1993.

CS8603

DISTRIBUTED SYSTEMS

L T P C  
3 0 0 3

#### OBJECTIVES:

- To understand the foundations of distributed systems.
- To learn issues related to clock Synchronization and the need for global state in distributed systems.
- To learn distributed mutual exclusion and deadlock detection algorithms.
- To understand the significance of agreement, fault tolerance and recovery protocols in Distributed Systems.
- To learn the characteristics of peer-to-peer and distributed shared memory systems.

#### UNIT I INTRODUCTION

9

**Introduction:** Definition –Relation to computer system components –Motivation –Relation to parallel systems – Message-passing systems versus shared memory systems –Primitives for distributed communication –Synchronous versus asynchronous executions –Design issues and challenges. **A model of distributed computations:** A distributed program –A model of distributed executions –Models of communication networks –Global state – Cuts –Past and future cones of an event –Models of process communications. **Logical Time:** A framework for a system of logical clocks –Scalar time –Vector time – Physical clock synchronization: NTP.

#### UNIT II MESSAGE ORDERING & SNAPSHOTS

9

**Message ordering and group communication:** Message ordering paradigms –Asynchronous execution with synchronous communication –Synchronous program order on an asynchronous system –Group communication – Causal order (CO) - Total order. **Global state and snapshot recording algorithms:** Introduction –System model and definitions –Snapshot algorithms for FIFO channels

#### UNIT III DISTRIBUTED MUTEX & DEADLOCK

9

**Distributed mutual exclusion algorithms:** Introduction – Preliminaries – Lamport's algorithm – Ricart-Agrawala algorithm – Maekawa's algorithm – Suzuki–Kasami's broadcast algorithm. **Deadlock detection in distributed systems:** Introduction – System model – Preliminaries – Models of deadlocks – Knapp's classification – Algorithms for the single resource model, the AND model and the OR model.

**UNIT IV RECOVERY & CONSENSUS****9**

**Checkpointing and rollback recovery:** Introduction – Background and definitions – Issues in failure recovery – Checkpoint-based recovery – Log-based rollback recovery – Coordinated checkpointing algorithm – Algorithm for asynchronous checkpointing and recovery. **Consensus and agreement algorithms:** Problem definition – Overview of results – Agreement in a failure – free system – Agreement in synchronous systems with failures.

**UNIT V P2P & DISTRIBUTED SHARED MEMORY****9**

**Peer-to-peer computing and overlay graphs:** Introduction – Data indexing and overlays – Chord – Content addressable networks – Tapestry. **Distributed shared memory:** Abstraction and advantages – Memory consistency models – Shared memory Mutual Exclusion.

**TOTAL: 45 PERIODS****OUTCOMES:****At the end of this course, the students will be able to:**

- Elucidate the foundations and issues of distributed systems
- Understand the various synchronization issues and global state for distributed systems.
- Understand the Mutual Exclusion and Deadlock detection algorithms in distributed systems
- Describe the agreement protocols and fault tolerance mechanisms in distributed systems.
- Describe the features of peer-to-peer and distributed shared memory systems

**TEXT BOOKS:**

1. Kshemkalyani, Ajay D., and Mukesh Singhal. Distributed computing: principles, algorithms, and systems. Cambridge University Press, 2011.
2. George Coulouris, Jean Dollimore and Tim Kindberg, “Distributed Systems Concepts and Design”, Fifth Edition, Pearson Education, 2012.

**REFERENCES:**

1. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
2. Mukesh Singhal and Niranjana G. Shivaratri. Advanced concepts in operating systems. McGraw-Hill, Inc., 1994.
3. Tanenbaum A.S., Van Steen M., “Distributed Systems: Principles and Paradigms”, Pearson Education, 2007.
4. Liu M.L., “Distributed Computing, Principles and Applications”, Pearson Education, 2004.
5. Nancy A Lynch, “Distributed Algorithms”, Morgan Kaufman Publishers, USA, 2003.

**CS8661****INTERNET PROGRAMMING LABORATORY****L T P C****0 0 4 2****OBJECTIVES:**

- To be familiar with Web page design using HTML/XML and style sheets
- To be exposed to creation of user interfaces using Java frames and applets.
- To learn to create dynamic web pages using server side scripting.
- To learn to write Client Server applications.
- To be familiar with the PHP programming.
- To be exposed to creating applications with AJAX

**LIST OF EXPERIMENTS**

1. Create a web page with the following using HTML
  - a. To embed a map in a web page
  - b. To fix the hot spots in that map
  - c. Show all the related information when the hot spots are clicked.

2. Create a web page with the following.
  - a. Cascading style sheets.
  - b. Embedded style sheets.
  - c. Inline style sheets. Use our college information for the web pages.
3. Validate the Registration, user login, user profile and payment by credit card pages using JavaScript.
4. Write programs in Java using Servlets:
  - i. To invoke servlets from HTML forms
  - ii. Session tracking using hidden form fields and Session tracking for a hit count
5. Write programs in Java to create three-tier applications using servlets for conducting on-line examination for displaying student mark list. Assume that student information is available in a database which has been stored in a database server.
6. Install TOMCAT web server. Convert the static web pages of programs into dynamic web pages using servlets (or JSP) and cookies. Hint: Users information (user id, password, credit card number) would be stored in web.xml. Each user should have a separate Shopping Cart.
7. Redo the previous task using JSP by converting the static web pages into dynamic web pages. Create a database with user information and books information. The books catalogue should be dynamically loaded from the database.
8. Create and save an XML document at the server, which contains 10 users Information. Write a Program, which takes user Id as an input and returns the User details by taking the user information from the XML document
9.
  - i. Validate the form using PHP regular expression.
  - ii. PHP stores a form data into database.
10. Write a web service for finding what people think by asking 500 people's opinion for any consumer product.

**TOTAL: 60PERIODS**

**OUTCOMES:**

**Upon Completion of the course, the students will be able to:**

- Construct Web pages using HTML/XML and style sheets.
- Build dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms.
- Develop dynamic web pages using server side scripting.
- Use PHP programming to develop web applications.
- Construct web applications using AJAX and web services.

**SOFTWARE REQUIRED:**

- Dream Weaver or Equivalent, MySQL or Equivalent, Apache Server, WAMP/XAMPP

|               |  |                |
|---------------|--|----------------|
| <b>CS8662</b> | <b>MOBILE APPLICATION DEVELOPMENT LABORATORY</b> | <b>L T P C</b> |
|               |  | <b>0 0 4 2</b> |

**OBJECTIVES:**

- To understand the components and structure of mobile application development frameworks for Android and windows OS based mobiles.
- To understand how to work with various mobile application development frameworks.
- To learn the basic and important design concepts and issues of development of mobile applications.
- To understand the capabilities and limitations of mobile devices.

## LIST OF EXPERIMENTS

1. Develop an application that uses GUI components, Font and Colours
2. Develop an application that uses Layout Managers and event listeners.
3. Write an application that draws basic graphical primitives on the screen.
4. Develop an application that makes use of databases.
5. Develop an application that makes use of Notification Manager
6. Implement an application that uses Multi-threading
7. Develop a native application that uses GPS location information
8. Implement an application that writes data to the SD card.
9. Implement an application that creates an alert upon receiving a message
10. Write a mobile application that makes use of RSS feed
11. Develop a mobile application to send an email.
12. Develop a Mobile application for simple needs (Mini Project)

**TOTAL: 60 PERIODS**

## OUTCOMES:

**Upon Completion of the course, the students will be able to:**

- Develop mobile applications using GUI and Layouts.
- Develop mobile applications using Event Listener.
- Develop mobile applications using Databases.
- Develop mobile applications using RSS Feed, Internal/External Storage, SMS, Multi-threading and GPS.
- Analyze and discover own mobile app for simple needs.

## REFERENCES:

1. Build Your Own Security Lab, Michael Gregg, Wiley India

## LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Standalone desktops with Windows or Android or

iOS or Equivalent Mobile Application Development

Tools with appropriate emulators and debuggers - 30 Nos.

**HS8581**

**PROFESSIONAL COMMUNICATION**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

## OBJECTIVES:

**The course aims to:**

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

## UNIT I

Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs

## UNIT II

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentations

### UNIT III

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -- questioning and clarifying –GD strategies- activities to improve GD skills

### UNIT IV

Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview – FAQs related to job interviews

### UNIT V

Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes

**TOTAL : 30 PERIODS**

### OUTCOMES:

**At the end of the course Learners will be able to:**

- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

### Recommended Software

1. Open Source Software
2. Win English

### REFERENCES:

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
3. Interact English Lab Manual for Undergraduate Students,. OrientBalckSwan: Hyderabad, 2016.
4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
5. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010.

**MG8591**

**PRINCIPLES OF MANAGEMENT**

**LT P C  
3 0 0 3**

### OBJECTIVES:

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization .

### UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

**9**

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

### UNIT II PLANNING

**9**

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

### UNIT III ORGANISING

**9**

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority –



centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management

**UNIT IV DIRECTING 9**

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication –communication and IT.

**UNIT V CONTROLLING 9**

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

**TEXTBOOKS:**

1. Stephen P. Robbins & Mary Coulter, “Management”, Prentice Hall (India) Pvt. Ltd., 10<sup>th</sup> Edition, 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, Pearson Education, 6th Edition, 2004.

**REFERENCES:**

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management” Pearson Education, 7th Edition, 2011.
2. Robert Kreitner & Mamata Mohapatra, “ Management”, Biztantra, 2008.
3. Harold Koontz & Heinz Weihrich “Essentials of management” Tata McGraw Hill, 1998.
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata McGraw Hill, 1999

|               |  |          |          |          |          |
|---------------|--|----------|----------|----------|----------|
| <b>CS8792</b> | <b>CRYPTOGRAPHY AND NETWORK SECURITY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To understand Cryptography Theories, Algorithms and Systems.
- To understand necessary Approaches and Techniques to build protection mechanisms in order to secure computer networks.

**UNIT I INTRODUCTION 9**

Security trends - Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies - Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography- Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.

**UNIT II SYMMETRIC KEY CRYPTOGRAPHY 9**

**MATHEMATICS OF SYMMETRIC KEY CRYPTOGRAPHY:** Algebraic structures - Modular arithmetic-Euclid's algorithm- Congruence and matrices - Groups, Rings, Fields- Finite fields- **SYMMETRIC KEY CIPHERS:** SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard - RC4 –

Key distribution.

**UNIT III PUBLIC KEY CRYPTOGRAPHY 9**

MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY: Primes – Primality Testing – Factorization – Euler’s totient function, Fermat’s and Euler’s Theorem - Chinese Remainder Theorem – Exponentiation and logarithm - ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange - ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.

**UNIT IV MESSAGE AUTHENTICATION AND INTEGRITY 9**

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications - Kerberos, X.509

**UNIT V SECURITY PRACTICE AND SYSTEM SECURITY 9**

Electronic Mail security – PGP, S/MIME – IP security – Web Security - SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls.

**TOTAL 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Understand the fundamentals of networks security, security architecture, threats and vulnerabilities
- Apply the different cryptographic operations of symmetric cryptographic algorithms
- Apply the different cryptographic operations of public key cryptography
- Apply the various Authentication schemes to simulate different applications.
- Understand various Security practices and System security standards

**TEXT BOOK:**

1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 3rd Edition, 2006.

**REFERENCES:**

1. C K Shyamala, N Harini and Dr. T R Padmanabhan: Cryptography and Network Security, Wiley India Pvt.Ltd
2. BehrouzA.Foruzan, Cryptography and Network Security, Tata McGraw Hill 2007.
3. Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: PRIVATE Communication in a PUBLIC World, Prentice Hall, ISBN 0-13-046019-2

**CS8791**

**CLOUD COMPUTING**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To understand the concept of cloud computing.
- To appreciate the evolution of cloud from the existing technologies.
- To have knowledge on the various issues in cloud computing.
- To be familiar with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.

**UNIT I INTRODUCTION 9**

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On-demand Provisioning.

**UNIT II CLOUD ENABLING TECHNOLOGIES 10**

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish-Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices –Virtualization Support and Disaster Recovery.

**UNIT III CLOUD ARCHITECTURE, SERVICES AND STORAGE 8**

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

**UNIT IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 10**

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM – Security Standards.

**UNIT V CLOUD TECHNOLOGIES AND ADVANCEMENTS 8**

Hadoop – MapReduce – Virtual Box -- Google App Engine – Programming Environment for Google App Engine — Open Stack – Federation in the Cloud – Four Levels of Federation – Federated Services and Applications – Future of Federation.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**On Completion of the course, the students should be able to:**

- Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
- Learn the key and enabling technologies that help in the development of cloud.
- Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
- Explain the core issues of cloud computing such as resource management and security.
- Be able to install and use current cloud technologies.
- Evaluate and choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

**TEXT BOOKS:**

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. Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, Management and Security", CRC Press, 2017.

**REFERENCES:**

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach", Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)", O'Reilly, 2009.

**OBJECTIVES:**

- To develop web applications in cloud
  - To learn the design and development process involved in creating a cloud based application
  - To learn to implement and use parallel programming using Hadoop
1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.
  2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
  3. Install Google App Engine. Create *hello world* app and other simple web applications using python/java.
  4. Use GAE launcher to launch the web applications.
  5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
  6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
  7. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
  8. Install Hadoop single node cluster and run simple applications like wordcount.

**TOTAL : 60 PERIODS****OUTCOMES:****On completion of this course, the students will be able to:**

- Configure various virtualization tools such as Virtual Box, VMware workstation.
- Design and deploy a web application in a PaaS environment.
- Learn how to simulate a cloud environment to implement new schedulers.
- Install and use a generic cloud environment that can be used as a private cloud.
- Manipulate large data sets in a parallel environment.

**OBJECTIVES:**

- To learn different cipher techniques
- To implement the algorithms DES, RSA, MD5, SHA-1
- To use network security tools and vulnerability assessment tools

**LIST OF EXPERIMENTS**

1. Perform encryption, decryption using the following substitution techniques  
(i) Ceaser cipher, (ii) playfair cipher iii) Hill Cipher iv) Vigenere cipher
2. Perform encryption and decryption using following transposition techniques  
i) Rail fence ii) row & Column Transformation
3. Apply DES algorithm for practical applications.
4. Apply AES algorithm for practical applications.
5. Implement RSA Algorithm using HTML and JavaScript
6. Implement the Diffie-Hellman Key Exchange algorithm for a given problem.
7. Calculate the message digest of a text using the SHA-1 algorithm.
8. Implement the SIGNATURE SCHEME - Digital Signature Standard.
9. Demonstrate intrusion detection system (ids) using any tool eg. Snort or any other s/w.

10. Automated Attack and Penetration Tools  
Exploring N-Stalker, a Vulnerability Assessment Tool
11. Defeating Malware  
i) Building Trojans ii) Rootkit Hunter

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**Upon Completion of the course, the students will be able to:**

- Develop code for classical Encryption Techniques to solve the problems.
- Build cryptosystems by applying symmetric and public key encryption algorithms.
- Construct code for authentication algorithms.
- Develop a signature scheme using Digital signature standard.
- Demonstrate the network security system using open source tools

**REFERENCES:**

1. Build Your Own Security Lab, Michael Gregg, Wiley India

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS: SOFTWARE:** C / C++ / Java or equivalent compiler GnuPG, Snort, N-Stalker or Equivalent **HARDWARE:** Standalone desktops - 30 Nos. (or) Server supporting 30 terminals or more.

**CS8811**

**PROJECT WORK**

**L T P C**  
**0 0 20 10**

**OBJECTIVES:**

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL: 300 PERIODS**

**OUTCOME:**

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

**CS8075**

**DATA WAREHOUSING AND DATA MINING**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To understand data warehouse concepts, architecture, business analysis and tools
- To understand data pre-processing and data visualization techniques
- To study algorithms for finding hidden and interesting patterns in data
- To understand and apply various classification and clustering techniques using tools.

**UNIT I DATA WAREHOUSING, BUSINESS ANALYSIS AND ON-LINE ANALYTICAL PROCESSING (OLAP) 9**

Basic Concepts - Data Warehousing Components – Building a Data Warehouse – Database Architectures for Parallel Processing – Parallel DBMS Vendors - Multidimensional Data Model – Data Warehouse Schemas for Decision Support, Concept Hierarchies -Characteristics of OLAP Systems – Typical OLAP Operations, OLAP and OLTP.

**UNIT II DATA MINING – INTRODUCTION 9**

Introduction to Data Mining Systems – Knowledge Discovery Process – Data Mining Techniques – Issues – applications- Data Objects and attribute types, Statistical description of data, Data Preprocessing – Cleaning, Integration, Reduction, Transformation and discretization, Data Visualization, Data similarity and dissimilarity measures.

**UNIT III DATA MINING - FREQUENT PATTERN ANALYSIS 9**

Mining Frequent Patterns, Associations and Correlations – Mining Methods- Pattern Evaluation Method – Pattern Mining in Multilevel, Multi Dimensional Space – Constraint Based Frequent Pattern Mining, Classification using Frequent Patterns

**UNIT IV CLASSIFICATION AND CLUSTERING 9**

Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back Propagation – Support Vector Machines — Lazy Learners – Model Evaluation and Selection-Techniques to improve Classification Accuracy.

Clustering Techniques – Cluster analysis-Partitioning Methods - Hierarchical Methods – Density Based Methods - Grid Based Methods – Evaluation of clustering – Clustering high dimensional data- Clustering with constraints, Outlier analysis-outlier detection methods.

**UNIT V WEKA TOOL 9**

Datasets – Introduction, Iris plants database, Breast cancer database, Auto imports database - Introduction to WEKA, The Explorer – Getting started, Exploring the explorer, Learning algorithms, Clustering algorithms, Association–rule learners.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the students should be able to:**

- Design a Data warehouse system and perform business analysis with OLAP tools.
- Apply suitable pre-processing and visualization techniques for data analysis
- Apply frequent pattern and association rule mining techniques for data analysis
- Apply appropriate classification and clustering techniques for data analysis

**TEXT BOOK:**

1. Jiawei Han and Micheline Kamber, “Data Mining Concepts and Techniques”, Third Edition, Elsevier, 2012.

**REFERENCES:**

1. Alex Berson and Stephen J.Smith, “Data Warehousing, Data Mining & OLAP”, Tata McGraw – Hill Edition, 35<sup>th</sup> Reprint 2016.
2. K.P. Soman, Shyam Diwakar and V. Ajay, “Insight into Data Mining Theory and Practice”, Eastern Economy Edition, Prentice Hall of India, 2006.
3. Ian H.Witten and Eibe Frank, “Data Mining: Practical Machine Learning Tools and Techniques”, Elsevier, Second Edition.

**OBJECTIVES:**

- To learn the criteria for test cases.
- To learn the design of test cases.
- To understand test management and test automation techniques.
- To apply test metrics and measurements.

**UNIT I INTRODUCTION****9**

Testing as an Engineering Activity – Testing as a Process – Testing Maturity Model- Testing axioms – Basic definitions – Software Testing Principles – The Tester's Role in a Software Development Organization – Origins of Defects – Cost of defects – Defect Classes – The Defect Repository and Test Design –Defect Examples- Developer/Tester Support of Developing a Defect Repository.

**UNIT II TEST CASE DESIGN STRATEGIES****9**

Test case Design Strategies – Using Black Box Approach to Test Case Design – Boundary Value Analysis – Equivalence Class Partitioning – State based testing – Cause-effect graphing – Compatibility testing – user documentation testing – domain testing - Random Testing – Requirements based testing – Using White Box Approach to Test design – Test Adequacy Criteria – static testing vs. structural testing – code functional testing – Coverage and Control Flow Graphs – Covering Code Logic – Paths – code complexity testing – Additional White box testing approaches- Evaluating Test Adequacy Criteria.

**UNIT III LEVELS OF TESTING****9**

The need for Levels of Testing – Unit Test – Unit Test Planning – Designing the Unit Tests – The Test Harness – Running the Unit tests and Recording results – Integration tests – Designing Integration Tests – Integration Test Planning – Scenario testing – Defect bash elimination System Testing – Acceptance testing – Performance testing – Regression Testing – Internationalization testing – Ad-hoc testing – Alpha, Beta Tests – Testing OO systems – Usability and Accessibility testing – Configuration testing –Compatibility testing – Testing the documentation – Website testing.

**UNIT IV TEST MANAGEMENT****9**

People and organizational issues in testing – Organization structures for testing teams – testing services – Test Planning – Test Plan Components – Test Plan Attachments – Locating Test Items – test management – test process – Reporting Test Results – Introducing the test specialist – Skills needed by a test specialist – Building a Testing Group- The Structure of Testing Group- .The Technical Training Program.

**UNIT V TEST AUTOMATION****9**

Software test automation – skills needed for automation – scope of automation – design and architecture for automation – requirements for a test tool – challenges in automation – Test metrics and measurements – project, progress and productivity metrics.

**TOTAL: 45 PERIODS****OUTCOMES:****At the end of the course the students will be able to:**

- Design test cases suitable for a software development for different domains.
- Identify suitable tests to be carried out.
- Prepare test planning based on the document.
- Document test plans and test cases designed.
- Use automatic testing tools.
- Develop and validate a test plan.

**TEXT BOOKS:**

1. Srinivasan Desikan and Gopaldaswamy Ramesh, "Software Testing – Principles and Practices", Pearson Education, 2006.
2. Ron Patton, "Software Testing", Second Edition, Sams Publishing, Pearson Education, 2007.  
AU Library.com

**REFERENCES:**

1. Ilene Burnstein, "Practical Software Testing", Springer International Edition, 2003.
2. Edward Kit, "Software Testing in the Real World – Improving the Process", Pearson Education, 1995.
3. Boris Beizer, "Software Testing Techniques" – 2nd Edition, Van Nostrand Reinhold, New York, 1990.
4. Aditya P. Mathur, "Foundations of Software Testing \_ Fundamental Algorithms and Techniques", Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

**IT8072****EMBEDDED SYSTEMS****L T P C  
3 0 0 3****OBJECTIVES:**

- To learn the architecture and programming of ARM processor.
- To become familiar with the embedded computing platform design and analysis.
- To get thorough knowledge in interfacing concepts
- To design an embedded system and to develop programs

**UNIT I INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS 9**

Complex systems and micro processors– Embedded system design process –Design example: Model train controller- Instruction sets preliminaries - ARM Processor – CPU: programming input and output- supervisor mode, exceptions and traps – Co-processors- Memory system mechanisms – CPU performance- CPU power consumption.

**UNIT II EMBEDDED COMPUTING PLATFORM DESIGN 9**

The CPU Bus-Memory devices and systems–Designing with computing platforms – consumer electronics architecture – platform-level performance analysis - Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing.

**UNIT III SENSOR INTERFACING WITH ARDUINO 9**

Basics of hardware design and functions of basic passive components-sensors and actuators- Arduino code - library file for sensor interfacing-construction of basic applications

**UNIT IV EMBEDDED FIRMWARE 9**

Reset Circuit, Brown-out Protection Circuit-Oscillator Unit - Real Time Clock-Watchdog Timer - Embedded Firmware Design Approaches and Development Languages.

**UNIT V EMBEDDED C PROGRAMMING 9**

Introduction-Creating 'hardware delays' using Timer 0 and Timer 1-Reading switches-Adding Structure to the code-Generating a minimum and maximum delay-Example: Creating a portable hardware delay- Timeout mechanisms-Creating loop timeouts-Testing loop timeouts- hardware timeouts-Testing a hardware timeout

**TOTAL : 45 PERIODS**



**OUTCOMES:**

Upon completion of the course, students will be able to:

- Describe the architecture and programming of ARM processor.
- Explain the concepts of embedded systems
- Understand the Concepts of peripherals and interfacing of sensors.
- Capable of using the system design techniques to develop firmware
- Illustrate the code for constructing a system

**TEXT BOOKS:**

1. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", Third Edition "Morgan Kaufmann Publisher (An imprint from Elsevier), 2012. (unit I & II)
2. <https://www.coursera.org/learn/interface-with-arduino#syllabus> (Unit III)
3. Michael J. Pont, "Embedded C", 2nd Edition, Pearson Education, 2008. (Unit IV & V)

**REFERENCES:**

1. Shibu K.V, "Introduction to Embedded Systems", McGraw Hill.2014
2. Jonathan W. Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition Cengage Learning, 2012
3. Raj Kamal, "Embedded Systems-Architecture, programming and design", 3 edition, TMH.2015
4. Lyla, "Embedded Systems", Pearson, 2013
6. David E. Simon, "An Embedded Software Primer", Pearson Education, 2000.

**CS8072****AGILE METHODOLOGIES**

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**OBJECTIVES:**

- To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand the benefits and pitfalls of working in an Agile team.
- To understand Agile development and testing.

**UNIT I AGILE METHODOLOGY****9**

Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values

**UNIT II AGILE PROCESSES****9**

Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

**UNIT III AGILITY AND KNOWLEDGE MANAGEMENT****9**

Agile Information Systems – Agile Decision Making - Earl'S Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment, Leveraging – KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).



**UNIT III** **9**  
 Network Flows - Planar Graph - Representation - Detection - Dual Graph - Geometric and Combinatorial Dual - Related Theorems - Digraph - Properties - Euler Digraph.

**UNIT IV** **9**  
 Matrix Representation - Adjacency matrix- Incidence matrix- Circuit matrix - Cut-set matrix - Path Matrix- Properties - Related Theorems - Correlations. Graph Coloring - Chromatic Polynomial - Chromatic Partitioning - Matching - Covering - Related Theorems.

**UNIT V** **9**  
 Graph Algorithms- Connectedness and Components- Spanning Tree- Fundamental Circuits- Cut Vertices- Directed Circuits- Shortest Path - Applications overview.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon completion of this course, the students should be able to**

- Understand the basic concepts of graphs, and different types of graphs
- Understand the properties, theorems and be able to prove theorems.
- Apply suitable graph model and algorithm for solving applications.

**TEXT BOOKS:**

1. Narsingh Deo, "Graph Theory with Application to Engineering and Computer Science", Prentice-Hall of India Pvt.Ltd, 2003.
2. L.R.Foulds , "Graph Theory Applications", Springer ,2016.

**REFERENCES:**

1. Bondy, J. A. and Murty, U.S.R., "Graph Theory with Applications", North Holland Publication,2008.
2. West, D. B., "Introduction to Graph Theory", Pearson Education, 2011.
3. John Clark, Derek Allan Holton, "A First Look at Graph Theory", World Scientific Publishing Company, 1991.
4. Diestel, R, "Graph Theory", Springer,3rd Edition,2006.
5. Kenneth H.Rosen, "Discrete Mathematics and Its Applications", Mc Graw Hill , 2007.

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| <b>IT8071</b> | <b>DIGITAL SIGNAL PROCESSING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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**OBJECTIVES:**

- To understand the basics of discrete time signals, systems and their classifications.
- To analyze the discrete time signals in both time and frequency domain.
- To design lowpass digital IIR filters according to predefined specifications based on analog filter theory and analog-to-digital filter transformation.
- To design Linear phase digital FIR filters using fourier method, window technique
- To realize the concept and usage of DSP in various engineering fields.

**UNIT I                    DISCRETE TIME SIGNALS AND SYSTEMS** **9**  
 Introduction to DSP – Basic elements of DSP– Sampling of Continuous time signals–Representation, Operation and Classification of Discrete Time Signal–Classification of Discrete Time Systems– Discrete Convolution: Linear and Circular–Correlation.

**UNIT II                    ANALYSIS OF LTI DISCRETE TIME SIGNALS AND SYSTEMS** **9**  
 Analysis of LTI Discrete Time Systems using DFT–Properties of DFT–Inverse DFT– Analysis of LTI Discrete Time Systems using FFT Algorithms– Inverse DFT using FFT Algorithm.

**UNIT III INFINITE IMPULSE RESPONSE FILTERS 9**

Frequency response of Analog and Digital IIR filters–Realization of IIR filter–Design of analog low pass filter–Analog to Digital filter Transformation using Bilinear Transformation and Impulse Invariant method–Design of digital IIR filters (LPF, HPF, BPF, and BRF) using various transformation techniques.

**UNIT IV FINITE IMPULSE RESPONSE FILTERS 9**

Linear Phase FIR filter–Phase delay–Group delay–Realization of FIR filter–Design of Causal and Non-causal FIR filters (LPF, HPF, BPF and BRF) using Window method (Rectangular, Hamming window, Hanning window) –Frequency Sampling Technique.

**UNIT V APPLICATIONS OF DSP 9**

Multirate Signal Processing: Decimation, Interpolation, Spectrum of the sampled signal –Processing of Audio and Radar signal.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the students should be able to:**

- Perform mathematical operations on signals.
- Understand the sampling theorem and perform sampling on continuous-time signals to get discrete time signal by applying advanced knowledge of the sampling theory.
- Transform the time domain signal into frequency domain signal and vice-versa.
- Apply the relevant theoretical knowledge to design the digital IIR/FIR filters for the given analog specifications.

**TEXT BOOK:**

1. John G. Proakis & Dimitris G. Manolakis, “Digital Signal Processing – Principles, Algorithms & Applications”, Fourth Edition, Pearson Education / Prentice Hall, 2007.

**REFERENCES**

1. Richard G. Lyons, “*Understanding Digital Signal Processing*”. Second Edition, Pearson Education.
2. A.V. Oppenheim, R.W. Schaffer and J.R. Buck, “*Discrete-Time Signal Processing*”, 8th Indian Reprint, Pearson, 2004.
3. Emmanuel C. Ifeachor, & Barrie.W. Jervis, “*Digital Signal Processing*”, Second Edition, Pearson Education / Prentice Hall, 2002.
4. William D. Stanley, “Digital Signal Processing”, Second Edition, Reston Publications.

**GE8075**

**INTELLECTUAL PROPERTY RIGHTS**

**L T P C  
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**OBJECTIVE:**

- To give an idea about IPR, registration and its enforcement.

**UNIT I INTRODUCTION 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 II REGISTRATION OF IPRs 10**

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

**UNIT III AGREEMENTS AND LEGISLATIONS 10**  
 International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

**UNIT IV 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 V ENFORCEMENT OF IPRs 7**  
 Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

**TOTAL : 45 PERIODS**

**OUTCOME:**

- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

**TEXT BOOKS:**

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

**REFERENCES:**

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

**CS8091**

**BIG DATA ANALYTICS**

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**OBJECTIVES:**

- To know the fundamental concepts of big data and analytics.
- To explore tools and practices for working with big data
- To learn about stream computing.
- To know about the research that requires the integration of large amounts of data.

**UNIT I INTRODUCTION TO BIG DATA 9**

Evolution of Big data - Best Practices for Big data Analytics - Big data characteristics - Validating - The Promotion of the Value of Big Data - Big Data Use Cases- Characteristics of Big Data Applications - Perception and Quantification of Value -Understanding Big Data Storage - A General Overview of High-Performance Architecture - HDFS - MapReduce and YARN - Map Reduce Programming Model

**UNIT II CLUSTERING AND CLASSIFICATION 9**

Advanced Analytical Theory and Methods: Overview of Clustering - K-means - Use Cases - Overview of the Method - Determining the Number of Clusters - Diagnostics - Reasons to Choose and Cautions .- Classification: Decision Trees - Overview of a Decision Tree - The General Algorithm - Decision Tree Algorithms - Evaluating a Decision Tree - Decision Trees in R - Naïve Bayes - Bayes' Theorem - Naïve Bayes Classifier.

### **UNIT III ASSOCIATION AND RECOMMENDATION SYSTEM 9**

Advanced Analytical Theory and Methods: Association Rules - Overview - Apriori Algorithm - Evaluation of Candidate Rules - Applications of Association Rules - Finding Association & finding similarity - Recommendation System: Collaborative Recommendation- Content Based Recommendation - Knowledge Based Recommendation- Hybrid Recommendation Approaches.

### **UNIT IV STREAM MEMORY 9**

Introduction to Streams Concepts – Stream Data Model and Architecture - Stream Computing, Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating moments – Counting oneness in a Window – Decaying Window – Real time Analytics Platform (RTAP) applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions. Using Graph Analytics for Big Data: Graph Analytics

### **UNIT V NOSQL DATA MANAGEMENT FOR BIG DATA AND VISUALIZATION 9**

NoSQL Databases : Schema-less Models”: Increasing Flexibility for Data Manipulation-Key Value Stores- Document Stores - Tabular Stores - Object Data Stores - Graph Databases Hive - Sharding – Hbase – Analyzing big data with twitter - Big data for E-Commerce Big data for blogs - Review of Basic Data Analytic Methods using R.

**TOTAL: 45 PERIODS**

#### **OUTCOMES:**

**Upon completion of the course, the students will be able to:**

- Work with big data tools and its analysis techniques
- Analyze data by utilizing clustering and classification algorithms
- Learn and apply different mining algorithms and recommendation systems for large volumes of data
- Perform analytics on data streams
- Learn NoSQL databases and management.

#### **TEXT BOOKS:**

1. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", Cambridge University Press, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann/El sevier Publishers, 2013.

#### **REFERENCES:**

1. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.
2. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.
3. Dietmar Jannach and Markus Zanker, "Recommender Systems: An Introduction", Cambridge University Press, 2010.
4. Kim H. Pries and Robert Dunnigan, "Big Data Analytics: A Practical Guide for Managers " CRC Press, 2015.
5. Jimmy Lin and Chris Dyer, "Data-Intensive Text Processing with MapReduce", Synthesis Lectures on Human Language Technologies, Vol. 3, No. 1, Pages 1-177, Morgan Claypool publishers, 2010.

**OBJECTIVES:**

- To understand the need for machine learning for various problem solving
- To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning
- To understand the latest trends in machine learning
- To design appropriate machine learning algorithms for problem solving

**UNIT I INTRODUCTION 9**

Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

**UNIT II NEURAL NETWORKS AND GENETIC ALGORITHMS 9**

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

**UNIT III BAYESIAN AND COMPUTATIONAL LEARNING 9**

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

**UNIT IV INSTANT BASED LEARNING 9**

K- Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case Based Learning.

**UNIT V ADVANCED LEARNING 9**

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning

**TOTAL :45 PERIODS****OUTCOMES:****At the end of the course, the students will be able to**

- Differentiate between supervised, unsupervised, semi-supervised machine learning approaches
- Discuss the decision tree algorithm and identify and overcome the problem of overfitting
- Discuss and apply the back propagation algorithm and genetic algorithms to various problems
- Apply the Bayesian concepts to machine learning
- Analyse and suggest appropriate machine learning approaches for various types of problems

**TEXT BOOK:**

1. Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (India) Private Limited, 2013.

**REFERENCES:**

1. Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation and Machine Learning)", The MIT Press 2004.
2. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", CRC Press, 2009.

**OBJECTIVES:**

- To develop an understanding and awareness how issues such as content, information architecture, motion, sound, design, and technology merge to form effective and compelling interactive experiences for a wide range of audiences and end users.
- To become familiar with various software programs used in the creation and implementation of multi- media
- To appreciate the importance of technical ability and creativity within design practice.
- To gain knowledge about graphics hardware devices and software used.
- To understand the two-dimensional graphics and their transformations.
- To understand the three-dimensional graphics and their transformations.
- To appreciate illumination and color models
- To become familiar with understand clipping techniques
- To become familiar with Blender Graphics

**UNIT I ILLUMINATION AND COLOR MODELS 9**

Light sources - basic illumination models – halftone patterns and dithering techniques; Properties of light - Standard primaries and chromaticity diagram; Intuitive colour concepts - RGB colour model - YIQ colour model - CMY colour model - HSV colour model - HLS colour model; Colour selection. Output primitives – points and lines, line drawing algorithms, loading the frame buffer, line function; circle and ellipse generating algorithms; Pixel addressing and object geometry, filled area primitives.

**UNIT II TWO-DIMENSIONAL GRAPHICS 9**

Two dimensional geometric transformations – Matrix representations and homogeneous coordinates, composite transformations; Two dimensional viewing – viewing pipeline, viewing coordinate reference frame; window-to-viewport coordinate transformation, Two dimensional viewing functions; clipping operations – point, line, and polygon clipping algorithms.

**UNIT III THREE-DIMENSIONAL GRAPHICS 9**

Three dimensional concepts; Three dimensional object representations – Polygon surfaces- Polygon tables- Plane equations - Polygon meshes; Curved Lines and surfaces, Quadratic surfaces; Blobby objects; Spline representations – Bezier curves and surfaces -B-Spline curves and surfaces. TRANSFORMATION AND VIEWING: Three dimensional geometric and modeling transformations – Translation, Rotation, Scaling, composite transformations; Three dimensional viewing – viewing pipeline, viewing coordinates, Projections, Clipping; Visible surface detection methods.

**UNIT IV MULTIMEDIA SYSTEM DESIGN & MULTIMEDIA FILE HANDLING 9**

Multimedia basics – Multimedia applications – Multimedia system architecture – Evolving technologies for multimedia – Defining objects for multimedia systems – Multimedia data interface standards – Multimedia databases. Compression and decompression – Data and file format standards – Multimedia I/O technologies – Digital voice and audio – Video image and animation – Full motion video – Storage and retrieval technologies.

**UNIT V HYPERMEDIA 9**

Multimedia authoring and user interface - Hypermedia messaging -Mobile messaging – Hypermedia message component – Creating hypermedia message – Integrated multimedia message standards – Integrated document management – Distributed multimedia systems.**CASE STUDY: BLENDER GRAPHICS** Blender Fundamentals – Drawing Basic Shapes – Modelling – Shading & Textures

**TOTAL: 45 PERIODS**



## OUTCOMES:

At the end of the course, the students should be able to:

- Design two dimensional graphics.
- Apply two dimensional transformations.
- Design three dimensional graphics.
- Apply three dimensional transformations.
- Apply Illumination and color models.
- Apply clipping techniques to graphics.
- Understood Different types of Multimedia File Format
- Design Basic 3d Scenes using Blender

## TEXT BOOKS:

1. Donald Hearn and Pauline Baker M, "Computer Graphics", Prentice Hall, New Delhi, 2007 [ UNIT I – III ]
2. Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", PHI, 2003. [ UNIT IV,V ]

## REFERENCES:

1. Judith Jeffcoate, "Multimedia in practice: Technology and Applications", PHI, 1998.
2. Foley, Vandam, Feiner and Hughes, "Computer Graphics: Principles and Practice", 2<sup>nd</sup> Edition, Pearson Education, 2003.
3. Jeffrey McConnell, "Computer Graphics: Theory into Practice", Jones and Bartlett Publishers,2006.
4. Hill F S Jr., "Computer Graphics", Maxwell Macmillan , 1990.
5. Peter Shirley, Michael Ashikhmin, Michael Gleicher, Stephen R Marschner, Erik Reinhard, KelvinSung, and AK Peters, "Fundamentals of Computer Graphics", CRC Press, 2010.
6. William M. Newman and Robert F.Sproull, "Principles of Interactive Computer Graphics", Mc Graw Hill 1978.  
<https://www.blender.org/support/tutorials/>

IT8075

SOFTWARE PROJECT MANAGEMENT

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## OBJECTIVES:

- To understand the Software Project Planning and Evaluation techniques.
- To plan and manage projects at each stage of the software development life cycle (SDLC).
- To learn about the activity planning and risk management principles.
- To manage software projects and control software deliverables.
- To develop skills to manage the various phases involved in project management and people management.
- To deliver successful software projects that support organization's strategic goals.

## UNIT I

### PROJECT EVALUATION AND PROJECT PLANNING

9

Importance of Software Project Management – Activities - Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.

**UNIT II PROJECT LIFE CYCLE AND EFFORT ESTIMATION 9**

Software process and Process Models – Choice of Process models - Rapid Application development – Agile methods – Dynamic System Development Method – Extreme Programming– Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points - COCOMO II - a Parametric Productivity Model.

**UNIT III ACTIVITY PLANNING AND RISK MANAGEMENT 9**

Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning –Risk Management – – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical paths – Cost schedules.

**UNIT IV PROJECT MANAGEMENT AND CONTROL 9**

Framework for Management and control – Collection of data – Visualizing progress – Cost monitoring – Earned Value Analysis – Prioritizing Monitoring – Project tracking – Change control – Software Configuration Management – Managing contracts – Contract Management.

**UNIT V STAFFING IN SOFTWARE PROJECTS 9**

Managing people – Organizational behavior – Best methods of staff selection – Motivation – The Oldham – Hackman job characteristic model – Stress – Health and Safety – Ethical and Professional concerns – Working in teams – Decision making – Organizational structures – Dispersed and Virtual teams – Communications genres – Communication plans – Leadership.

**TOTAL 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the students should be able to:**

- Understand Project Management principles while developing software.
- Gain extensive knowledge about the basic project management concepts, framework and the process models.
- Obtain adequate knowledge about software process models and software effort estimation techniques.
- Estimate the risks involved in various project activities.
- Define the checkpoints, project reporting structure, project progress and tracking mechanisms using project management principles.
- Learn staff selection process and the issues related to people management

**TEXT BOOK:**

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.

**REFERENCES:**

1. Robert K. Wysocki “Effective Software Project Management” – Wiley Publication, 2011.
2. Walker Royce: “Software Project Management”- Addison-Wesley, 1998.
3. Gopaldaswamy Ramesh, “Managing Global Software Projects” – McGraw Hill Education (India), Fourteenth Reprint 2013.

**OBJECTIVES:**

- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

**UNIT I FUNDAMENTALS OF IoT****9**

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

**UNIT II IoT PROTOCOLS****9**

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT

**UNIT III DESIGN AND DEVELOPMENT****9**

Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.

**UNIT IV DATA ANALYTICS AND SUPPORTING SERVICES****9**

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONF-YANG

**UNIT V CASE STUDIES/INDUSTRIAL APPLICATIONS****9**

Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – GridBlocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control

**TOTAL : 45 PERIODS****OUTCOMES:**

**Upon completion of the course, the student should be able to:**

- Explain the concept of IoT.
- Analyze various protocols for IoT.
- Design a PoC of an IoT system using Rasperry Pi/Arduino
- Apply data analytics and use cloud offerings related to IoT.
- Analyze applications of IoT in real time scenario

**TEXTBOOK:**

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017

## REFERENCES:

1. Arshdeep Bahga, Vijay Madiseti, "Internet of Things – A hands-on approach", Universities Press, 2015
2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012 (for Unit 2).
3. Jan Ho" ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
5. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2<sup>nd</sup> Edition, O'Reilly\_Media, 2011.  
<https://www.arduino.cc/>  
[https://www.ibm.com/smarterplanet/us/en/?ca=v\\_smarterplanet](https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet)

IT8074

SERVICE ORIENTED ARCHITECTURE

L T P C  
3 0 0 3

## OBJECTIVES:

- To learn fundamentals of XML
- To provide an overview of Service Oriented Architecture and Web services and their importance
- To learn web services standards and technologies
- To learn service oriented analysis and design for developing SOA based applications

### UNIT I XML

9

XML document structure – Well-formed and valid documents – DTD – XML Schema – Parsing XML using DOM, SAX – XPath - XML Transformation and XSL – Xquery

### UNIT II SERVICE ORIENTED ARCHITECTURE (SOA) BASICS

9

Characteristics of SOA, Benefits of SOA , Comparing SOA with Client-Server and Distributed architectures --- Principles of Service Orientation – Service layers

### UNIT III WEB SERVICES (WS) AND STANDARDS

8

Web Services Platform – Service descriptions – WSDL – Messaging with SOAP – Service discovery – UDDI – Service-Level Interaction Patterns – Orchestration and Choreography

### UNIT IV WEB SERVICES EXTENSIONS

8

WS-Addressing - WS-ReliableMessaging - WS-Policy – WS-Coordination – WS -Transactions - WS-Security - Examples

### UNIT V SERVICE ORIENTED ANALYSIS AND DESIGN

11

SOA delivery strategies – Service oriented analysis – Service Modelling – Service oriented design – Standards and composition guidelines -- Service design – Business process design – Case Study

**TOTAL : 45 PERIODS**

## OUTCOMES:

**Upon successful completion of this course, the students will be able to:**

- Understand XML technologies
- Understand service orientation, benefits of SOA
- Understand web services and WS standards
- Use web services extensions to develop solutions
- Understand and apply service modeling, service oriented analysis and design for application development

**TEXTBOOKS:**

1. Thomas Erl, "Service Oriented Architecture: Concepts, Technology, and Design", Pearson Education, 2005
2. Sandeep Chatterjee and James Webber, "Developing Enterprise Web Services: An Architect's Guide", Prentice Hall, 2004

**REFERENCES:**

1. James McGovern, Sameer Tyagi, Michael E Stevens, Sunil Mathew, "Java Web Services Architecture", Elsevier, 2003.
2. Ron Schmelzer et al. "XML and Web Services", Pearson Education, 2002.
3. Frank P.Coyle, "XML, Web Services and the Data Revolution", Pearson Education, 2002

**GE8077****TOTAL QUALITY MANAGEMENT****L T P C  
3 0 0 3****OBJECTIVE:**

- To facilitate the understanding of Quality Management principles and process.

**UNIT I 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 - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

**UNIT II TQM PRINCIPLES****9**

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

**UNIT III TQM TOOLS AND 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 IV TQM TOOLS AND TECHNIQUES II****9**

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

**UNIT V QUALITY MANAGEMENT SYSTEM****9**

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration- **ENVIRONMENTAL MANAGEMENT SYSTEM:** Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

**TOTAL: 45 PERIODS****OUTCOME:**

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

**TEXT BOOK:**

1. Dale H.Besterfield, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

**REFERENCES:**

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8<sup>th</sup> Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO9001-2015 standards

**CS8083****MULTI-CORE ARCHITECTURES AND PROGRAMMING****L T P C  
3 0 0 3****OBJECTIVES:**

- To understand the need for multi-core processors, and their architecture.
- To understand the challenges in parallel and multi-threaded programming.
- To learn about the various parallel programming paradigms,
- To develop multicore programs and design parallel solutions.

**UNIT I MULTI-CORE PROCESSORS****9**

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks - Symmetric and Distributed Shared Memory Architectures – Cache coherence - Performance Issues – Parallel program design.

**UNIT II PARALLEL PROGRAM CHALLENGES****9**

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

**UNIT III SHARED MEMORY PROGRAMMING WITH OpenMP****9**

OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs - Library functions – Handling Data and Functional Parallelism – Handling Loops - Performance Considerations.

**UNIT IV DISTRIBUTED MEMORY PROGRAMMING WITH MPI****9**

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation

**UNIT V PARALLEL PROGRAM DEVELOPMENT****9**

Case studies - n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

**TOTAL: 45 PERIODS****OUTCOMES:**

**At the end of the course, the students should be able to:**

- Describe multicore architectures and identify their characteristics and challenges.
- Identify the issues in programming Parallel Processors.
- Write programs using OpenMP and MPI.
- Design parallel programming solutions to common problems.
- Compare and contrast programming for serial processors and programming for parallel processors.

**TEXT BOOKS:**

1. Peter S. Pacheco, "An Introduction to Parallel Programming", Morgan-Kaufman/Elsevier, 2011.
2. Darryl Gove, "Multicore Application Programming for Windows, Linux, and Oracle Solaris", Pearson, 2011 (unit 2)

**REFERENCES:**

1. Michael J Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw Hill, 2003.
2. Victor Alessandrini, Shared Memory Application Programming, 1st Edition, Concepts and Strategies in Multicore Application Programming, Morgan Kaufmann, 2015.
3. Yan Solihin, Fundamentals of Parallel Multicore Architecture, CRC Press, 2015.

**CS8079****HUMAN COMPUTER INTERACTION****L T P C  
3 0 0 3****OBJECTIVES:**

- To learn the foundations of Human Computer Interaction.
- To become familiar with the design technologies for individuals and persons with disabilities.
- To be aware of mobile HCI.
- To learn the guidelines for user interface.

**UNIT I FOUNDATIONS OF HCI****9**

**The Human:** I/O channels – Memory – Reasoning and problem solving; **The Computer:** Devices – Memory – processing and networks; **Interaction:** Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms. - **Case Studies**

**UNIT II DESIGN & SOFTWARE PROCESS****9**

**Interactive Design:** Basics – process – scenarios – navigation – screen design – Iteration and prototyping. **HCI in software process:** Software life cycle – usability engineering – Prototyping in practice – design rationale. **Design rules:** principles, standards, guidelines, rules. **Evaluation Techniques – Universal Design**

**UNIT III MODELS AND THEORIES****9**

**HCI Models:** Cognitive models: Socio-Organizational issues and stakeholder requirements – Communication and collaboration models-**Hypertext, Multimedia and WWW.**

**UNIT IV MOBILE HCI****9**

**Mobile Ecosystem:** Platforms, Application frameworks- **Types of Mobile Applications:** Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, **Mobile Design:** Elements of Mobile Design, Tools. - **Case Studies**

**UNIT V WEB INTERFACE DESIGN****9**

**Designing Web Interfaces** – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow - **Case Studies**

**TOTAL :45 PERIODS****OUTCOMES:**

**Upon completion of the course, the students should be able to:**

- Design effective dialog for HCI
- Design effective HCI for individuals and persons with disabilities.
- Assess the importance of user feedback.
- Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites.
- Develop meaningful user interface.

**TEXT BOOKS:**

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004 (UNIT I, II & III)
2. Brian Fling, "Mobile Design and Development", First Edition, O'Reilly Media Inc., 2009 (UNIT – IV)
3. Bill Scott and Theresa Neil, "Designing Web Interfaces", First Edition, O'Reilly, 2009. (UNIT-V)

|               |                                |          |          |          |          |
|---------------|--------------------------------|----------|----------|----------|----------|
| <b>CS8073</b> | <b>C# AND .NET PROGRAMMING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To learn basic programming in C# and the object oriented programming concepts.
- To update and enhance skills in writing Windows applications, ADO.NET and ASP .NET.
- To study the advanced concepts in data connectivity, WPF, WCF and WWF with C# and .NET 4.5.
- To implement mobile applications using .Net compact framework
- To understand the working of base class libraries, their operations and manipulation of data using XML.

**UNIT I C# LANGUAGE BASICS 9**

.Net Architecture - Core C# - Variables - Data Types - Flow control - Objects and Types- Classes and Structs - Inheritance- Generics – Arrays and Tuples - Operators and Casts - Indexers

**UNIT II C# ADVANCED FEATURES 9**

Delegates - Lambdas - Lambda Expressions - Events - Event Publisher - Event Listener - Strings and Regular Expressions - Generics - Collections - Memory Management and Pointers - Errors and Exceptions - Reflection

**UNIT III BASE CLASS LIBRARIES AND DATA MANIPULATION 9**

Diagnostics -Tasks, Threads and Synchronization - .Net Security - Localization - Manipulating XML- SAX and DOM - Manipulating files and the Registry- Transactions - ADO.NET- Peer-to-Peer Networking - P2P - Building P2P Applications - Windows Presentation Foundation (WPF).

**UNIT IV WINDOW BASED APPLICATIONS, WCF AND WWF 9**

Window based applications - Core ASP.NET- ASP.NET Web forms -Windows Communication Foundation (WCF)- Introduction to Web Services - .Net Remoting - Windows Service - Windows Workflow Foundation (WWF) - Activities – Workflows

**UNIT V .NET FRAMEWORK AND COMPACT FRAMEWORK 9**

Assemblies - Shared assemblies - Custom Hosting with CLR Objects - Appdomains - Core XAML - Bubbling and Tunneling Events- Reading and Writing XAML - .Net Compact Framework - Compact Edition Data Stores – Errors, Testing and Debugging – Optimizing performance – Packaging and Deployment – Networking and Mobile Devices

**TOTAL :45 PERIODS**





**UNIT V SECURITY IN AD HOC AND SENSOR NETWORKS****9**

Security Attacks – Key Distribution and Management – Intrusion Detection – Software based Anti-tamper techniques – Water marking techniques – Defense against routing attacks - Secure Ad hoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS

**TOTAL :45 PERIODS****OUTCOMES:****Upon completion of the course, the students will be able to:**

- Identify different issues in wireless ad hoc and sensor networks .
- To analyze protocols developed for ad hoc and sensor networks .
- To identify and understand security issues in ad hoc and sensor networks.

**TEXT BOOKS:**

1. C.Siva Ram Murthy and B.S.Manoj, “Ad Hoc Wireless Networks – Architectures and Protocols”, Pearson Education, 2006.
2. Holger Karl, Andreas Willing, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, Inc., 2005.

**REFERENCES**

1. Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, “Ad Hoc Mobile Wireless Networks”, Auerbach Publications, 2008.
2. Carlos De Morais Cordeiro, Dharma Prakash Agrawal, “Ad Hoc and Sensor Networks: Theory and Applications (2<sup>nd</sup> Edition)”, World Scientific Publishing, 2011.
3. Walteneus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks Theory and Practice”, John Wiley and Sons, 2010
4. Xiang-Yang Li , “Wireless Ad Hoc and Sensor Networks: Theory and Applications”, 1227 th edition, Cambridge university Press,2008.

**CS8071****ADVANCED TOPICS ON DATABASES****L T P C  
3 0 0 3****OBJECTIVES:**

- To learn the modeling and design of databases.
- To acquire knowledge on parallel and distributed databases and their applications.
- To study the usage and applications of Object Oriented and Intelligent databases.
- To understand the usage of advanced data models.
- To learn emerging databases such as XML, Cloud and Big Data.
- To acquire inquisitive attitude towards research topics in databases.

**UNIT I PARALLEL AND DISTRIBUTED DATABASES****9**

Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems- Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Case Studies

**UNIT II OBJECT AND OBJECT RELATIONAL DATABASES****9**

Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects – Object Database Standards, Languages and Design: ODMG Model – ODL –

OQL – Object Relational and Extended – Relational Systems: Object Relational features in SQL/Oracle – Case Studies.

**UNIT III INTELLIGENT DATABASES 9**

Active Databases: Syntax and Semantics (Starburst, Oracle, DB2)- Taxonomy- Applications- Design Principles for Active Rules- Temporal Databases: Overview of Temporal Databases- TSQL2- Deductive Databases: Logic of Query Languages – Datalog- Recursive Rules-Syntax and Semantics of Datalog Languages- Implementation of Rules and Recursion- Recursive Queries in SQL- Spatial Databases- Spatial Data Types- Spatial Relationships- Spatial Data Structures- Spatial Access Methods- Spatial DB Implementation.

**UNIT IV ADVANCED DATA MODELS 9**

Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models -Concurrency Control - Transaction Commit Protocols- Multimedia Databases- Information Retrieval- Data Warehousing- Data Mining- Text Mining.

**UNIT V EMERGING TECHNOLOGIES 9**

XML Databases: XML-Related Technologies-XML Schema- XML Query Languages- Storing XML in Databases-XML and SQL- Native XML Databases- Web Databases- Geographic Information Systems- Biological Data Management- Cloud Based Databases: Data Storage Systems on the Cloud- Cloud Storage Architectures-Cloud Data Models- Query Languages- Introduction to Big Data-Storage-Analysis.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**Upon Completion of the course, the students will be able,**

- To develop in-depth understanding of relational databases and skills to optimize database performance in practice.
- To understand and critique on each type of databases.
- To design faster algorithms in solving practical database problems.
- To implement intelligent databases and various data models.

**TEXT BOOKS:**

1. Ramez Elmasri, Shamkant B. Navathe, “Fundamentals of Database Systems”, Sixth Edition , Pearson, 2011.
2. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Fourth Edition, Pearson Education, 2008.

**REFERENCES:**

1. Henry F Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Sixth Edition, McGraw Hill, 2011.
2. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
3. Carlo Zaniolo, Stefano Ceri, Christos Faloutsos, Richard T.Snodgrass, V.S.Subrahmanian, Roberto Zicari, “Advanced Database Systems”, Morgan Kaufmann publishers,2006.

|               |  |          |          |          |          |
|---------------|--|----------|----------|----------|----------|
| <b>GE8072</b> | <b>FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To understand the global trends and development methodologies of various types of



- Manage a project from start to finish

#### TEXTBOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

#### REFERENCES:

1. Hiriappa B, "Corporate Strategy – Managing the Business", Author House, 2013.
2. Peter F Drucker, "People and Performance", Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise Resource Planning – Concepts", Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

**GE8074**

**HUMAN RIGHTS**

**L T P C  
3 0 0 3**

#### OBJECTIVE :

- To sensitize the Engineering students to various aspects of Human Rights.

#### UNIT I

**9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

#### UNIT II

**9**

Evolution of the concept of Human Rights Magna carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

#### UNIT III

**9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

#### UNIT IV

**9**

Human Rights in India – Constitutional Provisions / Guarantees.

#### UNIT V

**9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

**TOTAL: 45 PERIODS**

#### OUTCOME:

- Engineering students will acquire the basic knowledge of human rights.

#### REFERENCES:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

**OBJECTIVES:**

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

**UNIT I INTRODUCTION TO DISASTERS 9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

**UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9**

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj

Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Process and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

**UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

**UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

**UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

**TOTAL: 45 PERIODS****OUTCOMES:****The students will be able to**

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

**TEXTBOOKS:**

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

**REFERENCES**

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

**EC8093****DIGITAL IMAGE PROCESSING**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods

**UNIT I DIGITAL IMAGE FUNDAMENTALS 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 II IMAGE ENHANCEMENT 9**

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

**UNIT III IMAGE RESTORATION 9**

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

**UNIT IV IMAGE SEGMENTATION 9**

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

**UNIT V IMAGE COMPRESSION AND RECOGNITION 9**

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

**TOTAL 45 PERIODS**

**OUTCOMES:****At the end of the course, the students should be able to:**

- Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
- Operate on images using the techniques of smoothing, sharpening and enhancement.
- Understand the restoration concepts and filtering techniques.
- Learn the basics of segmentation, features extraction, compression and recognition methods for color models.

**TEXT BOOKS:**

1. Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson, Third Edition, 2010.
2. Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson, 2002.

**REFERENCES:**

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 RM. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002
5. Milan Sonka et al 'Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999

**CS8085****SOCIAL NETWORK ANALYSIS****L T P C  
3 0 0 3****OBJECTIVES:**

- To understand the concept of semantic web and related applications.
- To learn knowledge representation using ontology.
- To understand human behaviour in social web and related communities.
- To learn visualization of social networks.

**UNIT I INTRODUCTION****9**

Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.

**UNIT II MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION****9**

Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of social relationships - Aggregating and reasoning with social network data - Advanced representations.

**UNIT III EXTRACTION AND MINING COMMUNITIES IN WEB SOCIAL NETWORKS****9**

Extracting evolution of Web Community from a Series of Web Archive - Detecting communities in social networks - Definition of community - Evaluating communities - Methods for community detection and mining - Applications of community mining algorithms - Tools for detecting



communities social network infrastructures and communities - Decentralized online social networks - Multi-Relational characterization of dynamic social network communities.

**UNIT IV PREDICTING HUMAN BEHAVIOUR AND PRIVACY ISSUES 9**

Understanding and predicting human behaviour for social communities - User data management - Inference and Distribution - Enabling new human experiences - Reality mining - Context - Awareness - Privacy in online social networks - Trust in online environment - Trust models based on subjective logic - Trust network analysis - Trust transitivity analysis - Combining trust and reputation - Trust derivation based on trust comparisons - Attack spectrum and countermeasures.

**UNIT V VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS 9**

Graph theory - Centrality - Clustering - Node-Edge Diagrams - Matrix representation - Visualizing online social networks, Visualizing social networks with matrix-based representations - Matrix and Node-Link Diagrams - Hybrid representations - Applications - Cover networks - Community welfare - Collaboration networks - Co-Citation networks.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the students should be able to:**

- Develop semantic web related applications.
- Represent knowledge using ontology.
- Predict human behaviour in social web and related communities.
- Visualize social networks.

**TEXT BOOKS:**

1. Peter Mika, "Social Networks and the Semantic Web", First Edition, Springer 2007.
2. Borko Furht, "Handbook of Social Network Technologies and Applications", 1<sup>st</sup> Edition, Springer, 2010.

**REFERENCES:**

1. Guandong Xu ,Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", First Edition, Springer, 2011.
2. Dion Goh and Schubert Foo, "Social information Retrieval Systems: Emerging Technologies and Applications for Searching the Web Effectively", IGI Global Snippet, 2008.
3. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, "Collaborative and Social Information Retrieval and Access: Techniques for Improved user Modelling", IGI Global Snippet, 2009.
4. John G. Breslin, Alexander Passant and Stefan Decker, "The Social Semantic Web", Springer, 2009.

**IT8073**

**INFORMATION SECURITY**

|          |          |          |          |
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| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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**OBJECTIVES:**

- To understand the basics of Information Security
- To know the legal, ethical and professional issues in Information Security
- To know the aspects of risk management
- To become aware of various standards in this area
- To know the technological aspects of Information Security

**UNIT I INTRODUCTION 9**

History, What is Information Security?, Critical Characteristics of Information, NSTISSC Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, The SDLC, The Security SDLC

|  |                               |                   |
|--|-------------------------------|-------------------|
| <b>UNIT II</b>   | <b>SECURITY INVESTIGATION</b> | <b>9</b>          |
| Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues - An Overview of Computer Security - Access Control Matrix, Policy-Security policies, Confidentiality policies, Integrity policies and Hybrid policies |                               |                   |
| <b>UNIT III</b>  | <b>SECURITY ANALYSIS</b>      | <b>9</b>          |
| Risk Management: Identifying and Assessing Risk, Assessing and Controlling Risk - Systems: Access Control Mechanisms, Information Flow and Confinement Problem   |                               |                   |
| <b>UNIT IV</b>   | <b>LOGICAL DESIGN</b>         | <b>9</b>          |
| Blueprint for Security, Information Security Policy, Standards and Practices, ISO 17799/BS 7799, NIST Models, VISA International Security Model, Design of Security Architecture, Planning for Continuity  |                               |                   |
| <b>UNIT V</b>  | <b>PHYSICAL DESIGN</b>        | <b>9</b>          |
| Security Technology, IDS, Scanning and Analysis Tools, Cryptography, Access Control Devices, Physical Security, Security and Personnel   |                               |                   |
| <b>TOTAL</b>   |                               | <b>45 PERIODS</b> |

**OUTCOMES:**

**At the end of this course, the students should be able to:**

- Discuss the basics of information security
- Illustrate the legal, ethical and professional issues in information security
- Demonstrate the aspects of risk management.
- Become aware of various standards in the Information Security System
- Design and implementation of Security Techniques.

**TEXT BOOK:**

1. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Vikas Publishing House, New Delhi, 2003

**REFERENCES**

1. Micki Krause, Harold F. Tipton, " Handbook of Information Security Management", Vol 1-3 CRCPress LLC, 2004.
2. Stuart McClure, Joel Scrambray, George Kurtz, "Hacking Exposed", Tata McGraw-Hill, 2003
3. Matt Bishop, " Computer Security Art and Science", Pearson/PHI, 2002.

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| <b>CS8087</b> | <b>SOFTWARE DEFINED NETWORKS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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**OBJECTIVES:**

- To learn the fundamentals of software defined networks.
- To understand the separation of the data plane and the control plane.
- To study about the SDN Programming.
- To study about the various applications of SDN

|  |  |          |
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| <b>UNIT I</b>  | <b>INTRODUCTION</b>                    | <b>9</b> |
| History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Date Planes |  |          |
| <b>UNIT II</b>   | <b>OPEN FLOW &amp; SDN CONTROLLERS</b> | <b>9</b> |
| Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor-   |  |          |

Based Overlays – SDN via Opening up the Device – SDN Controllers – General Concepts

**UNIT III DATA CENTERS 9**  
Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE

**UNIT IV SDN PROGRAMMING 9**  
Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications

**UNIT V SDN 9**  
Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration

**TOTAL :45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the students will be able to:**

- Analyze the evolution of software defined networks
- Express the various components of SDN and their uses
- Explain the use of SDN in the current networking scenario
- Design and develop various applications of SDN

**TEXT BOOKS:**

1. Paul Goransson and Chuck Black, —Software Defined Networks: A Comprehensive Approach, First Edition, Morgan Kaufmann, 2014.
2. Thomas D. Nadeau, Ken Gray, —SDN: Software Defined Networks, O'Reilly Media, 2013.

**REFERENCES:**

1. Siamak Azodolmolky, —Software Defined Networking with Open Flow, Packet Publishing, 2013.
2. Vivek Tiwari, —SDN and Open Flow for BeginnersII, Amazon Digital Services, Inc., 2013.
3. Fei Hu, Editor, —Network Innovation through Open Flow and SDN: Principles and Design, CRC Press, 2014.

**CS8074**

**CYBER FORENSICS**

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|---|---|---|---|
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**OBJECTIVES:**

- To learn computer forensics
- To become familiar with forensics tools
- To learn to analyze and validate forensics data

**UNIT I INTRODUCTION TO COMPUTER FORENSICS 9**  
Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & Identity Fraud. Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation. Preparation for IR: Creating response tool kit and IR team. - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

**UNIT II EVIDENCE COLLECTION AND FORENSICS TOOLS 9**  
Processing Crime and Incident Scenes – Working with Windows and DOS Systems.  
**Current Computer Forensics Tools:** Software/ Hardware Tools.

**UNIT III ANALYSIS AND VALIDATION 9**  
 Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics

**UNIT IV ETHICAL HACKING 9**  
 Introduction to Ethical Hacking - Footprinting and Reconnaissance - Scanning Networks - Enumeration - System Hacking - Malware Threats - Sniffing

**UNIT V ETHICAL HACKING IN WEB 9**  
 Social Engineering - Denial of Service - Session Hijacking - Hacking Web servers - Hacking Web Applications – SQL Injection - Hacking Wireless Networks - Hacking Mobile Platforms.

**TOTAL 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Understand the basics of computer forensics
- Apply a number of different computer forensic tools to a given scenario
- Analyze and validate forensics data
- Identify the vulnerabilities in a given network infrastructure
- Implement real-world hacking techniques to test system security

**TEXT BOOKS:**

1. Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, “Computer Forensics and Investigations”, Cengage Learning, India Edition, 2016.
2. CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2015.

**REFERENCES**

1. John R.Vacca, “Computer Forensics”, Cengage Learning, 2005
2. MarjieT.Britz, “Computer Forensics and Cyber Crime”: An Introduction”, 3<sup>rd</sup> Edition, Prentice Hall, 2013.
3. AnkitFadia “ Ethical Hacking” Second Edition, Macmillan India Ltd, 2006
4. Kenneth C.Brancik “Insider Computer Fraud” Auerbach Publications Taylor & Francis Group–2008.

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| <b>CS8086</b> | <b>SOFT COMPUTING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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**OBJECTIVES:**

- To learn the basic concepts of Soft Computing
- To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
- To apply soft computing techniques to solve problems.

**UNIT I INTRODUCTION TO SOFT COMPUTING 9**  
 Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.

**UNIT II ARTIFICIAL NEURAL NETWORKS 9**  
 Back propagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization -Hamming Neural Network - Hopfield Neural Network- Bi-directional

Associative Memory -Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.

**UNIT III FUZZY SYSTEMS 9**

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations -Membership Functions -Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.

**UNIT IV GENETIC ALGORITHMS 9**

Basic Concepts- Working Principles -Encoding- Fitness Function - Reproduction - Inheritance Operators - Cross Over - Inversion and Deletion -Mutation Operator - Bit-wise Operators -Convergence of Genetic Algorithm.

**UNIT V HYBRID SYSTEMS 9**

Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon completion of this course, the students should be able to**

- Apply suitable soft computing techniques for various applications.
- Integrate various soft computing techniques for complex problems.

**TEXT BOOKS:**

1. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
2. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 2nd Edition, 2011.
3. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications ", PHI Learning Pvt. Ltd., 2017.

**REFERENCES:**

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro-Fuzzy and Soft Computing", Prentice-Hall of India, 2002.
2. Kwang H.Lee, "First course on Fuzzy Theory and Applications", Springer, 2005.
3. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall, 1996.
4. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Addison Wesley, 2003.

**GE8076**

**PROFESSIONAL ETHICS IN ENGINEERING**

**LT P C  
3 0 0 3**

**OBJECTIVES:**

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

**UNIT I HUMAN VALUES**

**10**

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 – Introduction to Yoga and meditation for professional excellence and stress management.

**UNIT II      ENGINEERING ETHICS      9**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

**UNIT III      ENGINEERING AS SOCIAL EXPERIMENTATION      9**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

**UNIT IV      SAFETY, RESPONSIBILITIES AND RIGHTS      9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

**UNIT V      GLOBAL ISSUES      8**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

**TEXT BOOKS:**

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

**REFERENCES:**

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd., New Delhi, 2013.
6. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011.

**Web sources:**

1. [www.onlineethics.org](http://www.onlineethics.org)
2. [www.nspe.org](http://www.nspe.org)
3. [www.globalethics.org](http://www.globalethics.org)
4. [www.ethics.org](http://www.ethics.org)

**OBJECTIVES:**

- To understand the basics of Information Retrieval.
- To understand machine learning techniques for text classification and clustering.
- To understand various search engine system operations.
- To learn different techniques of recommender system.

**UNIT I INTRODUCTION****9**

Information Retrieval – Early Developments – The IR Problem – The User’s Task – Information versus Data Retrieval - The IR System – The Software Architecture of the IR System – The Retrieval and Ranking Processes - The Web – The e-Publishing Era – How the web changed Search – Practical Issues on the Web – How People Search – Search Interfaces Today – Visualization in Search Interfaces.

**UNIT II MODELING AND RETRIEVAL EVALUATION****9**

Basic IR Models - Boolean Model - TF-IDF (Term Frequency/Inverse Document Frequency) Weighting - Vector Model – Probabilistic Model – Latent Semantic Indexing Model – Neural Network Model – Retrieval Evaluation – Retrieval Metrics – Precision and Recall – Reference Collection – User-based Evaluation – Relevance Feedback and Query Expansion – Explicit Relevance Feedback.

**UNIT III TEXT CLASSIFICATION AND CLUSTERING****9**

A Characterization of Text Classification – Unsupervised Algorithms: Clustering – Naïve Text Classification – Supervised Algorithms – Decision Tree – k-NN Classifier – SVM Classifier – Feature Selection or Dimensionality Reduction – Evaluation metrics – Accuracy and Error – Organizing the classes – Indexing and Searching – Inverted Indexes – Sequential Searching – Multi-dimensional Indexing.

**UNIT IV WEB RETRIEVAL AND WEB CRAWLING****9**

The Web – Search Engine Architectures – Cluster based Architecture – Distributed Architectures – Search Engine Ranking – Link based Ranking – Simple Ranking Functions – Learning to Rank – Evaluations -- Search Engine Ranking – Search Engine User Interaction – Browsing – Applications of a Web Crawler – Taxonomy – Architecture and Implementation – Scheduling Algorithms – Evaluation.

**UNIT V RECOMMENDER SYSTEM****9**

Recommender Systems Functions – Data and Knowledge Sources – Recommendation Techniques – Basics of Content-based Recommender Systems – High Level Architecture – Advantages and Drawbacks of Content-based Filtering – Collaborative Filtering – Matrix factorization models – Neighborhood models.

**TOTAL: 45 PERIODS****OUTCOMES:****Upon completion of the course, the students will be able to:**

- Use an open source search engine framework and explore its capabilities
- Apply appropriate method of classification or clustering.
- Design and implement innovative features in a search engine.
- Design and implement a recommender system.

**TEXT BOOKS:**

1. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, —Modern Information Retrieval: The Concepts and Technology behind Search, Second Edition, ACM Press Books, 2011.
2. Ricci, F, Rokach, L. Shapira, B.Kantor, “Recommender Systems Handbook”, First Edition, 2011.

**REFERENCES:**

1. C. Manning, P. Raghavan, and H. Schütze, —Introduction to Information Retrieval, Cambridge University Press, 2008.
2. Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, —Information Retrieval: Implementing and Evaluating Search Engines, The MIT Press, 2010.

**CS8078**

**GREEN COMPUTING**

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**OBJECTIVES:**

- To learn the fundamentals of Green Computing.
- To analyze the Green computing Grid Framework.
- To understand the issues related with Green compliance.
- To study and develop various case studies.

**UNIT I FUNDAMENTALS**

**9**

Green IT Fundamentals: Business, IT, and the Environment – Green computing: carbon foot print, scoop on power – Green IT Strategies: Drivers, Dimensions, and Goals – Environmentally Responsible Business: Policies, Practices, and Metrics.

**UNIT II GREEN ASSETS AND MODELING**

**9**

Green Assets: Buildings, Data Centers, Networks, and Devices – Green Business Process Management: Modeling, Optimization, and Collaboration – Green Enterprise Architecture – Environmental Intelligence – Green Supply Chains – Green Information Systems: Design and Development Models.

**UNIT III GRID FRAMEWORK**

**9**

Virtualization of IT systems – Role of electric utilities, Telecommuting, teleconferencing and teleporting – Materials recycling – Best ways for Green PC – Green Data center – Green Grid framework.

**UNIT IV GREEN COMPLIANCE**

**9**

Socio-cultural aspects of Green IT – Green Enterprise Transformation Roadmap – Green Compliance: Protocols, Standards, and Audits – Emergent Carbon Issues: Technologies and Future.

**UNIT V CASE STUDIES**

**9**

The Environmentally Responsible Business Strategies (ERBS) – Case Study Scenarios for Trial Runs – Case Studies – Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the students will be able to:**

- Acquire knowledge to adopt green computing practices to minimize negative impacts on the environment.
- Enhance the skill in energy saving practices in their use of hardware.
- Evaluate technology tools that can reduce paper waste and carbon footprint by the stakeholders.
- Understand the ways to minimize equipment disposal requirements .



**TEXT BOOKS:**

1. Bhuvan Unhelkar, "Green IT Strategies and Applications-Using Environmental Intelligence", CRC Press, June 2014.
2. Woody Leonhard, Katherine Murray, "Green Home computing for dummies", August 2012.

**REFERENCES:**

1. Alin Gales, Michael Schaefer, Mike Ebbers, "Green Data Center: steps for the Journey", Shroff/IBM rebook, 2011.
2. John Lamb, "The Greening of IT", Pearson Education, 2009.
3. Jason Harris, "Green Computing and Green IT- Best Practices on regulations & industry", Lulu.com, 2008
4. Carl speshocky, "Empowering Green Initiatives with IT", John Wiley & Sons, 2010.
5. Wu Chun Feng (editor), "Green computing: Large Scale energy efficiency", CRC Press

**CS8076****GPU ARCHITECTURE AND PROGRAMMING****L T P C  
3 0 0 3****OBJECTIVES:**

- To understand the basics of GPU architectures
- To write programs for massively parallel processors
- To understand the issues in mapping algorithms for GPUs
- To introduce different GPU programming models

**UNIT I GPU ARCHITECTURE****12**

Evolution of GPU architectures - Understanding Parallelism with GPU –Typical GPU Architecture - CUDA Hardware Overview - Threads, Blocks, Grids, Warps, Scheduling - Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.

**UNIT II CUDA PROGRAMMING****8**

Using CUDA - Multi GPU - Multi GPU Solutions - Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.

**UNIT III PROGRAMMING ISSUES****8**

Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.

**UNIT IV OPENCL BASICS****8**

OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples.

**UNIT V ALGORITHMS ON GPU****9**

Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix - Matrix Multiplication - Programming Heterogeneous Cluster.

**TOTAL: 45 PERIODS****OUTCOMES:****Upon completion of the course, the students will be able to**

- Describe GPU Architecture
- Write programs using CUDA, identify issues and debug them
- Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication
- Write simple programs using OpenCL
- Identify efficient parallel programming patterns to solve problems

**TEXT BOOKS:**

1. Shane Cook, CUDA Programming: —A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, "Heterogeneous computing with OpenCL", 3<sup>rd</sup> Edition, Morgan Kauffman, 2015.

**REFERENCES:**

1. Nicholas Wilt, —CUDA Handbook: A Comprehensive Guide to GPU Programming, Addison - Wesley, 2013.
2. Jason Sanders, Edward Kandrot, —CUDA by Example: An Introduction to General Purpose GPU ProgrammingII, Addison - Wesley, 2010.
3. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors - A Hands-on Approach, Third Edition, Morgan Kaufmann, 2016.
4. [http://www.nvidia.com/object/cuda\\_home\\_new.html](http://www.nvidia.com/object/cuda_home_new.html)
5. <http://www.openCL.org>

**CS8084****NATURAL LANGUAGE PROCESSING****L T P C  
3 0 0 3****OBJECTIVES:**

- To learn the fundamentals of natural language processing
- To understand the use of CFG and PCFG in NLP
- To understand the role of semantics of sentences and pragmatics
- To apply the NLP techniques to IR applications

**UNIT I 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 II WORD LEVEL ANALYSIS****9**

Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule-based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

**UNIT III SYNTACTIC ANALYSIS****9**

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs - Feature structures, Unification of feature structures.

**UNIT IV SEMANTICS AND PRAGMATICS****10**

Requirements for representation, First-Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selectional restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

**UNIT V DISCOURSE ANALYSIS AND LEXICAL RESOURCES****8**

Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

**TOTAL :45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the students will be able to:**

- To tag a given text with basic Language features
- To design an innovative application using NLP components
- To implement a rule based system to tackle morphology/syntax of a language
- To design a tag set to be used for statistical processing for real-time applications
- To compare and contrast the use of different statistical approaches for different types of NLP applications.

**TEXT BOOKS:**

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 PythonI, First Edition, O'Reilly Media, 2009.

**REFERENCES:**

1. Breck Baldwin, —Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
2. Richard M Reese, —Natural Language Processing with Javall, O'Reilly Media, 2015.
3. Nitin Indurkhya and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
4. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

**CS8001****PARALLEL ALGORITHMS**

|          |          |          |          |
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**OBJECTIVES:**

To understand different parallel architectures and models of computation.

To introduce the various classes of parallel algorithms.

To study parallel algorithms for basic problems.

**UNIT I INTRODUCTION****9**

Need for Parallel Processing - Data and Temporal Parallelism - Models of Computation - RAM and PRAM Model – Shared Memory and Message Passing Models- Processor Organisations - PRAM Algorithm – Analysis of PRAM Algorithms- Parallel Programming Languages.

**UNIT II PRAM ALGORITHMS****9**

Parallel Algorithms for Reduction – Prefix Sum – List Ranking –Preorder Tree Traversal – Searching -Sorting - Merging Two Sorted Lists – Matrix Multiplication - Graph Coloring - Graph Searching.

**UNIT III SIMD ALGORITHMS -I****9**

2D Mesh SIMD Model - Parallel Algorithms for Reduction - Prefix Computation - Selection - Odd-Even Merge Sorting - Matrix Multiplication

**UNIT IV SIMD ALGORITHMS -II 9**  
 Hypercube SIMD Model - Parallel Algorithms for Selection- Odd-Even Merge Sort- Bitonic Sort- Matrix Multiplication Shuffle Exchange SIMD Model - Parallel Algorithms for Reduction -Bitonic Merge Sort - Matrix Multiplication - Minimum Cost Spanning Tree

**UNIT V MIMD ALGORITHMS 9**  
 UMA Multiprocessor Model -Parallel Summing on Multiprocessor- Matrix Multiplication on Multiprocessors and Multicomputer - Parallel Quick Sort - Mapping Data to Processors.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon completion of this course, the students should be able to**

- Develop parallel algorithms for standard problems and applications.
- Analyse efficiency of different parallel algorithms.

**TEXT BOOKS:**

1. Michael J. Quinn, "Parallel Computing : Theory & Practice", Tata McGraw Hill Edition, Second edition, 2017.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", University press, Second edition , 2011.
3. V Rajaraman, C Siva Ram Murthy, " Parallel computers- Architecture and Programming ", PHI learning, 2016.

**REFERENCES:**

1. Ananth Grame, George Karpis, Vipin Kumar and Anshul Gupta, "Introduction to Parallel Computing", 2nd Edition, Addison Wesley, 2003.
2. M Sasikumar, Dinesh Shikhare and P Ravi Prakash , " Introduction to Parallel Processing", PHI learning , 2013.
3. S.G.Akl, "The Design and Analysis of Parallel Algorithms", PHI, 1989.

**IT8077**

**SPEECH PROCESSING**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To understand the fundamentals of the speech processing
- Explore the various speech models
- Gather knowledge about the phonetics and pronunciation processing
- Perform wavelet analysis of speech
- To understand the concepts of speech recognition

**UNIT I INTRODUCTION 9**

Introduction - knowledge in speech and language processing - ambiguity - models and algorithms - language - thought - understanding - regular expression and automata - words & transducers – N grams

**UNIT II SPEECH MODELLING 9**

Word classes and part of speech tagging – hidden markov model – computing likelihood: the forward algorithm – training hidden markov model – maximum entropy model – transformation-based tagging – evaluation and error analysis – issues in part of speech tagging – noisy channel model for spelling

**UNIT III SPEECH PRONUNCIATION AND SIGNAL PROCESSING 9**

Phonetics - speech sounds and phonetic transcription - articulatory phonetics - phonological categories and pronunciation variation - acoustic phonetics and signals - phonetic resources - articulatory and gestural phonology

**UNIT IV SPEECH IDENTIFICATION 9**  
Speech synthesis - text normalization - phonetic analysis - prosodic analysis – diphone waveform synthesis - unit selection waveform synthesis - evaluation

**UNIT V SPEECH RECOGNITION 9**  
Automatic speech recognition - architecture - applying hidden markov model - feature extraction: mfcc vectors - computing acoustic likelihoods - search and decoding - embedded training - multipass decoding: n-best lists and lattices- a\* ('stack') decoding - context-dependent acoustic models: triphones - discriminative training - speech recognition by humans

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**On Successful completion of the course ,Students will be able to**

- Create new algorithms with speech processing
- Derive new speech models
- Perform various language phonetic analysis
- Create a new speech identification system
- Generate a new speech recognition system

**TEXT BOOK:**

1. Daniel Jurafsky and James H. Martin, “ Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, Person education,2013.

**REFERENCES**

1. Kai-Fu Lee, “Automatic Speech Recognition”, The Springer International Series in Engineering and Computer Science, 1999.
2. Himanshu Chaurasiya, “Soft Computing Implementation of Automatic Speech Recognition”, LAP Lambert Academic Publishing, 2010.
3. Claudio Becchetti, Klucio Prina Ricotti, “Speech Recognition: Theory and C++ implementation”,Wiley publications 2008.
4. Ikrami Eldirawy , Wesam Ashour, “Visual Speech Recognition”, Wiley publications , 2011

**GE8073**

**FUNDAMENTALS OF NANOSCIENCE**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

To learn about basis of nanomaterial science, preparation method, types and application

**UNIT I INTRODUCTION 8**  
Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires- ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

**UNIT II GENERAL METHODS OF PREPARATION 9**  
Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

### UNIT III NANOMATERIALS

12

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO<sub>2</sub>,MgO, ZrO<sub>2</sub>, NiO, nanoalumina, CaO, AgTiO<sub>2</sub>, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

### UNIT IV CHARACTERIZATION TECHNIQUES

9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

### UNIT V APPLICATIONS

7

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

**TOTAL: 45 PERIODS**

#### OUTCOMES:

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial


#### TEXT BOOKS :

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

#### REFERENCES:

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.



  
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**ANNA UNIVERSITY, CHENNAI**  
**AFFILIATED INSTITUTIONS**  
**B.E. ELECTRICAL AND ELECTRONICS ENGINEERING**  
**REGULATIONS – 2017**  
**CHOICE BASED CREDIT SYSTEM**

**Educational Objectives**

Bachelor of Electrical and Electronics Engineering curriculum is designed to prepare the graduates having attitude and knowledge to

1. Have successful technical and professional careers in their chosen fields such as circuit theory, Field theory, control theory and computational platforms.
2. Engross in life long process of learning to keep themselves abreast of new developments in the field of Electronics and their applications in power engineering.

**Programme Outcomes**

The graduates will have the ability to

- a. Apply the Mathematical knowledge and the basics of Science and Engineering to solve the problems pertaining to Electronics and Instrumentation Engineering.
- b. Identify and formulate Electrical and Electronics Engineering problems from research literature and be able to analyze the problem using first principles of Mathematics and Engineering Sciences.
- c. Come out with solutions for the complex problems and to design system components or process that fulfill the particular needs taking into account public health and safety and the social, cultural and environmental issues.
- d. Draw well-founded conclusions applying the knowledge acquired from research and research methods including design of experiments, analysis and interpretation of data and synthesis of information and to arrive at significant conclusion.
- e. Form, select and apply relevant techniques, resources and Engineering and IT tools for Engineering activities like electronic prototyping, modeling and control of systems and also being conscious of the limitations.
- f. Understand the role and responsibility of the Professional Electrical and Electronics Engineer and to assess societal, health, safety issues based on the reasoning received from the contextual knowledge.
- g. Be aware of the impact of professional Engineering solutions in societal and environmental contexts and exhibit the knowledge and the need for Sustainable Development.
- h. Apply the principles of Professional Ethics to adhere to the norms of the engineering practice and to discharge ethical responsibilities.
- i. Function actively and efficiently as an individual or a member/leader of different teams and multidisciplinary projects.
- j. Communicate efficiently the engineering facts with a wide range of engineering community and others, to understand and prepare reports and design documents; to make effective presentations and to frame and follow instructions.
- k. Demonstrate the acquisition of the body of engineering knowledge and insight and Management Principles and to apply them as member / leader in teams and multidisciplinary environments.
- l. Recognize the need for self and life-long learning, keeping pace with technological challenges in the broadest sense.

| PEO \ PO | a | b | c | d | e | f | g | h | i | j | k | l |
|----------|---|---|---|---|---|---|---|---|---|---|---|---|
| 1        | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |   |   |   |   | ✓ |
| 2        | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |   | ✓ |   | ✓ |   |   |



| SEMESTER       | NAME OF THE SUBJECT                               | PROGRAM OUTCOMES |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------|---|------------------|---|---|---|---|---|---|---|---|---|---|---|---|
|                |   | a                | b | c | d | e | f | g | h | i | j | k | l |   |
|                | <b>THEORY</b>                                     |                  |   |   |   |   |   |   |   |   |   |   |   |   |
| <b>SEM I</b>   | Communicative English                             |                  |   |   |   |   |   |   |   | ✓ | ✓ |   | ✓ |   |
|                | Engineering Mathematics - I                       | ✓                | ✓ |   |   | ✓ |   |   |   |   |   |   | ✓ |   |
|                | Engineering Physics                               | ✓                | ✓ | ✓ |   | ✓ |   | ✓ |   |   |   |   | ✓ |   |
|                | Engineering Chemistry                             | ✓                | ✓ | ✓ |   | ✓ |   |   |   |   |   |   | ✓ |   |
|                | Problem Solving and Python Programming            | ✓                | ✓ | ✓ | ✓ | ✓ |   |   |   |   |   |   | ✓ |   |
|                | Engineering Graphics                              |                  |   | ✓ | ✓ |   |   |   |   |   |   |   |   |   |
|                | <b>PRACTICAL</b>                                  |                  |   |   |   |   |   |   |   |   |   |   |   |   |
|                | Problem Solving and Python Programming Laboratory | ✓                |   | ✓ | ✓ | ✓ | ✓ |   |   |   |   | ✓ |   | ✓ |
|                | Physics and Chemistry Laboratory                  | ✓                | ✓ |   |   |   |   |   |   |   |   |   |   |   |
|                | <b>THEORY</b>                                     |                  |   |   |   |   |   |   |   |   |   |   |   |   |
| <b>SEM II</b>  | Technical English                                 |                  |   |   |   |   |   |   |   | ✓ | ✓ |   | ✓ |   |
|                | Engineering Mathematics - II                      | ✓                | ✓ | ✓ |   | ✓ |   |   |   |   |   |   | ✓ |   |
|                | Physics For Electronics Engineering               | ✓                | ✓ | ✓ |   | ✓ |   | ✓ |   |   |   |   | ✓ |   |
|                | Basic Civil and Mechanical Engineering            |                  |   |   | ✓ |   | ✓ |   |   |   |   |   |   |   |
|                | Circuit Theory                                    | ✓                | ✓ | ✓ | ✓ | ✓ |   |   |   |   |   |   | ✓ |   |
|                | Environmental Science and Engineering             | ✓                | ✓ |   |   | ✓ | ✓ | ✓ | ✓ |   |   |   | ✓ |   |
|                | <b>PRACTICALS</b>                                 |                  |   |   |   |   |   |   |   |   |   |   |   |   |
|                | Engineering Practices Laboratory                  | ✓                |   | ✓ | ✓ | ✓ | ✓ |   |   |   |   | ✓ |   |   |
|                | Electric Circuits Lab                             | ✓                |   | ✓ | ✓ | ✓ | ✓ |   |   |   |   | ✓ |   | ✓ |
|                | <b>THEORY</b>                                     |                  |   |   |   |   |   |   |   |   |   |   |   |   |
| <b>SEM III</b> | Transforms and Partial Differential Equations     | ✓                | ✓ |   |   | ✓ |   |   |   |   |   |   | ✓ |   |
|                | Digital Logic Circuits                            |                  |   |   | ✓ | ✓ |   |   |   |   |   |   |   |   |
|                | Electromagnetic Theory                            | ✓                | ✓ | ✓ | ✓ | ✓ |   |   |   |   | ✓ |   | ✓ |   |
|                | Electrical Machines - I                           | ✓                | ✓ | ✓ | ✓ | ✓ |   |   |   |   | ✓ |   |   |   |



|               |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|---------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|               | Electron Devices and Circuits                     | ✓ | ✓ | ✓ | ✓ | ✓ |   |   |   |   |   |   | ✓ |   |
|               | Power Plant Engineering                           |   |   | ✓ | ✓ | ✓ |   | ✓ | ✓ | ✓ |   |   |   |   |
|               | <b>PRACTICALS</b>                                 |   |   |   |   |   |   |   |   |   |   |   |   |   |
|               | Electronics Laboratory                            | ✓ |   |   | ✓ | ✓ |   |   |   |   |   | ✓ | ✓ |   |
|               | Electrical Machines Laboratory - I                | ✓ |   |   | ✓ | ✓ |   |   |   |   |   | ✓ | ✓ |   |
|               | <b>THEORY</b>                                     |   |   |   |   |   |   |   |   |   |   |   |   |   |
| <b>SEM IV</b> | Numerical Methods                                 | ✓ | ✓ | ✓ |   |   |   |   |   |   |   |   | ✓ |   |
|               | Electrical Machines - II                          | ✓ | ✓ | ✓ | ✓ | ✓ |   | ✓ |   |   |   |   | ✓ |   |
|               | Transmission and Distribution                     | ✓ | ✓ | ✓ | ✓ | ✓ |   | ✓ |   |   |   |   | ✓ |   |
|               | Measurements and Instrumentation                  | ✓ | ✓ | ✓ | ✓ | ✓ |   |   |   |   |   |   | ✓ |   |
|               | Linear Integrated Circuits and Applications       | ✓ | ✓ | ✓ |   | ✓ |   |   |   |   |   |   |   |   |
|               | Control Systems                                   | ✓ | ✓ | ✓ | ✓ | ✓ |   |   |   |   |   |   | ✓ |   |
|               | <b>PRACTICALS</b>                                 |   |   |   |   |   |   |   |   |   |   |   |   |   |
|               | Electrical Machines Lab II                        | ✓ | ✓ | ✓ | ✓ | ✓ |   |   |   |   |   |   | ✓ |   |
|               | Linear and Digital Integrated Circuits Laboratory | ✓ |   |   | ✓ | ✓ |   |   |   |   |   | ✓ | ✓ | ✓ |
|               | Technical Seminar                                 |   |   |   |   |   |   |   |   |   | ✓ | ✓ | ✓ |   |
|               | <b>THEORY</b>                                     |   |   |   |   |   |   |   |   |   |   |   |   |   |
| <b>SEM V</b>  | Power System Analysis                             | ✓ | ✓ | ✓ | ✓ | ✓ |   | ✓ |   |   |   |   | ✓ |   |
|               | Microprocessors and Microcontrollers              | ✓ |   |   | ✓ |   | ✓ |   | ✓ | ✓ |   |   | ✓ | ✓ |
|               | Power Electronics                                 | ✓ | ✓ | ✓ | ✓ | ✓ |   | ✓ |   |   |   |   |   |   |
|               | Digital Signal Processing                         | ✓ | ✓ | ✓ | ✓ | ✓ |   | ✓ |   |   |   |   | ✓ |   |
|               | Object Oriented Programming                       |   |   |   | ✓ | ✓ | ✓ |   |   |   |   |   | ✓ |   |
|               | Open Elective I                                   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|               | <b>PRACTICALS</b>                                 |   |   |   |   |   |   |   |   |   |   |   |   |   |
|               | Control and Instrumentation Laboratory            |   |   |   | ✓ | ✓ | ✓ | ✓ |   |   |   | ✓ | ✓ |   |

|                                     |   |   |   |   |   |   |  |   |  |   |   |   |   |
|-------------------------------------|---|---|---|---|---|---|--|---|--|---|---|---|---|
|                                     | Professional Communication                      |   |   |   |   |   |  |   |  | ✓ | ✓ | ✓ |   |
|                                     | Object Oriented Programming Laboratory          |   |   | ✓ | ✓ | ✓ |  |   |  |   |   |   | ✓ |
|                                     | <b>THEORY</b>                                   |   |   |   |   |   |  |   |  |   |   |   |   |
| <b>SEM VI</b>                       | Solid State Drives                              | ✓ | ✓ | ✓ | ✓ | ✓ |  | ✓ |  |   |   |   |   |
|                                     | Protection and Switchgear                       | ✓ | ✓ | ✓ | ✓ | ✓ |  | ✓ |  |   |   |   | ✓ |
|                                     | Embedded Systems                                |   |   |   |   |   |  |   |  |   |   |   |   |
|                                     | Professional Elective I                         |   |   |   |   |   |  |   |  |   |   |   |   |
|                                     | Professional Elective II                        |   |   |   |   |   |  |   |  |   |   |   |   |
|                                     | <b>PRACTICALS</b>                               |   |   |   |   |   |  |   |  |   |   |   |   |
|                                     | Power Electronics and Drives Laboratory         | ✓ |   | ✓ | ✓ |   |  |   |  |   | ✓ | ✓ | ✓ |
|                                     | Microprocessors and Microcontrollers Laboratory | ✓ |   | ✓ | ✓ |   |  |   |  |   | ✓ | ✓ | ✓ |
| Mini Project                        | ✓   |   | ✓ | ✓ |   |   |  |   |  | ✓ | ✓ | ✓ |   |
|                                     | <b>THEORY</b>                                   |   |   |   |   |   |  |   |  |   |   |   |   |
| <b>SEM VII</b>                      | High Voltage Engineering                        | ✓ | ✓ | ✓ | ✓ | ✓ |  | ✓ |  |   |   |   | ✓ |
|                                     | Power System Operation and Control              | ✓ | ✓ | ✓ | ✓ | ✓ |  | ✓ |  |   |   |   | ✓ |
|                                     | Renewable Energy Systems                        | ✓ | ✓ | ✓ | ✓ | ✓ |  | ✓ |  |   |   |   | ✓ |
|                                     | Open Elective II                                |   |   |   |   |   |  |   |  |   |   |   |   |
|                                     | Professional Elective III                       |   |   |   |   |   |  |   |  |   |   |   |   |
|                                     | Professional Elective IV                        |   |   |   |   |   |  |   |  |   |   |   |   |
|                                     | <b>PRACTICALS</b>                               |   |   |   |   |   |  |   |  |   |   |   |   |
|                                     | Power System Simulation Laboratory              | ✓ |   | ✓ | ✓ |   |  |   |  |   | ✓ | ✓ | ✓ |
| Renewable Energy Systems Laboratory | ✓   |   | ✓ | ✓ |   |   |  |   |  | ✓ | ✓ | ✓ |   |
| <b>SEM VIII</b>                     | <b>THEORY</b>                                   |   |   |   |   |   |  |   |  |   |   |   |   |
|                                     | Professional Elective V                         |   |   |   |   |   |  |   |  |   |   |   |   |

|  |                          |   |   |   |   |   |   |   |   |   |   |   |   |
|--|--------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
|  | Professional Elective VI |   |   |   |   |   |   |   |   |   |   |   |   |
|  | <b>PRACTICALS</b>        |   |   |   |   |   |   |   |   |   |   |   |   |
|  | Project Work             | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

**. PROFESSIONAL ELECTIVE**

| SL.NO.                | NAME OF THE SUBJECT                                 | PROGRAM OUTCOMES |   |   |   |   |   |   |   |   |   |   |   |
|-----------------------|---|------------------|---|---|---|---|---|---|---|---|---|---|---|
|                       |   | a                | b | c | d | e | f | g | h | i | j | k | l |
|                       | <b>THEORY</b>                                       |                  |   |   |   |   |   |   |   |   |   |   |   |
| <b>ELECTIVE – I</b>   | Advanced Control System                             |                  | ✓ | ✓ |   |   |   |   | ✓ | ✓ |   |   |   |
|                       | Visual Languages and Applications                   | ✓                | ✓ |   | ✓ | ✓ |   |   |   |   |   |   |   |
|                       | Design of Electrical Apparatus                      | ✓                |   | ✓ | ✓ | ✓ |   | ✓ |   |   |   |   |   |
|                       | Power Systems Stability                             |                  |   |   | ✓ | ✓ |   |   |   |   |   |   |   |
|                       | Modern Power Converters                             | ✓                |   | ✓ | ✓ | ✓ |   | ✓ |   |   |   |   |   |
|                       | Intellectual Property Rights                        |                  |   |   |   |   |   |   | ✓ |   | ✓ |   | ✓ |
| <b>ELECTIVE – II</b>  | Principles of Robotics                              | ✓                |   | ✓ |   | ✓ |   |   |   |   |   |   |   |
|                       | Special Electrical Machines                         | ✓                |   | ✓ | ✓ | ✓ |   |   | ✓ |   |   |   |   |
|                       | Power Quality                                       | ✓                |   | ✓ | ✓ | ✓ |   |   | ✓ |   |   |   | ✓ |
|                       | EHVAC Transmission                                  | ✓                |   | ✓ | ✓ | ✓ |   |   | ✓ |   |   |   | ✓ |
|                       | Communication Engineering                           |                  |   |   |   |   |   |   |   |   |   |   |   |
| <b>ELECTIVE – III</b> | Disaster Management                                 | ✓                |   | ✓ |   | ✓ | ✓ |   |   |   |   | ✓ | ✓ |
|                       | Human Rights  |                  |   | ✓ | ✓ | ✓ | ✓ |   |   |   |   |   |   |
|                       | Operations Research                                 | ✓                | ✓ | ✓ |   |   |   |   | ✓ | ✓ |   |   | ✓ |
|                       | Probability and Statistics                          |                  |   |   |   |   |   |   |   |   |   |   |   |
|                       | Fibre Optics and Laser Instrumentation              | ✓                | ✓ |   |   | ✓ |   |   |   |   |   | ✓ | ✓ |
|                       | Foundation Skills in Integrated Product Development |                  |   |   |   |   |   |   |   |   |   |   |   |

|                      |  |   |   |   |   |   |   |   |   |   |   |   |   |
|----------------------|--|---|---|---|---|---|---|---|---|---|---|---|---|
| <b>ELECTIVE – IV</b> | System Identification and Adaptive Control               | ✓ | ✓ | ✓ |   | ✓ |   |   |   |   |   |   |   |
|                      | Computer Architecture                                    | ✓ |   | ✓ |   | ✓ |   |   |   |   |   |   |   |
|                      | Control of Electrical Drives                             | ✓ |   | ✓ |   | ✓ |   |   | ✓ |   |   |   | ✓ |
|                      | VLSI Design  | ✓ | ✓ | ✓ |   |   | ✓ | ✓ |   |   |   |   |   |
|                      | Power Systems Transients                                 |   | ✓ |   | ✓ | ✓ |   |   |   |   |   |   |   |
|                      | Total Quality Management                                 |   | ✓ |   |   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |   |   |
|                      |  |   |   |   |   |   |   |   |   |   |   |   |   |
| <b>ELECTIVE – V</b>  | Flexible AC Transmission Systems                         | ✓ | ✓ | ✓ |   | ✓ |   |   |   |   | ✓ |   | ✓ |
|                      | Soft Computing Techniques                                | ✓ |   | ✓ |   | ✓ |   |   |   |   |   |   |   |
|                      | Power Systems Dynamics                                   | ✓ |   | ✓ |   | ✓ |   |   |   |   |   |   |   |
|                      | SMPS and UPS   | ✓ |   | ✓ |   | ✓ |   |   |   |   |   |   |   |
|                      | Electric Energy Generation, Utilization and Conservation | ✓ | ✓ | ✓ | ✓ | ✓ |   | ✓ |   |   |   |   | ✓ |
|                      | Professional Ethics in Engineering                       | ✓ | ✓ |   | ✓ |   |   | ✓ |   |   |   | ✓ | ✓ |
|                      | Principals of Management                                 |   |   |   |   | ✓ | ✓ |   |   | ✓ |   |   |   |
| <b>ELECTIVE – VI</b> | Energy Management and Auditing                           |   | ✓ |   |   | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |   |   |
|                      | Data Structures  |   |   |   |   | ✓ | ✓ |   |   | ✓ |   |   |   |
|                      | High Voltage Direct Current Transmission                 | ✓ | ✓ | ✓ |   |   |   |   | ✓ | ✓ |   |   | ✓ |
|                      | Microcontroller Based System Design                      | ✓ | ✓ | ✓ |   |   |   |   | ✓ | ✓ |   |   | ✓ |
|                      | Smart Grid   | ✓ | ✓ | ✓ |   |   |   |   | ✓ | ✓ |   |   | ✓ |
|                      | Biomedical Instrumentation                               | ✓ |   | ✓ | ✓ | ✓ | ✓ |   |   |   |   |   |   |
|                      | Fundamentals of Nano Science                             |   |   |   |   |   |   |   |   |   |   |   |   |

**ANNA UNIVERSITY, CHENNAI**  
**AFFILIATED INSTITUTIONS**  
**B.E. ELECTRICAL AND ELECTRONICS ENGINEERING**  
**REGULATIONS – 2017**  
**CHOICE BASED CREDIT SYSTEM**  
**I TO VIII SEMESTERS CURRICULA & SYLLABI**

**SEMESTER I**

| S.NO.             | COURSE CODE | COURSE TITLE                                      | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |           |           |
| 1.                | HS8151      | Communicative English                             | HS       | 4               | 4         | 0        | 0         | 4         |
| 2.                | MA8151      | Engineering Mathematics - I                       | BS       | 4               | 4         | 0        | 0         | 4         |
| 3.                | PH8151      | Engineering Physics                               | BS       | 3               | 3         | 0        | 0         | 3         |
| 4.                | CY8151      | Engineering Chemistry                             | BS       | 3               | 3         | 0        | 0         | 3         |
| 5.                | GE8151      | Problem Solving and Python Programming            | ES       | 3               | 3         | 0        | 0         | 3         |
| 6.                | GE8152      | Engineering Graphics                              | ES       | 6               | 2         | 0        | 4         | 4         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |           |           |
| 7.                | GE8161      | Problem Solving and Python Programming Laboratory | ES       | 4               | 0         | 0        | 4         | 2         |
| 8.                | BS8161      | Physics and Chemistry Laboratory                  | BS       | 4               | 0         | 0        | 4         | 2         |
| <b>TOTAL</b>      |             |   |          | <b>31</b>       | <b>19</b> | <b>0</b> | <b>12</b> | <b>25</b> |

**SEMESTER II**

| S.NO.             | COURSE CODE | COURSE TITLE                           | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|--|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |  |          |                 |           |          |          |           |
| 1.                | HS8251      | Technical English                      | HS       | 4               | 4         | 0        | 0        | 4         |
| 2.                | MA8251      | Engineering Mathematics - II           | BS       | 4               | 4         | 0        | 0        | 4         |
| 3.                | PH8253      | Physics for Electronics Engineering    | BS       | 3               | 3         | 0        | 0        | 3         |
| 4.                | BE8252      | Basic Civil and Mechanical Engineering | ES       | 4               | 4         | 0        | 0        | 4         |
| 5.                | EE8251      | Circuit Theory                         | PC       | 4               | 2         | 2        | 0        | 3         |
| 6.                | GE8291      | Environmental Science and Engineering  | HS       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |  |          |                 |           |          |          |           |
| 7.                | GE8261      | Engineering Practices Laboratory       | ES       | 4               | 0         | 0        | 4        | 2         |
| 8.                | EE8261      | Electric Circuits Laboratory           | PC       | 4               | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>      |             |  |          | <b>30</b>       | <b>20</b> | <b>2</b> | <b>8</b> | <b>25</b> |

### SEMESTER III

| S.NO.             | COURSE CODE | COURSE TITLE                                  | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |          |           |
| 1.                | MA8353      | Transforms and Partial Differential Equations | BS       | 4               | 4         | 0        | 0        | 4         |
| 2.                | EE8351      | Digital Logic Circuits                        | PC       | 4               | 2         | 2        | 0        | 3         |
| 3.                | EE8391      | Electromagnetic Theory                        | PC       | 4               | 2         | 2        | 0        | 3         |
| 4.                | EE8301      | Electrical Machines - I                       | PC       | 4               | 2         | 2        | 0        | 3         |
| 5.                | EC8353      | Electron Devices and Circuits                 | ES       | 3               | 3         | 0        | 0        | 3         |
| 6.                | ME8792      | Power Plant Engineering                       | ES       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |          |           |
| 7.                | EC8311      | Electronics Laboratory                        | ES       | 4               | 0         | 0        | 4        | 2         |
| 8.                | EE8311      | Electrical Machines Laboratory - I            | PC       | 4               | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>      |             |   |          | <b>30</b>       | <b>16</b> | <b>6</b> | <b>8</b> | <b>23</b> |

### SEMESTER IV

| S.NO.             | COURSE CODE | COURSE TITLE                                      | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |           |           |
| 1.                | MA8491      | Numerical Methods                                 | BS       | 4               | 4         | 0        | 0         | 4         |
| 2.                | EE8401      | Electrical Machines - II                          | PC       | 4               | 2         | 2        | 0         | 3         |
| 3.                | EE8402      | Transmission and Distribution                     | PC       | 3               | 3         | 0        | 0         | 3         |
| 4.                | EE8403      | Measurements and Instrumentation                  | PC       | 3               | 3         | 0        | 0         | 3         |
| 5.                | EE8451      | Linear Integrated Circuits and Applications       | PC       | 3               | 3         | 0        | 0         | 3         |
| 6.                | IC8451      | Control Systems                                   | PC       | 5               | 3         | 2        | 0         | 4         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |           |           |
| 7.                | EE8411      | Electrical Machines Laboratory - II               | PC       | 4               | 0         | 0        | 4         | 2         |
| 8.                | EE8461      | Linear and Digital Integrated Circuits Laboratory | PC       | 4               | 0         | 0        | 4         | 2         |
| 9.                | EE8412      | Technical Seminar                                 | EEC      | 2               | 0         | 0        | 2         | 1         |
| <b>TOTAL</b>      |             |   |          | <b>32</b>       | <b>18</b> | <b>4</b> | <b>10</b> | <b>25</b> |

### SEMESTER V

| S.NO.             | COURSE CODE | COURSE TITLE                           | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|--|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |  |          |                 |           |          |           |           |
| 1.                | EE8501      | Power System Analysis                  | PC       | 3               | 3         | 0        | 0         | 3         |
| 2.                | EE8551      | Microprocessors and Microcontrollers   | PC       | 3               | 3         | 0        | 0         | 3         |
| 3.                | EE8552      | Power Electronics                      | PC       | 3               | 3         | 0        | 0         | 3         |
| 4.                | EE8591      | Digital Signal Processing              | PC       | 4               | 2         | 2        | 0         | 3         |
| 5.                | CS8392      | Object Oriented Programming            | ES       | 3               | 3         | 0        | 0         | 3         |
| 6.                |             | Open Elective I*                       | OE       | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |  |          |                 |           |          |           |           |
| 7.                | EE8511      | Control and Instrumentation Laboratory | PC       | 4               | 0         | 0        | 4         | 2         |
| 8.                | HS8581      | Professional Communication             | EEC      | 2               | 0         | 0        | 2         | 1         |
| 9.                | CS8383      | Object Oriented Programming Laboratory | ES       | 4               | 0         | 0        | 4         | 2         |
| <b>TOTAL</b>      |             |  |          | <b>29</b>       | <b>17</b> | <b>2</b> | <b>10</b> | <b>23</b> |

### SEMESTER VI

| S.NO.             | COURSE CODE | COURSE TITLE                                    | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |           |           |
| 1.                | EE8601      | Solid State Drives                              | PC       | 3               | 3         | 0        | 0         | 3         |
| 2.                | EE8602      | Protection and Switchgear                       | PC       | 3               | 3         | 0        | 0         | 3         |
| 3.                | EE8691      | Embedded Systems                                | ES       | 3               | 3         | 0        | 0         | 3         |
| 4.                |             | Professional Elective I                         | PE       | 3               | 3         | 0        | 0         | 3         |
| 5.                |             | Professional Elective II                        | PE       | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |           |           |
| 6.                | EE8661      | Power Electronics and Drives Laboratory         | PC       | 4               | 0         | 0        | 4         | 2         |
| 7.                | EE8681      | Microprocessors and Microcontrollers Laboratory | PC       | 4               | 0         | 0        | 4         | 2         |
| 8.                | EE8611      | Mini Project                                    | EEC      | 4               | 0         | 0        | 4         | 2         |
| <b>TOTAL</b>      |             |   |          | <b>27</b>       | <b>15</b> | <b>0</b> | <b>12</b> | <b>21</b> |

**SEMESTER VII**

| S.NO.             | COURSE CODE | COURSE TITLE                        | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|-------------------------------------|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |                                     |          |                 |           |          |          |           |
| 1.                | EE8701      | High Voltage Engineering            | PC       | 3               | 3         | 0        | 0        | 3         |
| 2.                | EE8702      | Power System Operation and Control  | PC       | 3               | 3         | 0        | 0        | 3         |
| 3.                | EE8703      | Renewable Energy Systems            | PC       | 3               | 3         | 0        | 0        | 3         |
| 4.                |             | Open Elective II*                   | OE       | 3               | 3         | 0        | 0        | 3         |
| 5.                |             | Professional Elective III           | PE       | 3               | 3         | 0        | 0        | 3         |
| 6.                |             | Professional Elective IV            | PE       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |                                     |          |                 |           |          |          |           |
| 7.                | EE8711      | Power System Simulation Laboratory  | PC       | 4               | 0         | 0        | 4        | 2         |
| 8.                | EE8712      | Renewable Energy Systems Laboratory | PC       | 4               | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>      |             |                                     |          | <b>26</b>       | <b>18</b> | <b>0</b> | <b>8</b> | <b>22</b> |

**SEMESTER VIII**

| S.NO.             | COURSE CODE | COURSE TITLE             | CATEGORY | CONTACT PERIODS | L        | T        | P         | C         |
|-------------------|-------------|--------------------------|----------|-----------------|----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |                          |          |                 |          |          |           |           |
| 1.                |             | Professional Elective V  | PE       | 3               | 3        | 0        | 0         | 3         |
| 2.                |             | Professional Elective VI | PE       | 3               | 3        | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |                          |          |                 |          |          |           |           |
| 3.                | EE8811      | Project Work             | EEC      | 20              | 0        | 0        | 20        | 10        |
| <b>TOTAL</b>      |             |                          |          | <b>26</b>       | <b>6</b> | <b>0</b> | <b>20</b> | <b>16</b> |

**TOTAL NO. OF CREDITS: 180**

\*Course from the curriculum of other UG Programmes.



**PROFESSIONAL ELECTIVE – I ( VI SEMESTER)**

| S.NO. | COURSE CODE | COURSE TITLE                      | CATEGORY | CONTACT PERIODS | L | T | P | C |
|-------|-------------|-----------------------------------|----------|-----------------|---|---|---|---|
| 1.    | IC8651      | Advanced Control System           | PE       | 4               | 2 | 2 | 0 | 3 |
| 2.    | EE8001      | Visual Languages and Applications | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.    | EE8002      | Design of Electrical Apparatus    | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.    | EE8003      | Power Systems Stability           | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.    | EE8004      | Modern Power Converters           | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.    | GE8075      | Intellectual Property Rights      | PE       | 3               | 3 | 0 | 0 | 3 |

**PROFESSIONAL ELECTIVE – II ( VI SEMESTER)**

|    |        |                             |    |   |   |   |   |   |
|----|--------|-----------------------------|----|---|---|---|---|---|
| 1. | RO8591 | Principles of Robotics      | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | EE8005 | Special Electrical Machines | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | EE8006 | Power Quality               | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | EE8007 | EHVAC Transmission          | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | EC8395 | Communication Engineering   | PE | 3 | 3 | 0 | 0 | 3 |

**PROFESSIONAL ELECTIVE – III ( VII SEMESTER)**

|    |        |   |    |   |   |   |   |   |
|----|--------|---|----|---|---|---|---|---|
| 1. | GE8071 | Disaster Management                                 | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | GE8074 | Human Rights  | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | MG8491 | Operations Research                                 | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | MA8391 | Probability and Statistics                          | PE | 4 | 4 | 0 | 0 | 4 |
| 5. | EI8075 | Fibre Optics and Laser Instrumentation              | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | GE8072 | Foundation Skills in Integrated Product Development | PE | 3 | 3 | 0 | 0 | 3 |

**PROFESSIONAL ELECTIVE – IV ( VII SEMESTER)**

|    |        |  |    |   |   |   |   |   |
|----|--------|--|----|---|---|---|---|---|
| 1. | EE8008 | System Identification and Adaptive Control | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | CS8491 | Computer Architecture                      | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | EE8009 | Control of Electrical Drives               | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | EC8095 | VLSI Design                                | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | EE8010 | Power Systems Transients                   | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | GE8077 | Total Quality Management                   | PE | 3 | 3 | 0 | 0 | 3 |

**PROFESSIONAL ELECTIVE – V ( VIII SEMESTER)**

|    |        |  |    |   |   |   |   |   |
|----|--------|--|----|---|---|---|---|---|
| 1. | EE8011 | Flexible AC Transmission Systems                         | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | EE8012 | Soft Computing Techniques                                | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | EE8013 | Power Systems Dynamics                                   | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | EE8014 | SMPS and UPS   | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | EE8015 | Electric Energy Generation, Utilization and Conservation | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | GE8076 | Professional Ethics in Engineering                       | PE | 3 | 3 | 0 | 0 | 3 |
| 7. | MG8591 | Principles of Management                                 | PE | 3 | 3 | 0 | 0 | 3 |

**PROFESSIONAL ELECTIVE – VI ( VIII SEMESTER)**

|    |        |  |    |   |   |   |   |   |
|----|--------|--|----|---|---|---|---|---|
| 1. | EE8016 | Energy Management and Auditing           | PE | 3 | 3 | 0 | 0 | 3 |
| 2. | CS8391 | Data Structures                          | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | EE8017 | High Voltage Direct Current Transmission | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | EE8018 | Microcontroller Based System Design      | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | EE8019 | Smart Grid                               | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | EI8073 | Biomedical Instrumentation               | PE | 3 | 3 | 0 | 0 | 3 |
| 7. | GE8073 | Fundamentals of Nanoscience              | PE | 3 | 3 | 0 | 0 | 3 |

**\*Professional Electives are grouped according to elective number as was done previously.**

### HUMANITIES AND SOCIALSCIENCES (HS)

| S.No | COURSE CODE | COURSE TITLE                          | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|---------------------------------------|----------|-----------------|---|---|---|---|
| 1.   | HS8151      | Communicative English                 | HS       | 4               | 4 | 0 | 0 | 4 |
| 2.   | HS8251      | Technical English                     | HS       | 4               | 4 | 0 | 0 | 4 |
| 3.   | GE8291      | Environmental Science and Engineering | HS       | 3               | 3 | 0 | 0 | 3 |

### BASIC SCIENCES (BS)

| S.No | COURSE CODE | COURSE TITLE                                  | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|---|----------|-----------------|---|---|---|---|
| 1.   | MA8151      | Engineering Mathematics I                     | BS       | 4               | 4 | 0 | 0 | 4 |
| 2.   | PH8151      | Engineering Physics                           | BS       | 3               | 3 | 0 | 0 | 3 |
| 3.   | CY8151      | Engineering Chemistry                         | BS       | 3               | 3 | 0 | 0 | 3 |
| 4.   | BS8161      | Physics and Chemistry Laboratory              | BS       | 4               | 0 | 0 | 4 | 2 |
| 5.   | MA8251      | Engineering Mathematics II                    | BS       | 4               | 4 | 0 | 0 | 4 |
| 6.   | PH8253      | Physics For Electronics Engineering           | BS       | 3               | 3 | 0 | 0 | 3 |
| 7.   | MA8353      | Transforms and Partial Differential Equations | BS       | 4               | 4 | 0 | 0 | 4 |
| 8.   | MA8491      | Numerical Methods                             | BS       | 4               | 4 | 0 | 0 | 4 |

### ENGINEERING SCIENCES (ES)

| S.NO | COURSE CODE | COURSE TITLE                           | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|--|----------|-----------------|---|---|---|---|
| 1.   | GE8151      | Problem Solving and Python programming | ES       | 3               | 3 | 0 | 0 | 3 |
| 2.   | GE8152      | Engineering Graphics                   | ES       | 6               | 2 | 0 | 4 | 4 |
| 3.   | GE8161      | Problem Solving and                    | ES       |                 | 0 | 0 | 4 | 2 |

|     |        |  |    |   |   |   |   |   |
|-----|--------|--|----|---|---|---|---|---|
|     |        | Python programming Laboratory          |    | 4 |   |   |   |   |
| 4.  | BE8252 | Basic Civil and Mechanical Engineering | ES | 4 | 4 | 0 | 0 | 4 |
| 5.  | GE8261 | Engineering Practices Laboratory       | ES | 4 | 0 | 0 | 4 | 2 |
| 6.  | EC8353 | Electron Devices and Circuits          | ES | 3 | 3 | 0 | 0 | 3 |
| 7.  | ME8792 | Power Plant Engineering                | ES | 3 | 3 | 0 | 0 | 3 |
| 8.  | EC8311 | Electronics Laboratory                 | ES | 4 | 0 | 0 | 4 | 2 |
| 9.  | CS8392 | Object Oriented Programming            | ES | 3 | 3 | 0 | 0 | 3 |
| 10. | CS8383 | Object Oriented Programming Laboratory | ES | 4 | 0 | 0 | 4 | 2 |
| 11. | EE8691 | Embedded Systems                       | ES | 3 | 3 | 0 | 0 | 3 |

#### PROFESSIONAL CORE (PC)

| S.No | COURSE CODE | COURSE TITLE                                | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|---|----------|-----------------|---|---|---|---|
| 1.   | EE8251      | Circuit Theory                              | PC       | 4               | 2 | 2 | 0 | 3 |
| 2.   | EE8261      | Electric Circuits Laboratory                | PC       | 4               | 0 | 0 | 4 | 2 |
| 3.   | EE8351      | Digital Logic Circuits                      | PC       | 4               | 2 | 2 | 0 | 3 |
| 4.   | EE8391      | Electromagnetic Theory                      | PC       | 4               | 2 | 2 | 0 | 3 |
| 5.   | EE8301      | Electrical Machines - I                     | PC       | 4               | 2 | 2 | 0 | 3 |
| 6.   | EE8311      | Electrical Machines Laboratory - I          | PC       | 4               | 0 | 0 | 4 | 2 |
| 7.   | EE8401      | Electrical Machines - II                    | PC       | 4               | 2 | 2 | 0 | 3 |
| 8.   | EE8402      | Transmission and Distribution               | PC       | 3               | 3 | 0 | 0 | 3 |
| 9.   | EE8403      | Measurements and Instrumentation            | PC       | 3               | 3 | 0 | 0 | 3 |
| 10.  | EE8451      | Linear Integrated Circuits and Applications | PC       | 3               | 3 | 0 | 0 | 3 |
| 11.  | IC8451      | Control Systems                             | PC       | 5               | 3 | 2 | 0 | 4 |
| 12.  | EE8411      | Electrical Machines Laboratory II           | PC       | 4               | 0 | 0 | 4 | 2 |

|     |        |   |    |   |   |   |   |   |
|-----|--------|---|----|---|---|---|---|---|
| 13. | EE8461 | Linear and Digital Integrated Circuits Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 14. | EE8501 | Power System Analysis                             | PC | 3 | 3 | 0 | 0 | 3 |
| 15. | EE8551 | Microprocessors and Microcontrollers              | PC | 3 | 3 | 0 | 0 | 3 |
| 16. | EE8552 | Power Electronics                                 | PC | 3 | 3 | 0 | 0 | 3 |
| 17. | EE8591 | Digital Signal Processing                         | PC | 4 | 2 | 2 | 0 | 3 |
| 18. | EE8511 | Control and Instrumentation Laboratory            | PC | 4 | 0 | 0 | 4 | 2 |
| 19. | EE8601 | Solid State Drives                                | PC | 3 | 3 | 0 | 0 | 3 |
| 20. | EE8602 | Protection and Switchgear                         | PC | 3 | 3 | 0 | 0 | 3 |
| 21. | EE8661 | Power Electronics and Drives Laboratory           | PC | 4 | 0 | 0 | 4 | 2 |
| 22. | EE8681 | Microprocessors and Microcontrollers Laboratory   | PC | 4 | 0 | 0 | 4 | 2 |
| 23. | EE8701 | High Voltage Engineering                          | PC | 3 | 3 | 0 | 0 | 3 |
| 24. | EE8702 | Power System Operation and Control                | PC | 3 | 3 | 0 | 0 | 3 |
| 25. | EE8703 | Renewable Energy Systems                          | PC | 3 | 3 | 0 | 0 | 3 |
| 26. | EE8711 | Power System Simulation Laboratory                | PC | 4 | 0 | 0 | 4 | 2 |
| 27. | EE8712 | Renewable Energy Systems Laboratory               | PC | 4 | 0 | 0 | 4 | 2 |

#### EMPLOYABILITY ENHANCEMENT COURSES (EEC)

| S.No | COURSE CODE | COURSE TITLE               | CATEGORY | CONTACT PERIODS | L | T | P  | C  |
|------|-------------|----------------------------|----------|-----------------|---|---|----|----|
| 1.   | EE8412      | Technical seminar          | EEC      | 2               | 0 | 0 | 2  | 1  |
| 2.   | HS8581      | Professional Communication | EEC      | 2               | 0 | 0 | 2  | 1  |
| 3.   | EE8611      | Mini Project               | EEC      | 4               | 0 | 0 | 4  | 2  |
| 4.   | EE8811      | Project work               | EEC      | 20              | 0 | 0 | 20 | 10 |

## SUMMARY

| S.NO. | SUBJECT AREA                  | CREDITS AS PER SEMESTER |           |           |           |           |           |           |           | CREDITS TOTAL |
|-------|-------------------------------|-------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------------|
|       |                               | I                       | II        | III       | IV        | V         | VI        | VII       | VIII      |               |
| 1.    | HS                            | 4                       | 7         | -         | -         | -         | -         | -         |           | 11            |
| 2.    | BS                            | 12                      | 7         | 4         | 4         | -         | -         | -         |           | 27            |
| 3.    | ES                            | 9                       | 6         | 8         | -         | 5         | 3         | -         |           | 31            |
| 4.    | PC                            | -                       | 5         | 11        | 20        | 14        | 10        | 13        | -         | 73            |
| 5.    | PE                            |                         |           |           |           |           | 6         | 6         | 6         | 18            |
| 6.    | OE                            |                         |           |           |           | 3         | -         | 3         |           | 6             |
| 7.    | EEC                           |                         |           |           | 1         | 1         | 2         |           | 10        | 14            |
|       | <b>Total</b>                  | <b>25</b>               | <b>25</b> | <b>23</b> | <b>25</b> | <b>23</b> | <b>21</b> | <b>22</b> | <b>16</b> | <b>180</b>    |
|       | <b>Non Credit / Mandatory</b> | -                       | -         | -         | -         | -         | -         | -         | -         | 0             |

**OBJECTIVES:**

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

**UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 12**

**Reading-** short comprehension passages, practice in skimming-scanning and predicting- **Writing-** completing sentences- - developing hints. **Listening-** short texts- short formal and informal conversations. **Speaking-** introducing oneself - exchanging personal information- **Language development-** Wh- Questions- asking and answering-yes or no questions- parts of speech. **Vocabulary development--** prefixes- suffixes- articles.- count/ uncount nouns.

**UNIT II GENERAL READING AND FREE WRITING 12**

**Reading** - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register- **Writing** - paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures -**Listening-** telephonic conversations. **Speaking** – sharing information of a personal kind—greeting - taking leave- **Language development** - prepositions, conjunctions **Vocabulary development-** guessing meanings of words in context.

**UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 12**

**Reading-** short texts and longer passages (close reading) **Writing-** understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences **Listening** – listening to longer texts and filling up the table- product description- narratives from different sources. **Speaking-** asking about routine actions and expressing opinions. **Language development-** degrees of comparison- pronouns- direct vs indirect questions- **Vocabulary development** – single word substitutes- adverbs.

**UNIT IV READING AND LANGUAGE DEVELOPMENT 12**

**Reading-** comprehension-reading longer texts- reading different types of texts- magazines **Writing-** letter writing, informal or personal letters-e-mails-conventions of personal email- **Listening-** listening to dialogues or conversations and completing exercises based on them. **Speaking-** speaking about oneself- speaking about one's friend- **Language development-** Tenses- simple present-simple past-present continuous and past continuous- **Vocabulary development-** synonyms-antonyms- phrasal verbs

## UNIT V EXTENDED WRITING

12

**Reading-** longer texts- close reading -**Writing-** brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing-**Listening** – listening to talks- conversations- **Speaking** – participating in conversations- short group conversations-**Language development**-modal verbs- present/ past perfect tense - **Vocabulary development**-collocations- fixed and semi-fixed expressions

**TOTAL: 60 PERIODS**

**OUTCOMES: At the end of the course, learners will be able to:**

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English
- Write short essays of a general kind and personal letters and emails in English.

### TEXT BOOKS:

1. Board of Editors. **Using English** A Coursebook for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015
2. Richards, C. Jack. **Interchange Students' Book-2** New Delhi: CUP, 2015.

### REFERENCES

- 1 Bailey, Stephen. **Academic Writing: A practical guide for students**. New York: Rutledge, 2011.
- 2 Comfort, Jeremy, et al. **Speaking Effectively : Developing Speaking Skills for Business English**. Cambridge University Press, Cambridge: Reprint 2011
- 3 Dutt P. Kiranmai and Rajeevan Geeta. **Basic Communication Skills**, Foundation Books: 2013
- 4 Means, L. Thomas and Elaine Langlois. **English & Communication For Colleges**. Cengage Learning, USA: 2007
- 5 Redston, Chris & Gillies Cunningham **Face2Face** (Pre-intermediate Student's Book & Workbook) Cambridge University Press, New Delhi: 2005



**OBJECTIVES :**

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

**UNIT I DIFFERENTIAL CALCULUS****12**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

**UNIT II 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 - Lagrange's method of undetermined multipliers.

**UNIT III 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 IV 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.

**UNIT V DIFFERENTIAL EQUATIONS****12**

Higher order linear differential equations with constant coefficients - Method of variation of parameters - Homogenous equation of Euler's and Legendre's type - System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

**TOTAL : 60 PERIODS****OUTCOMES :**

After completing this course, students should demonstrate competency in the following skills:

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.

- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Apply various techniques in solving differential equations.

#### TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7<sup>th</sup> Edition, New Delhi, 2015. [For Units I & III - 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].

#### REFERENCES :

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10<sup>th</sup> Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3<sup>rd</sup> Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, "Thomas Calculus", 12<sup>th</sup> Edition, Pearson India, 2016.

PH8151

ENGINEERING PHYSICS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

#### OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

#### UNIT I PROPERTIES OF MATTER

9

Elasticity - Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment - cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

#### UNIT II WAVES AND FIBER OPTICS

9

Oscillatory motion - forced and damped oscillations: differential equation and its solution - plane progressive waves - wave equation. Lasers : population of energy levels, Einstein's A and B coefficients derivation - resonant cavity, optical amplification (qualitative) - Semiconductor lasers: homojunction and heterojunction - Fiber optics: principle, numerical aperture and acceptance angle -

types of optical fibres (material, refractive index, mode) - losses associated with optical fibers - fibre optic sensors: pressure and displacement.

**UNIT III THERMAL PHYSICS 9**

Transfer of heat energy - thermal expansion of solids and liquids - expansion joints - bimetallic strips - thermal conduction, convection and radiation - heat conduction in solids - thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) - thermal insulation - applications: heat exchangers, refrigerators, ovens and solar water heaters.

**UNIT IV QUANTUM PHYSICS 9**

Black body radiation - Planck's theory (derivation) - Compton effect: theory and experimental verification - wave particle duality - electron diffraction - concept of wave function and its physical significance - Schrödinger's wave equation - time independent and time dependent equations - particle in a one-dimensional rigid box - tunnelling (qualitative) - scanning tunnelling microscope.

**UNIT V CRYSTAL PHYSICS 9**

Single crystalline, polycrystalline and amorphous materials - single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices - inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects - Burger vectors, stacking faults - role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

Upon completion of this course,

- the students will gain knowledge on the basics of properties of matter and its applications,
- the students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
- the students will understand the basics of crystals, their structures and different crystal growth techniques.

**TEXT BOOKS:**

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

**REFERENCES:**

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics". W.H. Freeman, 2007.

**OBJECTIVES:**

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

**UNIT I WATER AND ITS TREATMENT****9**

Hardness of water - types - expression of hardness - units - estimation of hardness of water by EDTA - numerical problems - boiler troubles (scale and sludge) - treatment of boiler feed water - Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment - Ion exchange process, zeolite process - desalination of brackish water - Reverse Osmosis.

**UNIT II SURFACE CHEMISTRY AND CATALYSIS****9**

Adsorption: Types of adsorption - adsorption of gases on solids - adsorption of solute from solutions - adsorption isotherms - Freundlich's adsorption isotherm - Langmuir's adsorption isotherm - contact theory - kinetics of surface reactions, unimolecular reactions, Langmuir - applications of adsorption on pollution abatement.

Catalysis: Catalyst - types of catalysis - criteria - autocatalysis - catalytic poisoning and catalytic promoters - acid base catalysis - applications (catalytic convertor) - enzyme catalysis- Michaelis - Menten equation.

**UNIT III ALLOYS AND PHASE RULE****9**

Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) - heat treatment of steel. Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.

**UNIT IV FUELS AND COMBUSTION****9**

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel. Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

**UNIT V ENERGY SOURCES AND STORAGE DEVICES****9**

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of

batteries - primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H<sub>2</sub>-O<sub>2</sub> fuel cell.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

**TEXT BOOKS:**

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

**REFERENCES:**

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

**GE8151**

**PROBLEM SOLVING AND PYTHON PROGRAMMING**

**L T P C  
3 0 0 3**

**COURSE OBJECTIVES:**

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures – lists, tuples, dictionaries.
- To do input/output with files in Python.

**UNIT I ALGORITHMIC PROBLEM SOLVING**

**9**

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

**UNIT II DATA, EXPRESSIONS, STATEMENTS**

**9**

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

### **UNIT III CONTROL FLOW, FUNCTIONS**

**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. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

### **UNIT IV 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; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

### **UNIT V FILES, MODULES, PACKAGES**

**9**

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

### **COURSE OUTCOMES:**

**Upon completion of the course, students will be able to**

- Develop algorithmic solutions to simple computational problems
- Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python Programs.

**TOTAL : 45 PERIODS**

### **TEXT BOOKS:**

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2<sup>nd</sup> edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (<http://greenteapress.com/wp/think-python/>)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python - Revised and updated for Python 3.2, Network Theory Ltd., 2011.

### **REFERENCES:**

1. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
2. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
3. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
4. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.
5. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
6. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.

**OBJECTIVES:**

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.

**CONCEPTS AND CONVENTIONS (Not for Examination)****1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

**UNIT I PLANE CURVES AND FREEHAND SKETCHING****7+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloid - construction of involutes of square and circle - Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles -Representation of Three Dimensional objects - Layout of views- Freehand sketching of multiple views from pictorial views of objects

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE****6+12**

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

**UNIT III PROJECTION OF SOLIDS****5+12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

**UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES****5+12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other - obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids - Prisms, pyramids cylinders and cones.

**UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS****6+12**

Principles of isometric projection – isometric scale -Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

**TOTAL: 90 PERIODS****OUTCOMES:**

On successful completion of this course, the student will be able to

- familiarize with the fundamentals and standards of Engineering graphics
- perform freehand sketching of basic geometrical constructions and multiple views of objects.
- project orthographic projections of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- visualize and to project isometric and perspective sections of simple solids.

**TEXT BOOK:**

1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.

**REFERENCES:**

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50<sup>th</sup> Edition, 2010.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff, John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy And Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2<sup>nd</sup> Edition, 2009.

**Publication of Bureau of Indian Standards:**

1. IS 10711 - 2001: Technical products Documentation - Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) - 2001: Technical products Documentation - Lettering.
3. IS 10714 (Part 20) - 2001 & SP 46 - 2003: Lines for technical drawings.
4. IS 11669 - 1986 & SP 46 - 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) - 2001: Technical drawings - Projection Methods.

**Special points applicable to University Examinations on Engineering Graphics:**

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

**GE8161****PROBLEM SOLVING AND PYTHON PROGRAMMING  
LABORATORY****LT P C  
0 0 4 2****COURSE OBJECTIVES:**

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.



## LIST OF PROGRAMS

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

## PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

## COURSE OUTCOMES:

**Upon completion of the course, students will be able to**

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

**TOTAL :60 PERIODS**

**BS8161**

**PHYSICS AND CHEMISTRY LABORATORY**  
**(Common to all branches of B.E. / B.Tech Programmes)**

**L T P C**  
**0 0 4 2**

## OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

### **LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)**

1. Determination of rigidity modulus - Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser  
(b) Determination of acceptance angle in an optical fiber.
4. Determination of thermal conductivity of a bad conductor - Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid - Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum - spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire - Air wedge method

**TOTAL: 30 PERIODS**

**OUTCOMES:**

Upon completion of the course, the students will be able to

- apply principles of elasticity, optics and thermal properties for engineering applications.

**CHEMISTRY LABORATORY: (Any seven experiments to be conducted)**

**OBJECTIVES:**

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
  - To acquaint the students with the determination of molecular weight of a polymer by viscometry.
1. Estimation of HCl using  $\text{Na}_2\text{CO}_3$  as primary standard and Determination of alkalinity in water sample.
  2. Determination of total, temporary & permanent hardness of water by EDTA method.
  3. Determination of DO content of water sample by Winkler's method.
  4. Determination of chloride content of water sample by argentometric method.
  5. Estimation of copper content of the given solution by Iodometry.
  6. Determination of strength of given hydrochloric acid using pH meter.
  7. Determination of strength of acids in a mixture of acids using conductivity meter.
  8. Estimation of iron content of the given solution using potentiometer.
  9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
  10. Estimation of sodium and potassium present in water using flame photometer.
  11. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
  12. Pseudo first order kinetics-ester hydrolysis.
  13. Corrosion experiment-weight loss method.
  14. Determination of CMC.
  15. Phase change in a solid.
  16. Conductometric titration of strong acid vs strong base.

**OUTCOMES:**

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

**TOTAL: 30 PERIODS**

**TEXTBOOKS:**

1. Vogel's Textbook of Quantitative Chemical Analysis (8<sup>TH</sup> edition, 2014)

HS8251

TECHNICAL ENGLISH

L T P C

4 0 0 4

**OBJECTIVES:** The Course prepares second semester engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations , participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialisation.

**UNIT I INTRODUCTION TECHNICAL ENGLISH 12**

**Listening-** Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- **Speaking** -Asking for and giving directions- **Reading** - reading short technical texts from journals- newspapers- **Writing**- purpose statements – extended definitions – issue- writing instructions – checklists-recommendations-**Vocabulary Development**- technical vocabulary **Language Development** -subject verb agreement - compound words.

**UNIT II READING AND STUDY SKILLS 12**

**Listening-** Listening to longer technical talks and completing exercises based on them-**Speaking** - describing a process-**Reading** - reading longer technical texts- identifying the various transitions in a text- paragraphing- **Writing**- interpreting charts, graphs- **Vocabulary Development**-vocabulary used in formal letters/emails and reports **Language Development**- impersonal passive voice, numerical adjectives.

**UNIT III TECHNICAL WRITING AND GRAMMAR 12**

**Listening-** Listening to classroom lectures/ talks on engineering/technology -**Speaking** - introduction to technical presentations- **Reading** – longer texts both general and technical, practice in speed reading; **Writing**-Describing a process, use of sequence words- **Vocabulary Development**- sequence words- Misspelled words. **Language Development**- embedded sentences

**UNIT IV REPORT WRITING 12**

**Listening-** Listening to documentaries and making notes. **Speaking** - mechanics of presentations- **Reading** – reading for detailed comprehension- **Writing**- email etiquette- job application – cover letter -Résumé preparation( via email and hard copy)- analytical essays and issue based essays-- **Vocabulary Development**- finding suitable synonyms-paraphrasing-. **Language Development**- clauses- if conditionals.

**UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 12**

**Listening-** TED/Ink talks; **Speaking** -participating in a group discussion -**Reading**- reading and understanding technical articles **Writing**- Writing reports- minutes of a meeting- accident and survey- **Vocabulary Development**- verbal analogies **Language Development**- reported speech

**TOTAL : 60 PERIODS**

**OUTCOMES: At the end of the course learners will be able to:**

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

**TEXT BOOKS:**

1. Board of editors. **Fluency in English A Course book for Engineering and Technology.** Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. **English for Technical Communication.** Cambridge University Press: New Delhi, 2016.

**REFERENCES**

1. Booth-L. Diana, **Project Work**, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, **English for Presentations**, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. **Engineering English.** Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, **English & Communication For Colleges.** Cengage Learning, USA: 2007
5. Raman, Meenakshi and Sharma, Sangeetha- **Technical Communication Principles and Practice.**Oxford University Press: New Delhi,2014.

**Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading.**

**MA8251**

**ENGINEERING MATHEMATICS – II**

**L T P C**  
**4 0 0 4**

**OBJECTIVES :**

- This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

**UNIT I MATRICES**

**12**

Eigenvalues and Eigenvectors of a real matrix - Characteristic equation - Properties of Eigenvalues and Eigenvectors - Cayley-Hamilton theorem - Diagonalization of matrices - Reduction of a quadratic form to canonical form by orthogonal transformation - Nature of quadratic forms.

**UNIT II VECTOR CALCULUS**

**12**

Gradient and directional derivative - Divergence and curl - Vector identities - Irrotational and Solenoidal vector fields - Line integral over a plane curve - Surface integral - Area of a curved

surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

### UNIT III ANALYTIC FUNCTIONS

12

Analytic functions - Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties - Harmonic conjugates - Construction of analytic function - Conformal mapping - Mapping by functions  $w = z + c, cz, \frac{1}{z}, z^2$  - Bilinear transformation.

### UNIT IV COMPLEX INTEGRATION

12

Line integral - Cauchy's integral theorem - Cauchy's integral formula - Taylor's and Laurent's series - Singularities - Residues - Residue theorem - Application of residue theorem for evaluation of real integrals - Use of circular contour and semicircular contour.

### UNIT V LAPLACE TRANSFORMS

12

Existence conditions - Transforms of elementary functions - Transform of unit step function and unit impulse function - Basic properties - Shifting theorems - Transforms of derivatives and integrals - Initial and final value theorems - Inverse transforms - Convolution theorem - Transform of periodic functions - Application to solution of linear second order ordinary differential equations with constant coefficients.

**TOTAL: 60 PERIODS**

### OUTCOMES :

After successfully completing the course, the student will have a good understanding of the following topics and their applications:

- Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
- Gradient, divergence and curl of a vector point function and related identities.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Analytic functions, conformal mapping and complex integration.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

### TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10<sup>th</sup> Edition, New Delhi, 2016.

### REFERENCES :

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7<sup>th</sup> Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3<sup>rd</sup> Edition, 2007.
3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4<sup>th</sup> Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

|               |   |          |          |          |          |
|---------------|---|----------|----------|----------|----------|
| <b>PH8253</b> | <b>PHYSICS FOR ELECTRONICS ENGINEERING</b><br>(Common to BME, ME, CC, ECE, EEE, E&I, ICE) | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To understand the essential principles of Physics of semiconductor device and Electron transport properties. Become proficient in magnetic, dielectric and optical properties of materials and nano devices.

**UNIT I ELECTRICAL PROPERTIES OF MATERIALS 9**

Classical free electron theory - Expression for electrical conductivity - Thermal conductivity, expression - Wiedemann-Franz law - Success and failures - electrons in metals - Particle in a three dimensional box - degenerate states - Fermi- Dirac statistics - Density of energy states - Electron in periodic potential: Bloch thorem - metals and insulators - Energy bands in solids- tight binding approximation - Electron effective mass - concept of hole.

**UNIT II SEMICONDUCTOR PHYSICS 9**

Intrinsic Semiconductors - Energy band diagram - direct and indirect semiconductors - Carrier concentration in intrinsic semiconductors - extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors - Carrier transport: Velocity-electric field relations - drift and diffusion transport - Einstein's relation - Hall effect and devices - Zener and avalanche breakdown in p-n junctions - Ohmic contacts - tunnel diode - Schottky diode - MOS capacitor - power transistor.

**UNIT III MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS 9**

Magnetism in materials - magnetic field and induction - magnetization - magnetic permeability and susceptibility-types of magnetic materials - microscopic classification of magnetic materials - Ferromagnetism: origin and exchange interaction- saturation magnetization and Curie temperature - Domain Theory. Dielectric materials: Polarization processes - dielectric loss - internal field - Clausius-Mosotti relation- dielectric breakdown - high-k dielectrics.

**UNIT IV OPTICAL PROPERTIES OF MATERIALS 9**

Classification of optical materials - carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and Semiconductors (concepts only) - photo current in a P- N diode - solar cell -photo detectors - LED - Organic LED - Laser diodes - excitons - quantum confined Stark effect - quantum dot laser.

**UNIT V NANO ELECTRONIC DEVICES 9**

Introduction - electron density in bulk material - Size dependence of Fermi energy- quantum confinement - quantum structures - Density of states in quantum well, quantum wire and quantum dot structures -Zener-Bloch oscillations – resonant tunneling – quantum interference effects – mesoscopic structures: conductance fluctuations and coherent transport - Coulomb blockade effects - Single electron phenomena and Single electron Transistor - magnetic semiconductors- spintronics - Carbon nanotubes: Properties and applications.

**TOTAL : 45 PERIODS**

## OUTCOMES:

At the end of the course, the students will be able to

- gain knowledge on classical and quantum electron theories, and energy band structures,
- acquire knowledge on basics of semiconductor physics and its applications in various devices,
- get knowledge on magnetic and dielectric properties of materials,
- have the necessary understanding on the functioning of optical materials for optoelectronics,
- understand the basics of quantum structures and their applications in spintronics and carbon electronics.

## TEXT BOOKS:

1. Kasap, S.O. "Principles of Electronic Materials and Devices", McGraw-Hill Education, 2007.
2. Umesh K Mishra & Jasprit Singh, "Semiconductor Device Physics and Design", Springer, 2008.
3. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials". Narosa Publishing House, 2009.

## REFERENCES

1. Garcia, N. & Damask, A. "Physics for Computer Science Students". Springer-Verlag, 2012.
2. Hanson, G.W. "Fundamentals of Nanoelectronics". Pearson Education, 2009
3. Rogers, B., Adams, J. & Pennathur, S. "Nanotechnology: Understanding Small Systems". CRC Press, 2014

BE8252

**BASIC CIVIL AND MECHANICAL ENGINEERING**

**L T P C**  
**4 0 0 4**

## OBJECTIVES:

- To impart basic knowledge on Civil and Mechanical Engineering.
- To familiarize the materials and measurements used in Civil Engineering.
- To provide the exposure on the fundamental elements of civil engineering structures.
- To enable the students to distinguish the components and working principle of power plant units, IC engines, and R & AC system.

## **A – OVER VIEW**

### **UNIT I SCOPE OF CIVIL AND MECHANICAL ENGINEERING**

**10**

**Overview of Civil Engineering** - Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering

**Overview of Mechanical Engineering** - Mechanical Engineering contributions to the welfare of Society -Specialized sub disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering.

## **B – CIVIL ENGINEERING**

**UNIT II SURVEYING AND CIVIL ENGINEERING MATERIALS****10**

**Surveying:** Objects - classification - principles - measurements of distances - angles - leveling - determination of areas- contours - examples.

**Civil Engineering Materials:** Bricks - stones - sand - cement - concrete - steel - timber - modern materials

**UNIT III BUILDING COMPONENTS AND STRUCTURES****15**

**Foundations:** Types of foundations - Bearing capacity and settlement – Requirement of good foundations.

**Civil Engineering Structures:** Brickmasonry - stonemasonry - beams - columns - lintels - roofing - flooring - plastering - floor area, carpet area and floor space index - Types of Bridges and Dams - water supply - sources and quality of water - Rain water harvesting - introduction to high way and rail way.

**C – MECHANICAL ENGINEERING****UNIT IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS****15**

Classification of Power Plants - Internal combustion engines as automobile power plant - Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants – working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps

**UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM****10**

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system-Layout of typical domestic refrigerator-Window and Split type room Air conditioner.

**OUTCOMES:**

On successful completion of this course, the student will be able to

- appreciate the Civil and Mechanical Engineering components of Projects.
- explain the usage of construction material and proper selection of construction materials.
- measure distances and area by surveying
- identify the components used in power plant cycle.
- demonstrate working principles of petrol and diesel engine.
- elaborate the components of refrigeration and Air conditioning cycle.

**TOTAL: 60 PERIODS****TEXTBOOKS:**

1. Shanmugam Gand Palanichamy MS, "Basic Civil and Mechanical Engineering", Tata McGraw Hill Publishing Co., New Delhi, 1996.

**REFERENCES:**

1. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.
2. Ramamrutham S., "Basic Civil Engineering", Dhanpat Rai Publishing Co.(P) Ltd. 1999.
3. Seetharaman S., "Basic Civil Engineering", Anuradha Agencies, 2005.
4. ShanthaKumar SRJ., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, 2000.



5. Venugopal K. and Prahu Raja V., "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, 2000.

|               |                       |          |          |          |          |
|---------------|-----------------------|----------|----------|----------|----------|
| <b>EE8251</b> | <b>CIRCUIT THEORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                       | <b>2</b> | <b>2</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To introduce electric circuits and its analysis
- To impart knowledge on solving circuit equations using network theorems
- To introduce the phenomenon of resonance in coupled circuits.
- To educate on obtaining the transient response of circuits.
- To introduce Phasor diagrams and analysis of three phase circuits

**UNIT I BASIC CIRCUITS ANALYSIS 6+6**

Resistive elements - Ohm's Law Resistors in series and parallel circuits - Kirchoffs laws - Mesh current and node voltage - methods of analysis.

**UNIT II NETWORK REDUCTION AND THEOREMS FOR DC AND AC IRCUITS 6+6**

Network reduction: voltage and current division, source transformation - star delta conversion. Thevenins and Norton Theorems - Superposition Theorem - Maximum power transfer theorem - Reciprocity Theorem - Millman's theorem.

**UNIT III TRANSIENT RESPONSE ANALYSIS 6+6**

L and C elements - Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.

**UNIT IV THREE PHASE CIRCUITS 6+6**

A.C. circuits - Average and RMS value - Phasor Diagram - Power, Power Factor and Energy.- Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced - phasor diagram of voltages and currents - power measurement in three phase circuits.

**UNIT V RESONANCE AND COUPLED CIRCUITS 6+6**

Series and parallel resonance - their frequency response - Quality factor and Bandwidth - Self and mutual inductance - Coefficient of coupling - Tuned circuits - Single tuned circuits.

**TOTAL : 60 PERIODS**

**OUTCOMES:**

- Ability to analyse electrical circuits
- Ability to apply circuit theorems
- Ability to analyse transients

**TEXT BOOKS:**

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, edition, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2013.

3. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 2013.

## REFERENCES

1. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.
2. Jegatheesan, R., "Analysis of Electric Circuits," McGraw Hill, 2015.
3. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, McGraw-Hill, New Delhi, 2010.
4. M E Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
5. Mahadevan, K., Chitra, C., "Electric Circuits Analysis," Prentice-Hall of India Pvt Ltd., New Delhi, 2015.
6. Richard C. Dorf and James A. Svoboda, "Introduction to Electric Circuits", 7th Edition, John Wiley & Sons, Inc. 2015.
7. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", McGraw Hill, 2015.

GE8291

ENVIRONMENTAL SCIENCE AND ENGINEERING

L T P C  
3 0 0 3

## OBJECTIVES:

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

## UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

14

Definition, scope and importance of environment - need for public awareness - concept of an ecosystem - structure and function of an ecosystem - producers, consumers and decomposers - energy flow in the ecosystem - ecological succession - food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) - Introduction to biodiversity definition: genetic, species and ecosystem diversity - biogeographical classification of India - value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local

levels - India as a mega-diversity nation - hot-spots of biodiversity - threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - endangered and endemic species of India - conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems - pond, river, hill slopes, etc.

## **UNIT II ENVIRONMENTAL POLLUTION**

**8**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards - solid waste management: causes, effects and control measures of municipal solid wastes - role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site - Urban / Rural / Industrial / Agricultural.

## **UNIT III NATURAL RESOURCES**

**10**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies - Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies - Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

## **UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT**

**7**

From unsustainable to sustainable development - urban problems related to energy - water conservation, rain water harvesting, watershed management - resettlement and rehabilitation of people; its problems and concerns, case studies - role of non-governmental organization- environmental ethics: Issues and possible solutions - climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. - wasteland reclamation - consumerism and waste products - environment production act - Air (Prevention and Control of Pollution) act - Water (Prevention and control of Pollution) act - Wildlife protection act - Forest conservation act - enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

## **UNIT V HUMAN POPULATION AND THE ENVIRONMENT**

**6**

Population growth, variation among nations - population explosion - family welfare programme - environment and human health - human rights - value education - HIV / AIDS - women and child welfare - role of information technology in environment and human health - Case studies.

**TOTAL: 45 PERIODS**

### **OUTCOMES:**

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

### **TEXTBOOKS:**

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.

2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2<sup>nd</sup> edition, Pearson Education, 2004.

#### REFERENCES :

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hyderabad, 2015.
3. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.

GE8261

ENGINEERING PRACTICES LABORATORY

L T P C  
0 0 4 2

#### OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

#### GROUP A (CIVIL & MECHANICAL)

#### I CIVIL ENGINEERING PRACTICE

13

#### Buildings:

- (a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

#### Plumbing Works:

- (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
- (b) Study of pipe connections requirements for pumps and turbines.
- (c) Preparation of plumbing line sketches for water supply and sewage works.
- (d) Hands-on-exercise:

Basic pipe connections - Mixed pipe material connection - Pipe connections with different joining components.

- (e) Demonstration of plumbing requirements of high-rise buildings.

#### Carpentry using Power Tools only:

- (a) Study of the joints in roofs, doors, windows and furniture.
- (b) Hands-on-exercise:  
Wood work, joints by sawing, planing and cutting.

#### II MECHANICAL ENGINEERING PRACTICE

18

#### Welding:

- (a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
- (b) Gas welding practice

**Basic Machining:**

- (a) Simple Turning and Taper turning
- (b) Drilling Practice

**Sheet Metal Work:**

- (a) Forming & Bending:
- (b) Model making - Trays and funnels.
- (c) Different type of joints.

**Machine assembly practice:**

- (a) Study of centrifugal pump
- (b) Study of air conditioner

**Demonstration on:**

- (a) Smithy operations, upsetting, swaging, setting down and bending. Example - Exercise - Production of hexagonal headed bolt.
- (b) Foundry operations like mould preparation for gear and step cone pulley.
- (c) Fitting - Exercises - Preparation of square fitting and V - fitting models.

**GROUP B (ELECTRICAL & ELECTRONICS)**

|            |  |           |
|------------|--|-----------|
| <b>III</b> | <b>ELECTRICAL ENGINEERING PRACTICE</b>   | <b>13</b> |
|            | <ul style="list-style-type: none"> <li>1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.</li> <li>2. Fluorescent lamp wiring.</li> <li>3. Stair case wiring</li> <li>4. Measurement of electrical quantities - voltage, current, power &amp; power factor in RLC circuit.</li> <li>5. Measurement of energy using single phase energy meter.</li> <li>6. Measurement of resistance to earth of an electrical equipment.</li> </ul> |           |
| <b>IV</b>  | <b>ELECTRONICS ENGINEERING PRACTICE</b>  | <b>16</b> |
|            | <ul style="list-style-type: none"> <li>1. Study of Electronic components and equipments - Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.</li> <li>2. Study of logic gates AND, OR, EX-OR and NOT.</li> <li>3. Generation of Clock Signal.</li> <li>4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.</li> <li>5. Measurement of ripple factor of HWR and FWR.</li> </ul> |           |

**TOTAL: 60 PERIODS**

**OUTCOMES:**

On successful completion of this course, the student will be able to

- fabricate carpentry components and pipe connections including plumbing works.
- use welding equipments to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundry and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

## LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

### CIVIL

|   |          |
|---|----------|
| 1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. | 15 Sets. |
| 2. Carpentry vice (fitted to work bench)  | 15 Nos.  |
| 3. Standard woodworking tools   | 15 Sets. |
| 4. Models of industrial trusses, door joints, furniture joints  | 5 each   |
| 5. Power Tools: (a) Rotary Hammer   | 2 Nos    |
| (b) Demolition Hammer   | 2 Nos    |
| (c) Circular Saw  | 2 Nos    |
| (d) Planer  | 2 Nos    |
| (e) Hand Drilling Machine   | 2 Nos    |
| (f) Jigsaw  | 2 Nos    |

### MECHANICAL

|   |           |
|---|-----------|
| 1. Arc welding transformer with cables and holders                            | 5 Nos.    |
| 2. Welding booth with exhaust facility  | 5 Nos.    |
| 3. Welding accessories like welding shield, chipping hammer, wire brush, etc. | 5 Sets.   |
| 4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.    | 2 Nos.    |
| 5. Centre lathe   | 2 Nos.    |
| 6. Hearth furnace, anvil and smithy tools                                     | 2 Sets.   |
| 7. Moulding table, foundry tools  | 2 Sets.   |
| 8. Power Tool: Angle Grinder  | 2 Nos     |
| 9. Study-purpose items: centrifugal pump, air-conditioner                     | One each. |

### ELECTRICAL

|   |         |
|---|---------|
| 1. Assorted electrical components for house wiring                  | 15 Sets |
| 2. Electrical measuring instruments                                 | 10 Sets |
| 3. Study purpose items: Iron box, fan and regulator, emergency lamp | 1 each  |
| 4. Megger (250V/500V)   | 1 No.   |
| 5. Power Tools: (a) Range Finder                                    | 2 Nos   |
| (b) Digital Live-wire detector                                      | 2 Nos   |

### ELECTRONICS

|   |         |
|---|---------|
| 1. Soldering guns   | 10 Nos. |
| 2. Assorted electronic components for making circuits                 | 50 Nos. |
| 3. Small PCBs   | 10 Nos. |
| 4. Multimeters  | 10 Nos. |
| 5. Study purpose items: Telephone, FM radio, low-voltage power supply |         |

**OBJECTIVES:**

- To simulate various electric circuits using Pspice/ Matlab/e-Sim / Scilab
- To gain practical experience on electric circuits and verification of theorems.

**LIST OF EXPERIMENTS**

1. Simulation and experimental verification of electrical circuit problems using Kirchhoff's voltage and current laws.
2. Simulation and experimental verification of electrical circuit problems using Thevenin's theorem.
3. Simulation and experimental verification of electrical circuit problems using Norton's theorem.
4. Simulation and experimental verification of electrical circuit problems using Superposition theorem.
5. Simulation and experimental verification of Maximum Power transfer Theorem.
6. Study of Analog and digital oscilloscopes and measurement of sinusoidal voltage, frequency and power factor.
7. Simulation and Experimental validation of R-C electric circuit transients.
8. Simulation and Experimental validation of frequency response of RLC electric circuit.
9. Design and Simulation of series resonance circuit.
10. Design and Simulation of parallel resonant circuits.
11. Simulation of three phase balanced and unbalanced star, delta networks circuits.

**TOTAL: 60 PERIODS****OUTCOMES:**

- Understand and apply circuit theorems and concepts in engineering applications.
- Simulate electric circuits.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

- 1 Regulated Power Supply: 0 - 15 V D.C - 10 Nos / Distributed Power Source.
- 2 Function Generator (1 MHz) - 10 Nos.
- 3 Single Phase Energy Meter - 1 No.
- 4 Oscilloscope (20 MHz) - 10 Nos.
- 5 Digital Storage Oscilloscope (20 MHz) - 1 No.
- 6 10 Nos. of PC with Circuit Simulation Software (min 10 Users) ( e-Sim / Scilab/ Pspice / MATLAB /other Equivalent software Package) and Printer (1 No.)
- 7 AC/DC - Voltmeters (10 Nos.), Ammeters (10 Nos.) and Multi-meters (10 Nos.)
- 8 Single Phase Wattmeter - 3 Nos.
- 9 Decade Resistance Box, Decade Inductance Box, Decade Capacitance Box - 6 Nos each.
- 10 Circuit Connection Boards - 10 Nos.

Necessary Quantities of Resistors, Inductors, Capacitors of various capacities (Quarter Watt to 10 Watt)

**MA8353 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS****L T P C**  
**4 0 0 4****OBJECTIVES :**

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

**UNIT I 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 II 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 III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS****12**

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation - One dimensional equation of heat conduction - Steady state solution of two dimensional equation of heat conduction.

**UNIT IV 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 V Z - TRANSFORMS AND DIFFERENCE EQUATIONS****12**

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations - Solution of difference equations using Z - transform.

**TOTAL : 60 PERIODS****OUTCOMES :**

Upon successful completion of the course, students should be able to:

- Understand how to solve the given standard partial differential equations.
  - Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
  - Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.



- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

**TEXT BOOKS :**

1. Grewal B.S., "Higher Engineering Mathematics", 43<sup>rd</sup> Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

**REFERENCES :**

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", 9<sup>th</sup> Edition, Laxmi Publications Pvt. Ltd, 2014.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10<sup>th</sup> Edition, John Wiley, India, 2016.
4. James, G., "Advanced Modern Engineering Mathematics", 3<sup>rd</sup> Edition, Pearson Education, 2007.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

**EE8351**

**DIGITAL LOGIC CIRCUITS**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>2</b> | <b>2</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To study various number systems and simplify the logical expressions using Boolean functions
- To study combinational circuits
- To design various synchronous and asynchronous circuits.
- To introduce asynchronous sequential circuits and PLDs
- To introduce digital simulation for development of application oriented logic circuits.

**UNIT I            NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES**

**6+6**

Review of number systems, binary codes, error detection and correction codes (Parity and Hamming code) - Digital Logic Families -comparison of RTL, DTL, TTL, ECL and MOS families -operation, characteristics of digital logic family.

**UNIT II            COMBINATIONAL CIRCUITS**

**6+6**

Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps - simplification and implementation of combinational logic – multiplexers and de multiplexers - code converters, adders, subtractors, Encoders and Decoders.





## REFERENCES

1. V.V.Sarwate, 'Electromagnetic fields and waves', First Edition, Newage Publishers, 1993.
2. J.P.Tewari, 'Engineering Electromagnetics - Theory, Problems and Applications', Second Edition, Khanna Publishers.
3. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), McGraw Hill, 2010.
4. S.P.Ghosh, Lipika Datta, 'Electromagnetic Field Theory', First Edition, McGraw Hill Education(India) Private Limited, 2012.
5. K A Gangadhar, 'Electromagnetic Field Theory', Khanna Publishers; Eighth Reprint : 2015

EE8301

### ELECTRICAL MACHINES – I

L T P C  
2 2 0 3

#### OBJECTIVES:

To impart knowledge on the following Topics

- Magnetic-circuit analysis and introduce magnetic materials
- Constructional details, the principle of operation, prediction of performance, the methods of testing the transformers and three phase transformer connections.
- Working principles of electrical machines using the concepts of electromechanical energy conversion principles and derive expressions for generated voltage and torque developed in all Electrical Machines.
- Working principles of DC machines as Generator types, determination of their no-load/load characteristics, starting and methods of speed control of motors.
- Various losses taking place in D.C. Motor and to study the different testing methods to arrive at their performance.

#### UNIT I MAGNETIC CIRCUITS AND MAGNETIC MATERIALS 6+6

Magnetic circuits -Laws governing magnetic circuits - Flux linkage, Inductance and energy - Statically and Dynamically induced EMF - Torque – Properties of magnetic materials, Hysteresis and Eddy Current losses - AC excitation, introduction to permanent magnets-Transformer as a magnetically coupled circuit.

#### UNIT II TRANSFORMERS 6+6

Construction - principle of operation - equivalent circuit parameters - phasor diagrams, losses - testing - efficiency and voltage regulation-all day efficiency-Sumpner's test, per unit representation - inrush current - three phase transformers-connections - Scott Connection - Phasing of transformer- parallel operation of three phase transformers-auto transformer - tap changing transformers- tertiary winding.

#### UNIT III ELECTROMECHANICAL ENERGY CONVERSION AND CONCEPTS IN ROTATING MACHINES 6+6

Energy in magnetic system - Field energy and co energy-force and torque equations - singly and multiply excited magnetic field systems-mmf of distributed windings - Winding Inductances-, magnetic fields in rotating machines - rotating mmf waves - magnetic

saturation and leakage fluxes.

**UNIT IV DC GENERATORS 6+6**

Construction and components of DC Machine – Principle of operation - Lap and wave windings-EMF equations- circuit model – armature reaction -methods of excitation-commutation - interpoles compensating winding -characteristics of DC generators.

**UNIT V DC MOTORS 6+6**

Principle and operations - types of DC Motors - Speed Torque Characteristics of DC Motors-starting and speed control of DC motors -Plugging, dynamic and regenerative braking-testing and efficiency - Retardation test- Swinburne's test and Hopkinson's test - Permanent Magnet DC (PMDC)motors-applications of DC Motor

**TOTAL : 60 PERIODS**

**OUTCOMES:**

- Ability to analyze the magnetic-circuits.
- Ability to acquire the knowledge in constructional details of transformers.
- Ability to understand the concepts of electromechanical energy conversion.
- Ability to acquire the knowledge in working principles of DC Generator.
- Ability to acquire the knowledge in working principles of DC Motor
- Ability to acquire the knowledge in various losses taking place in D.C. Machines

**TEXT BOOKS:**

1. Stephen J. Chapman, 'Electric Machinery Fundamentals'4<sup>th</sup> edition, McGraw Hill Education Pvt. Ltd, 2010.
2. P.C. Sen'Principles of Electric Machines and Power Electronics' John Wiley & Sons; 3rd Edition 2013.
3. Nagrath, I.J. and Kothari.D.P., 'Electric Machines', McGraw-Hill Education, 2004

**REFERENCES**

1. Theodore Wildi, "Electrical Machines, Drives, and Power Systems", Pearson Education., (5th Edition), 2002.
2. B.R. Gupta ,'Fundamental of Electric Machines' New age International Publishers,3<sup>rd</sup> Edition ,Reprint 2015.
3. S.K. Bhattacharya, 'Electrical Machines' McGraw - Hill Education, New Delhi, 3<sup>rd</sup> Edition,2009.
4. Vincent Del Toro, 'Basic Electric Machines' Pearson India Education, 2016.
5. Surinder Pal Bali, 'Electrical Technology Machines & Measurements, Vol.II, Pearson, 2013.
6. Fitzgerald. A.E., Charles Kingsely Jr, Stephen D.Umans, 'Electric Machinery', Sixth edition, McGraw Hill Books Company, 2003.

**OBJECTIVES:****The student should be made to:**

- Understand the structure of basic electronic devices.
- Be exposed to active and passive circuit elements.
- Familiarize the operation and applications of transistor like BJT and FET.
- Explore the characteristics of amplifier gain and frequency response.
- Learn the required functionality of positive and negative feedback systems.

**UNIT I PN JUNCTION DEVICES****9**

PN junction diode -structure, operation and V-I characteristics, diffusion and transition capacitance - Rectifiers – Half Wave and Full Wave Rectifier,- Display devices- LED, Laser diodes, Zener diode characteristics- Zener Reverse characteristics - Zener as regulator

**UNIT II TRANSISTORS AND THYRISTORS****9**

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristors and IGBT - Structure and characteristics.

**UNIT III AMPLIFIERS****9**

BJT small signal model - Analysis of CE, CB, CC amplifiers- Gain and frequency response -MOSFET small signal model- Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

**UNIT IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER****9**

BIMOS cascade amplifier, Differential amplifier - Common mode and Difference mode analysis - FET input stages - Single tuned amplifiers - Gain and frequency response - Neutralization methods, power amplifiers -Types (Qualitative analysis).

**UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS****9**

Advantages of negative feedback - voltage / current, series , Shunt feedback -positive feedback - Condition for oscillations, phase shift - Wien bridge, Hartley, Colpitts and Crystal oscillators.

**TOTAL : 45 PERIODS****OUTCOMES:****Upon Completion of the course, the students will be able to:**

- Explain the structure and working operation of basic electronic devices.
- Able to identify and differentiate both active and passive elements
- Analyze the characteristics of different electronic devices such as diodes and transistors
- Choose and adapt the required components to construct an amplifier circuit.
- Employ the acquired knowledge in design and analysis of oscillators

**TEXT BOOKS:**

1. . David A. Bell ,”Electronic devices and circuits”, Oxford University higher education, 5<sup>th</sup> edition 2008.
2. Sedra and smith, “Microelectronic circuits”, 7<sup>th</sup> Ed., Oxford University Press

## REFERENCES:

1. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2<sup>nd</sup> edition 2014.
2. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10<sup>th</sup> Edition, 2017.
3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
4. Robert L.Boylestad, "Electronic devices and circuit theory", 2002.
5. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2004.

ME8792

POWER PLANT ENGINEERING

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## OBJECTIVE:

- Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

### UNIT I COAL BASED THERMAL POWER PLANTS 9

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

### UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 9

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

### UNIT III NUCLEAR POWER PLANTS 9

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : *Boiling Water Reactor (BWR)*, *Pressurized Water Reactor (PWR)*, CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

### UNIT IV POWER FROM RENEWABLE ENERGY 9

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, *Solar Photo Voltaic (SPV)*, Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

### UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 9

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Explain the layout, construction and working of the components inside a thermal power plant.
- CO2 Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants.
- CO3 Explain the layout, construction and working of the components inside nuclear power plants.
- CO4 Explain the layout, construction and working of the components inside Renewable energy power plants.
- CO5 Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

**TEXT BOOK:**

- 1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.

**REFERENCES:**

- 1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
- 2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
- 3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.

**EC8311**

**ELECTRONICS LABORATORY**

**L T P C**  
**0 0 4 2**

**OBJECTIVES:**

- To enable the students to understand the behavior of semiconductor device based on experimentation.

**LIST OF EXPERIMENTS**

- 1. Characteristics of Semiconductor diode and Zener diode
- 2. Characteristics of a NPN Transistor under common emitter, common collector and common base configurations
- 3. Characteristics of JFET and draw the equivalent circuit
- 4. Characteristics of UJT and generation of saw tooth waveforms
- 5. Design and Frequency response characteristics of a Common Emitter amplifier
- 6. Characteristics of photo diode & photo transistor, Study of light activated relay circuit
- 7. Design and testing of RC phase shift and LC oscillators
- 8. Single Phase half-wave and full wave rectifiers with inductive and capacitive filters
- 9. Differential amplifiers using FET
- 10. Study of CRO for frequency and phase measurements



11. Realization of passive filters

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Ability to understand and analyse electronic circuits.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

1. Semiconductor devices like Diode, Zener Diode, NPN Transistors, JFET, UJT, Photo diode, Photo Transistor
2. Resistors, Capacitors and inductors
3. Necessary digital IC 8
4. Function Generators 10
5. Regulated 3 output Power Supply 5,  $\pm 15V$  10
6. CRO 10
7. Storage Oscilloscope 1
8. Bread boards
9. Atleast one demo module each for the listed equipments.
10. Component data sheets to be provided

**EE8311**

**ELECTRICAL MACHINES LABORATORY-I**

**L T P C**  
**0 0 4 2**

**OBJECTIVES:**

- To expose the students to the operation of D.C. machines and transformers and give them experimental skill.

**LIST OF EXPERIMENTS**

1. Open circuit and load characteristics of DC shunt generator- critical resistance and critical speed.
2. Load characteristics of DC compound generator with differential and cumulative connections.
3. Load test on DC shunt motor.
4. Load test on DC compound motor.
5. Load test on DC series motor.
6. Swinburne's test and speed control of DC shunt motor.
7. Hopkinson's test on DC motor - generator set.
8. Load test on single-phase transformer and three phase transformers.
9. Open circuit and short circuit tests on single phase transformer.
10. Sumpner's test on single phase transformers.
11. Separation of no-load losses in single phase transformer.
- 12 Study of starters and 3-phase transformers connections.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Ability to understand and analyze DC Generator

- Ability to understand and analyze DC Motor
- Ability to understand and analyse Transformers.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

1. DC Shunt Motor with Loading Arrangement - 3 nos
2. DC Shunt Motor Coupled with Three phase Alternator - 1 No.
3. Single Phase Transformer - 4 nos
4. DC Series Motor with Loading Arrangement - 1 No.
5. DC compound Motor with Loading Arrangement - 1 No.
6. Three Phase Induction Motor with Loading Arrangement - 2 nos
7. Single Phase Induction Motor with Loading Arrangement - 1 No.
8. DC Shunt Motor Coupled With DC Compound Generator - 2 nos
9. DC Shunt Motor Coupled With DC Shunt Motor - 1 No.
10. Tachometer -Digital/Analog - 8 nos
11. Single Phase Auto Transformer - 2 nos
12. Three Phase Auto Transformer - 1 No.
13. Single Phase Resistive Loading Bank - 2 nos
14. Three Phase Resistive Loading Bank. - 2 nos

**MA8491**

**NUMERICAL METHODS**

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**OBJECTIVES :**

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

**UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS**

**12**

Solution of algebraic and transcendental equations - Fixed point iteration method - Newton Raphson method - Solution of linear system of equations - Gauss elimination method - Pivoting - Gauss Jordan method - Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

**UNIT II INTERPOLATION AND APPROXIMATION 12**

Interpolation with unequal intervals - Lagrange's interpolation - Newton's divided difference interpolation - Cubic Splines - Difference operators and relations - Interpolation with equal intervals - Newton's forward and backward difference formulae.

**UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12**

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule - Romberg's Method - Two point and three point Gaussian quadrature formulae - Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

**UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12**

Single step methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge - Kutta method for solving first order equations - Multi step methods - Milne's and Adams - Bash forth predictor corrector methods for solving first order equations.

**UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12**

Finite difference methods for solving second order two - point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain - One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods - One dimensional wave equation by explicit method.

**TOTAL : 60 PERIODS**

**OUTCOMES :**

Upon successful completion of the course, students should be able to:

- Understand the basic concepts and techniques of solving algebraic and transcendental equations.
- Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.
- Apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

**TEXTBOOKS :**

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9<sup>th</sup> Edition, Cengage Learning, 2016.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10<sup>th</sup> Edition, New Delhi, 2015.

**REFERENCES :**

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
2. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6<sup>th</sup> Edition, New Delhi, 2006.
3. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2<sup>nd</sup> Edition, Prentice Hall, 1992.
4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3<sup>rd</sup> Edition, New Delhi, 2007.
5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5<sup>th</sup> Edition, 2015.

**OBJECTIVES:**

To impart knowledge on the following Topics

- Construction and performance of salient and non – salient type synchronous generators.
- Principle of operation and performance of synchronous motor.
- Construction, principle of operation and performance of induction machines.
- Starting and speed control of three-phase induction motors.
- Construction, principle of operation and performance of single phase induction motors and special machines.

**UNIT I SYNCHRONOUS GENERATOR 6+6**

Constructional details - Types of rotors -winding factors- emf equation - Synchronous reactance - Armature reaction - Phasor diagrams of non salient pole synchronous generator connected to infinite bus--Synchronizing and parallel operation - Synchronizing torque -Change of excitation and mechanical input- Voltage regulation - EMF, MMF, ZPF and A.S.A methods - steady state power- angle characteristics- Two reaction theory -slip test -short circuit transients - Capability Curves

**UNIT II SYNCHRONOUS MOTOR 6+6**

Principle of operation - Torque equation - Operation on infinite bus bars - V and Inverted V curves - Power input and power developed equations - Starting methods - Current loci for constant power input, constant excitation and constant power developed-Hunting - natural frequency of oscillations - damper windings- synchronous condenser.

**UNIT III THREE PHASE INDUCTION MOTOR 6+6**

Constructional details – Types of rotors – Principle of operation – Slip -cogging and crawling- Equivalent circuit - Torque-Slip characteristics - Condition for maximum torque - Losses and efficiency - Load test - No load and blocked rotor tests - Circle diagram - Separation of losses - Double cage induction motors -Induction generators - Synchronous induction motor.

**UNIT IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 6+6**

Need for starting - Types of starters - DOL, Rotor resistance, Autotransformer and Star-delta starters - Speed control - Voltage control, Frequency control and pole changing - Cascaded connection-V/f control - Slip power recovery scheme-Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.

**UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 6+6**

Constructional details of single phase induction motor - Double field revolving theory and operation - Equivalent circuit - No load and blocked rotor test - Performance analysis - Starting methods of single-phase induction motors - Capacitor-start capacitor run Induction motor- Shaded pole induction motor - Linear induction motor – Repulsion motor - Hysteresis motor - AC series motor- Servo motors- Stepper motors - introduction to magnetic levitation systems.

**TOTAL : 60 PERIODS**

**OUTCOMES:**

- Ability to understand the construction and working principle of Synchronous Generator
- Ability to understand MMF curves and armature windings.
- Ability to acquire knowledge on Synchronous motor.
- Ability to understand the construction and working principle of Three phase Induction Motor
- Ability to understand the construction and working principle of Special Machines
- Ability to predetermine the performance characteristics of Synchronous Machines.

**TEXT BOOKS:**

1. A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, 'Electric Machinery', Mc Graw Hill publishing Company Ltd, 2003.
2. Vincent Del Toro, 'Basic Electric Machines' Pearson India Education, 2016.
3. Stephen J. Chapman, 'Electric Machinery Fundamentals' 4<sup>th</sup> edition, McGraw Hill Education Pvt. Ltd, 2010.

**REFERENCES**

1. D.P. Kothari and I.J. Nagrath, 'Electric Machines', McGraw Hill Publishing Company Ltd, 2002.
2. P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, 2003.
3. M.N. Bandyopadhyay, Electrical Machines Theory and Practice, PHI Learning PVT LTD., New Delhi, 2009.
4. B.R.Gupta, 'Fundamental of Electric Machines' New age International Publishers, 3<sup>rd</sup> Edition, Reprint 2015.
5. Murugesh Kumar, 'Electric Machines', Vikas Publishing House Pvt. Ltd, 2002.
6. Alexander S. Langsdorf, 'Theory of Alternating-Current Machinery', McGraw Hill Publications, 2001.

**EE8402****TRANSMISSION AND DISTRIBUTION**

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**OBJECTIVES:**

- To study the structure of electric power system and to develop expressions for the computation of transmission line parameters.
- To obtain the equivalent circuits for the transmission lines based on distance and to determine voltage regulation and efficiency.
- To understand the mechanical design of transmission lines and to analyze the voltage distribution in insulator strings to improve the efficiency.
- To study the types, construction of cables and methods to improve the efficiency.
- To study about distribution systems, types of substations, methods of grounding, EHVAC, HVDC and FACTS.

**UNIT I TRANSMISSION LINE PARAMETERS****9**

Structure of Power System - Parameters of single and three phase transmission lines with single and double circuits -Resistance, inductance and capacitance of solid, stranded and bundled conductors, Symmetrical and unsymmetrical spacing and transposition - application of self and mutual GMD; skin and proximity effects -Typical configurations, conductor types and electrical parameters of EHV lines.

**UNIT II            MODELLING AND PERFORMANCE OF TRANSMISSION LINES            9**

Performance of Transmission lines - short line, medium line and long line - equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance - transmission efficiency and voltage regulation, real and reactive power flow in lines - Power Circle diagrams - Formation of Corona - Critical Voltages - Effect on Line Performance.

**UNIT III            MECHANICAL DESIGN OF LINES            9**

Mechanical design of OH lines – Line Supports –Types of towers – Stress and Sag Calculation – Effects of Wind and Ice loading. Insulators: Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators.

**UNIT IV            UNDER GROUND CABLES            9**

Underground cables - Types of cables – Construction of single core and 3 core cables - Insulation Resistance - Potential Gradient - Capacitance of Single-core and 3 core cables - Grading of cables - Power factor and heating of cables - DC cables.

**UNIT V            DISTRIBUTION SYSTEMS            9**

Distribution Systems – General Aspects – Kelvin’s Law – AC and DC distributions - Techniques of Voltage Control and Power factor improvement - Distribution Loss -Types of Substations -Methods of Grounding - Trends in Transmission and Distribution: EHVAC, HVDC and FACTS (Qualitative treatment only).

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- To understand the importance and the functioning of transmission line parameters.
- To understand the concepts of Lines and Insulators.
- To acquire knowledge on the performance of Transmission lines.
- To understand the importance of distribution of the electric power in power system.
- To acquire knowledge on Underground Cables
- To become familiar with the function of different components used in Transmission and Distribution levels of power system and modelling of these components.

**TEXT BOOKS:**

1. D.P.Kothari, I.J. Nagarath, ‘Power System Engineering’, Mc Graw-Hill Publishing Company limited, New Delhi, Second Edition, 2008.
2. C.L.Wadhwa, ‘Electrical Power Systems’, New Academic Science Ltd, 2009.
3. S.N. Singh, ‘Electric Power Generation, Transmission and Distribution’, Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011.

**REFERENCES**

1. B.R.Gupta, ‘Power System Analysis and Design’ S. Chand, New Delhi, Fifth Edition, 2008.
2. Luces M.Fualken berry, Walter Coffey, ‘Electrical Power Distribution and Transmission’, Pearson Education, 2007.
3. Arun Ingole, "power transmission and distribution" Pearson Education, 2017
4. J.Brian, Hardy and Colin R.Bayliss ‘Transmission and Distribution in Electrical Engineering’, Newnes; Fourth Edition, 2012.
5. G.Ramamurthy, “Handbook of Electrical power Distribution,” Universities Press, 2013.



**TEXT BOOKS:**

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2010.
2. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria & Sons, Delhi, 2013.
3. Doebelin E.O. and Manik D.N., Measurement Systems - Applications and Design, Special Indian Edition, McGraw Hill Education Pvt. Ltd., 2007.

**REFERENCES**

1. H.S. Kalsi, 'Electronic Instrumentation', McGraw Hill, III Edition 2010.
2. D.V.S. Murthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2015.
3. David Bell, ' Electronic Instrumentation & Measurements', Oxford University Press,2013.
4. Martin Reissland, 'Electrical Measurements', New Age International (P) Ltd., Delhi, 2001.
5. Alan. S. Morris, Principles of Measurements and Instrumentation, 2nd Edition, Prentice Hall of India, 2003.

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| <b>EE8451</b> | <b>LINEAR INTEGRATED CIRCUITS AND APPLICATIONS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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**OBJECTIVES:**

To impart knowledge on the following topics

- Signal analysis using Op-amp based circuits.
- Applications of Op-amp.
- Functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits.
- IC fabrication procedure.

**UNIT I IC FABRICATION 9**

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realisation of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance, FETs and PV Cell.

**UNIT II CHARACTERISTICS OF OPAMP 9**

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier; frequency response of OP-AMP; Basic applications of op-amp - Inverting and Non-inverting Amplifiers, summer, differentiator and integrator-V/I & I/V converters.

**UNIT III APPLICATIONS OF OPAMP 9**

Instrumentation amplifier and its applications for transducer Bridge, Log and Antilog Amplifiers- Analog multiplier & Divider, first and second order active filters, comparators, multivibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R- 2R ladder and weighted resistor types), A/D converters using opamps.

**UNIT IV SPECIAL ICs 9**

Functional block, characteristics of 555 Timer and its PWM application - IC-566 voltage controlled oscillator IC; 565-phase locked loop IC, AD633 Analog multiplier ICs.

**UNIT V APPLICATION ICs 9**



AD623 Instrumentation Amplifier and its application as load cell weight measurement - IC voltage regulators -LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply - LM317, 723 Variability voltage regulators, switching regulator- SMPS - ICL 8038 function generator IC.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to acquire knowledge in IC fabrication procedure
- Ability to analyze the characteristics of Op-Amp
- To understand the importance of Signal analysis using Op-amp based circuits.
- Functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits.
- To understand and acquire knowledge on the Applications of Op-amp
- Ability to understand and analyse, linear integrated circuits their Fabrication and Application.

**TEXT BOOKS:**

1. David A. Bell, 'Op-amp & Linear ICs', Oxford, 2013.
2. D. Roy Choudhary, Sheil B. Jani, 'Linear Integrated Circuits', II edition, New Age, 2003.
3. Ramakant A.Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, 2003 / PHI. 2000.

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1. Fiore,"Opamps & Linear Integrated Circuits Concepts & applications", Cengage, 2010.
2. Floyd ,Buchla,"Fundamentals of Analog Circuits, Pearson, 2013.
3. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', McGraw Hill, 2003.
4. Robert F.Coughlin, Fredrick F. Driscoll, 'Op-amp and Linear ICs', Pearson, 6th edition,2012.
5. Sergio Franco, 'Design with Operational Amplifiers and Analog Integrated Circuits', Mc Graw Hill, 2016.
6. Muhammad H. Rashid,' Microelectronic Circuits Analysis and Design' Cengage Learning, 2011.

**IC8451**

**CONTROL SYSTEMS**

**L T P C  
3 2 0 4**

**COURSE OBJECTIVES**

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed-loop frequency responses of systems.
- To introduce stability analysis and design of compensators



**INSTRUMENTATION:**

8. Bridge Networks -AC and DC Bridges
9. Dynamics of Sensors/Transducers
  - (a) Temperature (b) pressure (c) Displacement (d) Optical (e) Strain (f) Flow
- 10 Power and Energy Measurement
- 11 Signal Conditioning
  - (a) Instrumentation Amplifier
  - (b) Analog - Digital and Digital -Analog converters (ADC and DACs)
- 12 Process Simulation

**TOTAL: 60 PERIODS****OUTCOMES:**

- Ability to understand control theory and apply them to electrical engineering problems.
- Ability to analyze the various types of converters.
- Ability to design compensators
- Ability to understand the basic concepts of bridge networks.
- Ability to the basics of signal conditioning circuits.
- Ability to study the simulation packages.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:****CONTROLSYSTEMS:**

1. PID controller simulation and learner kit - 1 No.
2. Digital storage Oscilloscope for capturing transience- 1 No
  - 2 Personal Computer with control system simulation packages - 10 Nos
3. DC motor -Generator test set-up for evaluation of motor parameters
4. CRO 30MHz - 1 No.
5. 2MHz Function Generator - 1No.
6. Position Control Systems Kit (with manual) - 1 No., Tacho Generator Coupling set
7. AC Synchro transmitter& receiver - 1No.
8. Sufficient number of Digital multi meters, speed and torque sensors

**INSTRUMENTATION:**

9. R, L, C Bridge kit (with manual)
10. a) Electric heater - 1No.  
Thermometer - 1No. Thermistor (silicon type) RTD nickel type - 1No.
- b) 30 psi Pressure chamber (complete set) - 1No. Current generator (0 - 20mA) Air foot pump - 1 No. (with necessary connecting tubes)
- c) LVDT20mm core length movability type - 1No. CRO 30MHz - 1No.
- d) Optical sensor - 1 No. Light source
- e) Strain Gauge Kit with Handy lever beam - 1No.

- 100gm weights - 10 nos  
 f) Flow measurement Trainer kit - 1 No.  
 (1/2 HP Motor, Water tank, Digital Milliammeter, complete set)
11. Single phase Auto transformer - 1No. Watt-hour meter (energy meter) - 1No. Ammeter  
 Voltmeter Rheostat Stop watch  
 Connecting wires (3/20)
  12. IC Transistor kit - 1No.
  13. Instrumentation Amplifier kit-1 No
  14. Analog - Digital and Digital -Analog converters (ADC and DACs)- 1 No

**HS8581**

**PROFESSIONAL COMMUNICATION**

**L T P C  
 0 0 2 1**

**OBJECTIVES: The course aims to:**

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employability Graduates
- Develop their confidence and help them attend interviews successfully.

**UNIT I**

Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills--Grooming as a professional with values--Time Management--General awareness of Current Affairs

**UNIT II**

Self-Introduction-organizing the material - Introducing oneself to the audience - introducing the topic - answering questions - individual presentation practice-- presenting the visuals effectively - 5 minute presentations

**UNIT III**

Introduction to Group Discussion-- Participating in group discussions - understanding group dynamics - brainstorming the topic -- questioning and clarifying -GD strategies- activities to improve GD skills

**UNIT IV**

Interview etiquette - dress code - body language - attending job interviews- telephone/skype interview -one to one interview &panel interview - FAQs related to job interviews

**UNIT V**

Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes.

**TOTAL : 30 PERIODS**

**OUTCOMES: At the end of the course Learners will be able to:**

- Make effective presentations

- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

### Recommended Software

1. Open Source Software
2. Win English

### REFERENCES:

1. Butterfield, Jeff **Soft Skills for Everyone**. Cengage Learning: New Delhi, 2015
2. **Interact** English Lab Manual for Undergraduate Students,. OrientBlackSwan: Hyderabad, 2016.
3. E. Suresh Kumar et al. **Communication for Professional Success**. Orient Blackswan: Hyderabad, 2015
4. Raman, Meenakshi and Sangeeta Sharma. **Professional Communication**. Oxford University Press: Oxford, 2014
5. S. Hariharanetal. **Soft Skills**. MJP Publishers: Chennai, 2010.

CS8383

### OBJECT ORIENTED PROGRAMMING LABORATORY

LT P C  
0 0 4 2

### COURSE OBJECTIVES

- To build software development skills using java programming for real-world applications.
- To understand and apply the concepts of classes, packages, interfaces, arraylist, exception handling and file processing.
- To develop applications using generic programming and event handling.

### List of experiments

1. Develop a Java application to generate Electricity bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection(i.e domestic or commercial). Compute the bill amount using the following tariff. If the type of the EB connection is domestic, calculate the amount to be paid as follows:
  - First 100 units - Rs. 1 per unit
  - 101-200 units - Rs. 2.50 per unit
  - 201 -500 units - Rs. 4 per unit
  - > 501 units - Rs. 6 per unit
 If the type of the EB connection is commercial, calculate the amount to be paid as follows:
  - First 100 units - Rs. 2 per unit
  - 101-200 units - Rs. 4.50 per unit
  - 201 -500 units - Rs. 6 per unit
  - > 501 units - Rs. 7 per unit
2. Develop a java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa) , time converter (hours to minutes, seconds and vice versa) using packages.
3. Develop a java application with Employee class with Emp\_name, Emp\_id, Address, Mail\_id, Mobile\_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the

inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.

4. Design a Java interface for ADT Stack. Implement this interface using array. Provide necessary exception handling in both the implementations.
5. Write a program to perform string operations using ArrayList. Write functions for the following
  - a. Append - add at end
  - b. Insert - add at particular index
  - c. Search
  - d. List all string starts with given letter
6. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape.
7. Write a Java program to implement user defined exception handling.
8. Write a Java program that reads a file name from the user, displays information about whether the file exists, whether the file is readable, or writable, the type of file and the length of the file in bytes.
9. Write a java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.
10. Write a java program to find the maximum value from the given type of elements using a generic function.
11. Design a calculator using event-driven programming paradigm of Java with the following options.
  - a) Decimal manipulations
  - b) Scientific manipulations
12. Develop a mini project for any application using Java concepts.

**TOTAL : 60 PERIODS**

### **COURSE OUTCOMES**

Upon completion of the course, the students will be able to

- Develop and implement Java programs for simple applications that make use of classes, packages and interfaces.
- Develop and implement Java programs with arraylist, exception handling and multithreading .
- Design applications using file processing, generic programming and event handling.

**OBJECTIVES:**

To impart knowledge on the following Topics

- Steady state operation and transient dynamics of a motor load system.
- Analyze the operation of the converter/chopper fed dc drive, both qualitatively and quantitatively.
- Operation and performance of AC motor drives.
- Analyze and design the current and speed controllers for a closed loop solid state DC motor drive.

**UNIT I DRIVE CHARACTERISTICS 9**

Electric drive - Equations governing motor load dynamics - steady state stability - multi quadrant Dynamics: acceleration, deceleration, starting & stopping - typical load torque characteristics - Selection of motor.

**UNIT II CONVERTER / CHOPPER FED DC MOTOR DRIVE 9**

Steady state analysis of the single and three phase converter fed separately excited DC motor drive-continuous conduction - Time ratio and current limit control - 4 quadrant operation of converter / chopper fed drive-Applications.

**UNIT III INDUCTION MOTOR DRIVES 9**

Stator voltage control-V/f control- Rotor Resistance control-qualitative treatment of slip power recovery drives-closed loop control- vector control- Applications.

**UNIT IV SYNCHRONOUS MOTOR DRIVES 9**

V/f control and self-control of synchronous motor: Margin angle control and power factor control- Three phase voltage/current source fed synchronous motor- Applications.

**UNIT V DESIGN OF CONTROLLERS FOR DRIVES 9**

Transfer function for DC motor / load and converter - closed loop control with Current and speed feedback-armature voltage control and field weakening mode - Design of controllers; current controller and speed controller- converter selection and characteristics.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to understand and suggest a converter for solid state drive.
- Ability to select suitability drive for the given application.
- Ability to study about the steady state operation and transient dynamics of a motor load system.
- Ability to analyze the operation of the converter/chopper fed dc drive.
- Ability to analyze the operation and performance of AC motor drives.
- Ability to analyze and design the current and speed controllers for a closed loop solid state DC motor drive.

**TEXT BOOKS:**

1. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 1992.
2. Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002.
3. R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Pearson, 2001.

**REFERENCES**

1. Vedam Subramanyam, " Electric Drives Concepts and Applications ", 2e, McGraw Hill, 2016

2. Shaahin Felizadeh, "Electric Machines and Drives", CRC Press (Taylor and Francis Group), 2013.
3. John Hindmarsh and Alasdain Renfrew, "Electrical Machines and Drives System," Elsevier 2012.
4. Theodore Wildi, " Electrical Machines ,Drives and power systems ,6<sup>th</sup> edition, Pearson Education ,2015
5. N.K. De., P.K. SEN" Electric drives" PHI, 2012.

**EE8602**

**PROTECTION AND SWITCHGEAR**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

To impart knowledge on the following Topics

- Causes of abnormal operating conditions (faults, lightning and switching surges) of the apparatus and system.
- Characteristics and functions of relays and protection schemes.
- Apparatus protection, static and numerical relays
- Functioning of circuit breaker

**UNIT I PROTECTION SCHEMES**

**9**

Principles and need for protective schemes - nature and causes of faults - types of faults - Methods of Grounding - Zones of protection and essential qualities of protection - Protection scheme

**UNIT II ELECTROMAGNETIC RELAYS**

**9**

Operating principles of relays - the Universal relay – Torque equation – R-X diagram – Electromagnetic Relays - Over current, Directional, Distance, Differential, Negative sequence and Under frequency relays.

**UNIT III APPARATUS PROTECTION**

**9**

Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, bus bars and transmission line.

**UNIT IV STATIC RELAYS AND NUMERICAL PROTECTION**

**9**

Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators - Block diagram of Numerical relays - Over current protection, transformer differential protection, distant protection of transmission lines.

**UNIT V CIRCUIT BREAKERS**

**9**

Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching - current chopping - interruption of capacitive current - Types of circuit breakers – air blast, air break, oil, SF6, MCBs, MCCBs and vacuum circuit breakers – comparison of different circuit breakers – Rating and selection of Circuit breakers.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to understand and analyze Electromagnetic and Static Relays.
- Ability to suggest suitability circuit breaker.
- Ability to find the causes of abnormal operating conditions of the apparatus and system.



- Ability to analyze the characteristics and functions of relays and protection schemes.
- Ability to study about the apparatus protection, static and numerical relays.
- Ability to acquire knowledge on functioning of circuit breaker.

**TEXT BOOKS:**

1. Sunil S.Rao, 'Switchgear and Protection', Khanna Publishers, New Delhi, 2008.
2. B.Rabindranath and N.Chander, 'Power System Protection and Switchgear', New Age International (P) Ltd., First Edition 2011.
3. Arun Ingole, 'Switch Gear and Protection' Pearson Education, 2017.

**REFERENCES**

1. BadriRam ,B.H. Vishwakarma, 'Power System Protection and Switchgear', New Age International Pvt Ltd Publishers, Second Edition 2011.
2. Y.G.Paithankar and S.R.Bhide, 'Fundamentals of power system protection', Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
3. C.L.Wadhwa, 'Electrical Power Systems', 6th Edition, New Age International (P) Ltd., 2010
4. RavindraP.Singh, 'Switchgear and Power System Protection', PHI Learning Private Ltd., NewDelhi, 2009.
5. VK Metha," Principles of Power Systems" S. Chand, 2005.
6. Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chotani,'Protection and Switchgear' Oxford University Press, 2011.

**EE8691**

**EMBEDDED SYSTEMS**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

To impart knowledge on the following Topics

- Building Blocks of Embedded System
- Various Embedded Development Strategies
- Bus Communication in processors, Input/output interfacing.
- Various processor scheduling algorithms.
- Basics of Real time operating system and example tutorials to discuss on one real time operating system tool.

**UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9**

Introduction to Embedded Systems -Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

**UNIT II EMBEDDED NETWORKING 9**

Embedded Networking: Introduction, I/O Device Ports & Buses- Serial Bus communication protocols RS232 standard - RS422 - RS 485 - CAN Bus -Serial Peripheral Interface (SPI) - Inter Integrated Circuits (I<sup>2</sup>C) -need for device drivers.

**UNIT III EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT 9**

Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model,

Sequential Program Model, concurrent Model, object oriented Model.

**UNIT IV RTOS BASED EMBEDDED SYSTEM DESIGN 9**

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance.

**UNIT V EMBEDDED SYSTEM APPLICATION AND DEVELOPMENT 9**

Case Study of Washing Machine- Automotive Application- Smart card System Application-ATM machine -Digital camera

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to understand and analyze Embedded systems.
- Ability to suggest an embedded system for a given application.
- Ability to operate various Embedded Development Strategies
- Ability to study about the bus Communication in processors.
- Ability to acquire knowledge on various processor scheduling algorithms.
- Ability to understand basics of Real time operating system.

**TEXT BOOKS:**

1. Peckol, "Embedded system Design", John Wiley & Sons,2010
2. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson, 2013
3. Shibu. K.V, "Introduction to Embedded Systems", 2e, Mc graw Hill, 2017.

**REFERENCES**

1. Raj Kamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013.
2. C.R.Sarma, "Embedded Systems Engineering", University Press (India) Pvt. Ltd, 2013.
3. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.
4. Han-Way Huang, "Embedded system Design Using C8051", Cengage Learning, 2009.
5. Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.

**EE8661 POWER ELECTRONICS AND DRIVES LABORATORY L T P C**  
**0 0 4 2**

**OBJECTIVES:**

- To provide hands on experience with power electronic converters and testing.

**LIST OF EXPERIMENTS**

- 1 Gate Pulse Generation using R, RC and UJT.
- 2 Characteristics of SCR and TRIAC
- 3 Characteristics of MOSFET and IGBT
- 4 AC to DC half controlled converter
- 5 AC to DC fully controlled Converter
- 6 Step down and step up MOSFET based choppers
- 7 IGBT based single phase PWM inverter

- 8 IGBT based three phase PWM inverter
- 9 AC Voltage controller
- 10 Switched mode power converter.
- 11 Simulation of PE circuits (1 $\Phi$  & 3 $\Phi$  semi converters, 1 $\Phi$  & 3 $\Phi$  full converters, DC-DC converters, AC voltage controllers).
- 12 Characteristics of GTO & IGCT.
- 13 Characteristics of PMLD motor

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Ability to practice and understand converter and inverter circuits and apply software for engineering problems.
- Ability to experiment about switching characteristics various switches.
- Ability to analyze about AC to DC converter circuits.
- Ability to analyze about DC to AC circuits.
- Ability to acquire knowledge on AC to AC converters
- Ability to acquire knowledge on simulation software.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

1. Device characteristics(for SCR, MOSFET, TRIAC,GTO,IGCT and IGBT kit with built-in / discrete power supply and meters) - 2 each
2. SinglephaseSCRbasedhalfcontrolledconverterandfullycontrolledconverteralong with built-in/separate/firing circuit/module and meter - 2 each
3. MOSFET based step up and step down choppers (Built in/ Discrete) - 1 each
4. IGBT based single phase PWM inverter module/Discrete Component - 2
5. IGBT based three phase PWM inverter module/Discrete Component - 2
6. Switched mode power converter module/Discrete Component - 2
7. SCR & TRIAC based 1 phase AC controller along with lamp or rheostat load - 2
8. Cyclo converter kit with firing module - 1
9. Dual regulated DC power supply with common ground
10. Cathode ray Oscilloscope -10
11. Isolation Transformer - 5
12. Single phase Auto transformer -3
13. Components (Inductance, Capacitance ) 3 set for each
14. Multimeter - 5
15. LCR meter - 3
16. Rheostats of various ranges - 2 sets of 10 value
17. Work tabilitys - 10
18. DC and AC meters of required ranges - 20
19. Component data sheets to be provided

EE8681

**MICROPROCESSORS AND MICROCONTROLLERS  
LABORATORY**

**L T P C  
0 0 4 2**

**OBJECTIVES:**

- To provide training on programming of microprocessors and microcontrollers and understand the interface requirements.
- To simulate various microprocessors and microcontrollers using KEIL or Equivalent simulator.

**LIST OF EXPERIMENTS**

- 1 Simple arithmetic operations: addition / subtraction / multiplication / division.
- 2 Programming with control instructions:
  - (i) Ascending / Descending order, Maximum / Minimum of numbers.
  - (ii) Programs using Rotate instructions.
  - (iii) Hex / ASCII / BCD code conversions.
- 3 Interface Experiments: with 8085
  - (i) A/D Interfacing. & D/A Interfacing.
- 4 Traffic light controller.
- 5 I/O Port / Serial communication
- 6 Programming Practices with Simulators/Emulators/open source
- 7 Read a key ,interface display
- 8 Demonstration of basic instructions with 8051 Micro controller execution, including:
  - (i) Conditional jumps & looping
  - (ii) Calling subroutines.
- 9 Programming I/O Port and timer of 8051
  - (i) study on interface with A/D & D/A
  - (ii) Study on interface with DC & AC motors
- 10 Application hardware development using embedded processors.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Ability to understand and apply computing platform and software for engineering problems.
- Ability to programming logics for code conversion.
- Ability to acquire knowledge on A/D and D/A.
- Ability to understand basics of serial communication.
- Ability to understand and impart knowledge in DC and AC motor interfacing.
- Ability to understand basics of software simulators.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

| SI.No. | Description of Equipment                            | Quantity required |
|--------|---|-------------------|
| 1.     | 8085 Microprocessor Trainer with Power Supply       | 15                |
| 2.     | 8051 Micro Controller Trainer Kit with power supply | 15                |
| 3.     | 8255 Interface boards                               | 5                 |
| 4.     | 8251 Interface boards                               | 5                 |

|     |  |   |
|-----|--|---|
| 5.  | 8259 Interface boards                    | 5 |
| 6.  | 8279 Keyboard / Display Interface boards | 5 |
| 7.  | 8254 timer/ counters                     | 5 |
| 8.  | ADC and DAC cards                        | 5 |
| 9.  | AC & DC motor with Controller s          | 5 |
| 10. | Traffic Light Control Systems            | 5 |

**EE8611**

**MINI PROJECT**

**LT P C  
0 0 4 2**

**OBJECTIVES:**

- To develop their own innovative prototype of ideas.
- To train the students in preparing mini project reports and examination.

The students in a group of 5 to 6 works on a topic approved by the head of the department and prepares a comprehensive mini project report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A mini project report is required at the end of the semester. The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- On Completion of the mini project work students will be in a position to take up their final year project work and find solution by formulating proper methodology.

**EE8701**

**HIGH VOLTAGE ENGINEERING**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

To impart knowledge on the following Topics

- Various types of over voltages in power system and protection methods.
- Generation of over voltages in laboratories.
- Measurement of over voltages.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of power apparatus and insulation coordination

**UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS 9**

Causes of over voltages and its effects on power system - Lightning, switching surges and temporary over voltages, Corona and its effects – Bewley lattice diagram- Protection against over voltages.

**UNIT II DIELECTRIC BREAKDOWN 9**

Properties of Dielectric materials - Gaseous breakdown in uniform and non-uniform fields - Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics- Applications of insulating materials in electrical equipments.

**UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 9**

Generation of High DC voltage: Rectifiers, voltage multipliers, vandigraff generator: generation of high impulse voltage: single and multistage Marx circuits - generation of high AC voltages: cascaded transformers, resonant transformer and tesla coil- generation of switching surges – generation of impulse currents - Triggering and control of impulse generators.

**UNIT IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS 9**

High Resistance with series ammeter – Dividers, Resistance, Capacitance and Mixed dividers - Peak Voltmeter, Generating Voltmeters - Capacitance Voltage Transformers, Electrostatic Voltmeters – Sphere Gaps - High current shunts- Digital techniques in high voltage measurement.

**UNIT V HIGH VOLTAGE TESTING & INSULATION COORDINATION 9**

High voltage testing of electrical power apparatus as per International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators and transformers- Insulation Coordination& testing of cables.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to understand Transients in power system.
- Ability to understand Generation and measurement of high voltage.
- Ability to understand High voltage testing.
- Ability to understand various types of over voltages in power system.
- Ability to measure over voltages.
- Ability to test power apparatus and insulation coordination

**TEXT BOOKS:**

1. S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second Edition Elsevier , New Delhi, 2005.
3. C.L. Wadhwa, 'High voltage Engineering', New Age International Publishers, Third Edition, 2010.

**REFERENCES**

1. L.L. Alston, 'High Voltage Technology', Oxford University Press, First Indian Edition, 2011.
2. Mazen Abdel - Salam, Hussein Anis, Ahdab A-Morshedy, Roshday Radwan, High Voltage Engineering - Theory &Practice, Second Edition Marcel Dekker, Inc., 2010.
3. Subir Ray,' An Introduction to High Voltage Engineering' PHI Learning Private Limited, New Delhi, Second Edition, 2013.



**OUTCOMES:**

- Ability to understand the day-to-day operation of electric power system.
- Ability to analyze the control actions to be implemented on the system to meet the minute-to-minute variation of system demand.
- Ability to understand the significance of power system operation and control.
- Ability to acquire knowledge on real power-frequency interaction.
- Ability to understand the reactive power-voltage interaction.
- Ability to design SCADA and its application for real time operation.

**TEXT BOOKS:**

1. Olle.I.Elgerd, 'Electric Energy Systems theory - An introduction', McGraw Hill Education Pvt. Ltd., New Delhi, 34th reprint, 2010.
2. Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 2016.
3. Abhijit Chakrabarti and Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Third Edition, 2010.

**REFERENCES**

1. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition, 2008.
2. Hadi Saadat, 'Power System Analysis', McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.
3. Kundur P., 'Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

**EE8703**

**RENEWABLE ENERGY SYSTEMS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

To impart knowledge on the following Topics

- Awareness about renewable Energy Sources and technologies.
- Adequate inputs on a variety of issues in harnessing renewable Energy.
- Recognize current and possible future role of renewable energy sources.

**UNIT I RENEWABLE ENERGY (RE) SOURCES 9**

Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.

**UNIT II WIND ENERGY 9**

Power in the Wind - Types of Wind Power Plants(WPPs)-Components of WPPs-Working of WPPs- Siting of WPPs-Grid integration issues of WPPs.



**UNIT III SOLAR PV AND THERMAL SYSTEMS 9**

Solar Radiation, Radiation Measurement, Solar Thermal Power Plant, Central Receiver Power Plants, Solar Ponds.- Thermal Energy storage system with PCM- Solar Photovoltaic systems : Basic Principle of SPV conversion – Types of PV Systems- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array ,PV Module I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking, Applications.

**UNIT IV BIOMASS ENERGY 9**

Introduction-Bio mass resources -Energy from Bio mass: conversion processes-Biomass Cogeneration-Environmental Benefits. Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system.

**UNIT V OTHER ENERGY SOURCES 9**

Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean Thermal Energy Conversion (OTEC)- Hydrogen Production and Storage- Fuel cell : Principle of working- various types - construction and applications. Energy Storage System- Hybrid Energy Systems.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to create awareness about renewable Energy Sources and technologies.
- Ability to get adequate inputs on a variety of issues in harnessing renewable Energy.
- Ability to recognize current and possible future role of renewable energy sources.
- Ability to explain the various renewable energy resources and technologies and their applications.
- Ability to understand basics about biomass energy.
- Ability to acquire knowledge about solar energy.

**TEXT BOOKS:**

1. Joshua Earnest, Tore Wizeliu, 'Wind Power Plants and Project Development', PHI Learning Pvt.Ltd, New Delhi, 2011.
2. D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", PHI Learning Pvt.Ltd, New Delhi, 2013.
3. Scott Grinnell, "Renewable Energy & Sustainable Design", CENGAGE Learning, USA, 2016.

**REFERENCES**

1. A.K.Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design", PHI Learning Private Limited, New Delhi, 2011
2. Richard A. Dunlap," Sustainable Energy" Cengage Learning India Private Limited, Delhi, 2015.
3. Chetan Singh Solanki, " Solar Photovoltaics : Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2011
4. Bradley A. Striebig,Adebayo A.Ogundipe and Maria Papadakis," Engineering Applications in Sustainable Design and Development", Cengage Learning India Private Limited, Delhi, 2016.
5. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
6. Shobh Nath Singh, 'Non-conventional Energy resources' Pearson Education ,2015.

EE8711

**POWER SYSTEM SIMULATION LABORATORY**

**L T P C**  
**0 0 4 2**

**OBJECTIVES:**

- To provide better understanding of power system analysis through digital simulation.

**LIST OF EXPERIMENTS**

- 1 Computation of Transmission Line Parameters
- 2 Formation of Bus Admittance and Impedance Matrices and Solution of Networks
- 3 Power Flow Analysis using Gauss-Seidel Method
- 4 Power Flow Analysis using Newton Raphson Method
- 5 Symmetric and unsymmetrical fault analysis
- 6 Transient stability analysis of SMIB System
- 7 Economic Dispatch in Power Systems
- 8 Load - Frequency Dynamics of Single- Area and Two-Area Power Systems
- 9 State estimation: Weighted least square estimation
- 10 Electromagnetic Transients in Power Systems : Transmission Line Energization

**TOTAL: 60 PERIODS**

**OUTCOMES:**

Ability to

- Ability to understand power system planning and operational studies.
- Ability to acquire knowledge on Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
- Ability to analyze the power flow using GS and NR method
- Ability to find Symmetric and Unsymmetrical fault
- Ability to understand the economic dispatch.
- Ability to analyze the electromagnetic transients.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

1. Personal computers (Intel i3, 80GB, 2GBRAM) - 30 nos
2. Printer laser- 1 No.
3. Dot matrix- 1 No.
4. Server (Intel i5, 80GB, 2GBRAM) (High Speed Processor) - 1 No.
5. Software: any power system simulation software with 5 user license
6. Compilers: C, C++, VB, VC++ - 30 users

**OBJECTIVES:**

- To train the students in Renewable Energy Sources and technologies.
- To provide adequate inputs on a variety of issues in harnessing Renewable Energy.
- To recognize current and possible future role of Renewable energy sources.

**LIST OF EXPERIMENTS**

- 1 Simulation study on Solar PV Energy System.
- 2 Experiment on “VI-Characteristics and Efficiency of 1kWp Solar PV System”.
- 3 Experiment on “Shadowing effect & diode based solution in 1kWp Solar PV System”.
- 4 Experiment on Performance assessment of Grid connected and Standalone 1kWp Solar Power System.
- 5 Simulation study on Wind Energy Generator.
- 6 Experiment on Performance assessment of micro Wind Energy Generator.
- 7 Simulation study on Hybrid (Solar-Wind) Power System.
- 8 Experiment on Performance Assessment of Hybrid (Solar-Wind) Power System.
- 9 Simulation study on Hydel Power.
- 10 Experiment on Performance Assessment of 100W Fuel Cell.
- 11 Simulation study on Intelligent Controllers for Hybrid Systems.

**TOTAL: 60 PERIODS****OUTCOMES:**

- Ability to understand and analyze Renewable energy systems.
- Ability to train the students in Renewable Energy Sources and technologies.
- Ability to provide adequate inputs on a variety of issues in harnessing Renewable Energy.
- Ability to simulate the various Renewable energy sources.
- Ability to recognize current and possible future role of Renewable energy sources.
- Ability to understand basics of Intelligent Controllers.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

| S.No | Name of the equipments / Components                           | Quantity Required | Remarks |
|------|---|-------------------|---------|
| 1.   | Personal computers (Intel i3, 80GB, 2GBRAM)                   | 15                | -       |
| 2.   | CRO   | 9                 | 30MHz   |
| 3.   | Digital Multimeter  | 10                | Digital |
| 4.   | PV panels - 100W, 24V   | 1                 |         |
| 5.   | Battery storage system with charge and discharge control 40Ah | 1                 |         |
| 6.   | PV Emulator   | 1                 |         |
| 7.   | Micro Wind Energy Generator module                            | 1                 |         |
|      |   |                   |         |

| <b>Consumabilitys (Minimum of 5 Nos. each)</b> |                                      |   |               |
|--|--------------------------------------|---|---------------|
| 8.   | Potentiometer                        | 5 | -             |
| 9.   | Step-down transformer                | 5 | 230V/12-0-12V |
| 10   | Component data sheets to be provided |   |               |

**EE8811**

**PROJECT WORK**

**L T P C  
0 0 20 10**

**OBJECTIVES:**

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL: 300 PERIODS**

**OUTCOMES:**

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

**IC8651**

**ADVANCED CONTROL SYSTEM**

**L T P C  
2 2 0 3**

**OBJECTIVES:**

- To provide knowledge on design state feedback control and state observer.
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter

**UNIT I STATE VARIABLE ANALYSIS**

**6+6**

Introduction- concepts of state variables and state model-State model for linear continuous time systems, Diagonalisation- solution of state equations- Concepts of controllability and observability.

**UNIT II STATE VARIABLE DESIGN**

**6+6**

Introduction to state model: Effect of state feedback - Pole placement design: Necessary and sufficient condition for arbitrary pole placement, State regulator design Design of state observers- Separation principle- Design of servo systems: State feedback with integral control.

**UNIT III SAMPLED DATA ANALYSIS****6+6**

Introduction spectrum analysis of sampling process signal reconstruction difference equations The Z transform function, the inverse Z transform function, response of Linear discrete system, the Z transform analysis of sampled data control systems, response between sampling instants, the Z and S domain relationship. Stability analysis and compensation techniques.

**UNIT IV NON LINEAR SYSTEMS****6+6**

Introduction, common physical nonlinearities, The phase plane method: concepts, singular points, stability of non linear systems, construction of phase trajectories system analysis by phase plane method. The describing function method, stability analysis by describing function method, Jump resonance.

**UNIT V OPTIMAL CONTROL****6+6**

Introduction: Classical control and optimization, formulation of optimal control problem, Typical optimal control performance measures - Optimal state regulator design: Lyapunov equation, Matrix Riccati equation - LQR steady state optimal control – Application examples.

**TOTAL: 60 PERIODS****OUTCOMES:**

- i. Able to design state feedback controller and state observer.
- ii. Able to understand and analyse linear and nonlinear systems using phase plane method.
- iii. Able to understand and analyse nonlinear systems using describing function method.
- iv. Able to understand and design optimal controller.
- v. Able to understand optimal estimator including Kalman Filter.
- vi. Ability to apply advanced control strategies to practical engineering problems.

**TEXT BOOKS:**

1. M.Gopal, "Digital Control and State Variable Methods", 4<sup>th</sup> edition, Mc Graw Hill India, 2012
2. K. Ogata, 'Modern Control Engineering', 5th Edition, Pearson, 2012.
3. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006.

**REFERENCES:**

1. M.Gopal, Modern Control System Theory, 3<sup>rd</sup> edition, New Age International Publishers, 2014.
2. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Taylor and Francis Group, 2011.
3. Ashish Tewari, 'Modern Control Design with Matlab and Simulink', John Wiley, New Delhi, 2002.
4. T. Glad and L. Ljung,, "Control Theory -Multivariable and Non-Linear Methods", Taylor & Francis, 2002.
5. D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2009.

**EE8001****VISUAL LANGUAGES AND APPLICATIONS**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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**OBJECTIVES:** To impart knowledge about the following topics:

- To study about the concepts of windows programming models, MFC applications, drawing with the GDI, getting inputs from Mouse and the Keyboard.
- To study the concepts of Menu basics, menu magic and classic controls of the windows programming using VC++.
- To study the concept of Document/View Architecture with single & multiple document









**OBJECTIVES:**

- To understand the fundamental concepts of stability of power systems and its classification.
- To expose the students to dynamic behaviour of the power system for small and large disturbances.
- To understand and enhance the stability of power systems.

**UNIT I INTRODUCTION TO STABILITY 9**

Fundamental concepts - Stability and energy of a system - Power System Stability: Definition, Causes, Nature and Effects of disturbances, Classification of stability, Modelling of electrical components - Basic assumptions made in stability studies- Modelling of Synchronous machine for stability studies(classical model) - Rotor dynamics and the swing equation.

**UNIT II SMALL-SIGNAL STABILITY 9**

Basic concepts and definitions – State space representation, Physical Interpretation of small-signal stability, Eigen properties of the state matrix: Eigenvalues and eigenvectors, modal matrices, eigenvalue and stability, mode shape and participation factor. Small-signal stability analysis of a Single-Machine Infinite Bus (SMIB) Configuration with numerical example.

**UNIT III TRANSIENT STABILITY 9**

Review of numerical integration methods: modified Euler and Fourth Order Runge-Kutta methods, Numerical stability,. Interfacing of Synchronous machine (classical machine) model to the transient stability algorithm (TSA) with partitioned – explicit approaches- Application of TSA to SMIB system.

**UNIT IV VOLTAGE STABILITY 9**

Factors affecting voltage stability- Classification of Voltage stability-Transmission system characteristics- Generator characteristics- Load characteristics- Characteristics of reactive power compensating Devices- Voltage collapse.

**UNIT V ENHANCEMENT OF SMALL-SIGNAL STABILITY AND TRANSIENT STABILITY 9**

Power System Stabilizer -. Principle behind transient stability enhancement methods: high-speed fault clearing, regulated shunt compensation, dynamic braking, reactor switching, independent pole-operation of circuit-breakers, single-pole switching, fast-valving, high-speed excitation systems.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Learners will attain knowledge about the stability of power system
- Learners will have knowledge on small-signal stability, transient stability and voltage stability.
- Learners will be able to understand the dynamic behaviour of synchronous generator for different disturbances.

- Learners will be able to understand the various methods to enhance the stability of a power system.

**TEXT BOOKS:**

1. Power system stability and control ,P. Kundur ; edited by Neal J. Balu, Mark G. Lauby, McGraw-Hill, 1994.
2. R.Ramnujam,” Power System Dynamics Analysis and Simulation, PHI Learning Private Limited, New Delhi, 2009
3. T.V. Cutsem and C.Vournas, “Voltage Stability of Electric Power Systems”, Kluwer publishers, 1998.

**REFERENCES**

- 1 Peter W., Saucer, Pai M.A., “Power System Dynamics and Stability, Pearson Education (Singapore), 9th Edition, 2007.
- 2 E.W. Kimbark., “Power System Stability”, John Wiley & Sons Limited, New Jersey, 2013.
- 3 SB. Cray., “Power System Stability”, John Wiley & Sons Limited, New Jersey, 1955.
- 4 K.N. Shubhanga, “Power System Analysis” Pearson, 2017.
- 5 Power systems dynamics: Stability and control / K.R. Padiyar, BS Publications, 2008
- 6 Power system control and Stability P.M. Anderson, A.A. Foud, Iowa State University Press, 1977.

|               |                                |          |          |          |          |
|---------------|--------------------------------|----------|----------|----------|----------|
| <b>EE8004</b> | <b>MODERN POWER CONVERTERS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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**OBJECTIVES:** To impart knowledge about the following topics:

- Switched mode power supplies
- Matrix Converter
- Soft switched converters

**UNIT I SWITCHED MODE POWER SUPPLIES (SMPS) 9**

DC Power supplies and Classification; Switched mode dc power supplies - with and without isolation, single and multiple outputs; Closed loop control and regulation; Design examples on converter and closed loop performance.

**UNIT II AC-DC CONVERTERS 9**

Switched mode AC-DC converters. synchronous rectification - single and three phase topologies - switching techniques - high input power factor . reduced input current harmonic distortion. improved efficiency. with and without input-output isolation. performance indices design examples

**UNIT III DC-AC CONVERTERS 9**

Multi-level Inversion - concept, classification of multilevel inverters, Principle of operation, main features and analysis of Diode clamped, Flying capacitor and cascaded multilevel inverters; Modulation schemes.

**UNIT IV AC-AC CONVERTERS WITH AND WITHOUT DC LINK 9**

Matrix converters. Basic topology of matrix converter; Commutation – current path; Modulation techniques - scalar modulation, indirect modulation; Matrix converter as only





**UNIT IV PATH PLANNING****9**

Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning.

**UNIT V DYNAMICS AND CONTROL****9**

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model -Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator.

**TOTAL: 45 PERIODS****OUTCOMES:**

- Ability to understand basic concept of robotics.
- To analyze Instrumentation systems and their applications to various
- To know about the differential motion and statics in robotics
- To know about the various path planning techniques.
- To know about the dynamics and control in robotics industries.

**TEXT BOOKS:**

1. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
2. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.
3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.

**REFERENCES:**

1. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
2. K. K.Appu Kuttan, Robotics, I K International, 2007.
3. Edwin Wise, Applied Robotics, Cengage Learning, 2003.
4. R.D.Klafter,T.A.Chimielewski and M.Negin, Robotic Engineering-An Integrated Approach, Prentice Hall of India, New Delhi, 1994.
5. B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers,Chennai, 1998.
6. S.Ghoshal, " Embedded Systems & Robotics" – Projects using the 8051 Microcontroller", Cengage Learning, 2009.



**TEXT BOOKS:**

- K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.
- T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984
- E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.

**REFERENCES**

1. R.Krishnan, 'Switched Reluctance Motor Drives - Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
2. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.
3. T.J.E.Miller, 'Brushless Permanent-Magnet and Reluctance Motor Drives', Oxford University Press, 1989.
4. R.Srinivasan, 'Special Electrical Machines', Lakshmi Publications, 2013.

**EE8006****POWER QUALITY**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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**OBJECTIVES:** To impart knowledge about the following topics:

- Causes & Mitigation techniques of various PQ events.
- Various Active & Passive power filters.

**UNIT I INTRODUCTION TO POWER QUALITY 9**

Terms and definitions & Sources - Overloading, under voltage, over voltage - Concepts of transients - Short duration variations such as interruption - Long duration variation such as sustained interruption - Sags and swells - Voltage sag - Voltage swell - Voltage imbalance - Voltage fluctuations - Power frequency variations - International standards of power quality - Computer Business Equipment Manufacturers Associations (CBEMA) curve

**UNIT II VOLTAGE SAG AND SWELL 9**

Estimating voltage sag performance - Thevenin's equivalent source - Analysis and calculation of various faulted condition - Estimation of the sag severity - Mitigation of voltage sag, Static transfer switches and fast transfer switches. - Capacitor switching - Lightning - Ferro resonance - Mitigation of voltage swell.

**UNIT III HARMONICS 9**

Harmonic sources from commercial and industrial loads - Locating harmonic sources - Power system response characteristics - Harmonics Vs transients. Effect of harmonics - Harmonic distortion - Voltage and current distortions - Harmonic indices - Inter harmonics - Resonance Harmonic distortion evaluation, IEEE and IEC standards.

**UNIT IV PASSIVE POWER COMPENSATORS 9**

Principle of Operation of Passive Shunt and Series Compensators, Analysis and Design of Passive Shunt Compensators Simulation and Performance of Passive Power Filters- Limitations of Passive Filters Parallel Resonance of Passive Filters with the Supply System

and Its Mitigation. Fundamentals of load compensation - voltage regulation & power factor correction.

**UNIT V POWER QUALITY MONITORING & CUSTOM POWER DEVICES 9**

Monitoring considerations - Monitoring and diagnostic techniques for various power quality problems - Quality measurement equipment - Harmonic / spectrum analyzer - Flicker meters Disturbance analyzer - Applications of expert systems for power quality monitoring. Principle & Working of DSTATCOM - DSTATCOM in Voltage control mode, current control mode, DVR Structure - Rectifier supported DVR - DC Capacitor supported DVR - Unified power quality conditioner.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to understand various sources, causes and effects of power quality issues, electrical systems and their measures and mitigation.
- Ability to analyze the causes & Mitigation techniques of various PQ events.
- Ability to study about the various Active & Passive power filters.
- Ability to understand the concepts about Voltage and current distortions, harmonics.
- Ability to analyze and design the passive filters.
- Ability to acquire knowledge on compensation techniques.
- Ability to acquire knowledge on DVR.

**TEXT BOOKS:**

1. Roger. C. Dugan, Mark. F. Mc Granagham, Surya Santoso, H.WayneBeaty, "Electrical Power Systems Quality", McGraw Hill,2003
2. J. Arrillaga, N.R. Watson, S. Chen, "Power System Quality Assessment", (New York : Wiley),2000.
3. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad," Power Quality Problems & Mitigation Techniques" Wiley, 2015.

**REFERENCES**

1. G.T. Heydt, "Electric Power Quality", 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994.
2. M.H.J Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", (New York: IEEE Press), 2000.

**EE8007**

**EHVAC TRANSMISSION**

|          |          |          |          |
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| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:** To impart knowledge about the following topics:

- EHVAC Transmission lines
- Electrostatic field of AC lines
- Corona in E.H.V. lines

**UNIT I INTRODUCTION 9**

EHVAC Transmission line trends and preliminary aspect - standard transmission voltages - Estimation at line and ground parameters-Bundle conductors: Properties -Inductance and Capacitance of EHV lines – Positive, negative and zero sequence impedance – Line Parameters for Modes of Propagation.



**UNIT II ELECTROSTATIC FIELDS 9**

Electrostatic field and voltage gradients – Calculations of electrostatic field of AC lines – Effect of high electrostatic field on biological organisms and human beings - Surface voltage gradients and Maximum gradients of actual transmission lines - Voltage gradients on sub conductor.

**UNIT III POWER CONTROL 9**

Electrostatic induction in un energized lines - Measurement of field and voltage gradients for three phase single and double circuit lines - Un energized lines. Power Frequency Voltage control and overvoltage in EHV lines: No load voltage - Charging currents at power frequency-Voltage control - Shunt and Series compensation - Static VAR compensation.

**UNIT IV CORONA EFFECTS AND RADIO INTERFERENCE 9**

Corona in EHV lines – Corona loss formulae-Charge voltage diagram- Attenuation of traveling waves due to Corona – Audio noise due to Corona, its generation, characteristic and limits. Measurements of audio noise radio interference due to Corona - properties of radio noise – Frequency spectrum of RI fields - Measurements of RI and RIV.

**UNIT V STEADY STATE AND TRANSIENT LIMITS 9**

Design of EHV lines based on steady state and transient limits - EHV cables and their characteristics-Introduction six phase transmission – UHV.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to understand the principles and types of EHVAC system.
- Ability to analyze the electrostatic field of AC lines
- Ability to study about the compensation.
- Ability to study about the corona in E.H.V. lines
- Ability to understand the EHV cables.
- Ability to analyze the steady state and transient limits.

**TEXT BOOKS:**

1. Rokosh Das Begamudre, "Extra High Voltage AC Transmission Engineering"- Wiley Eastern LTD., NEW DELHI 1990.
2. S. Rao, "HVAC and HVDC Transmission, Engineering and Practice" Khanna Publisher, Delhi, 1990.

**REFERENCES**

1. Subir Ray, "An Introduction to High Voltage Engineering", Prentice Hall of India Private Limited, 2013.
2. RD Begamudre, "Extra High Voltage AC Transmission Engineering"- New Academic Science Ltd; 4 edition 2011.
3. Edison, " EHV Transmission line"- Electric Institution, GEC, 1968.

**OBJECTIVES:**

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study the various analog and digital modulation techniques
- To study the principles behind information theory and coding
- To study the various digital communication techniques

**UNIT I ANALOG MODULATION****9**

Amplitude Modulation - AM, DSBSC, SSBSC, VSB - PSD, modulators and demodulators - Angle modulation - PM and FM - PSD, modulators and demodulators - Superheterodyne receivers

**UNIT II PULSE MODULATION****9**

Low pass sampling theorem - Quantization - PAM - Line coding - PCM, DPCM, DM, and ADPCM And ADM, Channel Vocoder - Time Division Multiplexing, Frequency Division Multiplexing

**UNIT III DIGITAL MODULATION AND TRANSMISSION****9**

Phase shift keying - BPSK, DPSK, QPSK - Principles of M-ary signaling M-ary PSK & QAM - Comparison, ISI - Pulse shaping - Duo binary encoding - Cosine filters - Eye pattern, equalizers

**UNIT IV INFORMATION THEORY AND CODING****9**

Measure of information - Entropy - Source coding theorem - Shannon-Fano coding, Huffman Coding, LZ Coding - Channel capacity - Shannon-Hartley law - Shannon's limit - Error control codes - Cyclic codes, Syndrome calculation - Convolution Coding, Sequential and Viterbi decoding

**UNIT V SPREAD SPECTRUM AND MULTIPLE ACCESS****9**

PN sequences - properties - m-sequence - DSSS - Processing gain, Jamming - FHSS - Synchronisation and tracking - Multiple Access - FDMA, TDMA, CDMA,

**TOTAL: 45 PERIODS****OUTCOMES:**

**At the end of the course, the student should be able to:**

- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Apply analog and digital communication techniques.
- Use data and pulse communication techniques.
- Analyze Source and Error control coding.

**TEXT BOOKS:**

1. H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007
2. S. Haykin "Digital Communications" John Wiley 2005

**REFERENCES:**

1. B.P.Lathi, "Modern Digital and Analog Communication Systems", 3<sup>rd</sup> edition, Oxford University Press, 2007
2. H P Hsu, Schaum Outline Series - "Analog and Digital Communications" TMH 2006
3. B.Sklar, Digital Communications Fundamentals and Applications" 2/e Pearson Education 2007.

**OBJECTIVES:**

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

**UNIT I INTRODUCTION TO DISASTERS 9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

**UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9**

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System - Advisories from Appropriate Agencies.

**UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

**UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster - Disaster Damage Assessment.

**UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9**

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

**TOTAL: 45 PERIODS****OUTCOMES:**

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.

- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

#### TEXTBOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerability India: A Geographical Study of Disasters, IAS and Sage Publishers, New Delhi, 2010.

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1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

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**HUMAN RIGHTS**

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#### OBJECTIVES :

- To sensitize the Engineering students to various aspects of Human Rights.

#### UNIT I

**9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

#### UNIT II

**9**

Evolution of the concept of Human Rights Magna carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

#### UNIT III

**9**

Theories and perspectives of UN Laws - UN Agencies to monitor and compliance.

#### UNIT IV

**9**

Human Rights in India - Constitutional Provisions / Guarantees.

#### UNIT V

**9**

Human Rights of Disadvantaged People - Women, Children, Displaced persons and Disability persons, including Aged and HIV Infected People. Implementation of Human Rights - National and State Human Rights Commission - Judiciary - Role of NGO's, Media, Educational Institutions, Social Movements.

**TOTAL : 45 PERIODS**

#### OUTCOME :

- Engineering students will acquire the basic knowledge of human rights.

**REFERENCES:**

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

**MG8491****OPERATIONS RESEARCH**

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**OBJECTIVES:**

- To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.

**UNIT I          LINEAR MODELS****15**

The phase of an operation research study - Linear programming - Graphical method- Simplex algorithm - Duality formulation - Sensitivity analysis.

**UNIT II          TRANSPORTATION MODELS AND NETWORK MODELS****8**

Transportation Assignment Models -Traveling Salesman problem-Networks models - Shortest route – Minimal spanning tree – Maximum flow models -Project network – CPM and PERT networks - Critical path scheduling - Sequencing models.

**UNIT III          INVENTORY MODELS****6**

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models - Multi product models - Inventory control models in practice.

**UNIT IV          QUEUEING MODELS****6**

Queueing models - Queueing systems and structures - Notation parameter - Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.

**UNIT V          DECISION MODELS****10**

Decision models - Game theory - Two person zero sum games - Graphical solution- Algebraic solution- Linear Programming solution - Replacement models - Models based on service life - Economic life- Single / Multi variability search technique - Dynamic Programming - Simple Problem.

**TOTAL: 45 PERIODS****OUTCOMES:**

- Upon completion of this course, the students can ability to use the optimization techniques for use engineering and Business problems

**TEXT BOOK:**

1. Hillier and Libeberman, "Operations Research", Holden Day, 2005
2. Taha H.A., "Operations Research", Sixth Edition, Prentice Hall of India, 2003.

**REFERENCES:**

1. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley, 2009.

2. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.
3. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 1992.
4. Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.
5. Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002.

**MA8391**

**PROBABILITY AND STATISTICS**

**L T P C**  
**4 0 0 4**

**OBJECTIVES :**

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

**UNIT I PROBABILITY AND RANDOM VARIABLES 12**  
Probability - The axioms of probability - Conditional probability - Baye's theorem - Discrete and continuous random variables - Moments - Moment generating functions - Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

**UNIT II 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 III TESTING OF HYPOTHESIS 12**  
Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means - Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

**UNIT IV DESIGN OF EXPERIMENTS 12**  
One way and Two way classifications - Completely randomized design - Randomized block design - Latin square design -  $2^2$  factorial design.

**UNIT V STATISTICAL QUALITY CONTROL 12**  
Control charts for measurements (X and R charts) - Control charts for attributes (p, c and np charts) - Tolerance limits - Acceptance sampling.

**TOTAL : 60 PERIODS**

**OUTCOMES :**

Upon successful completion of the course, students will be able to:

- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
- Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

#### **TEXT BOOKS :**

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8<sup>th</sup> Edition, 2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4<sup>th</sup> Edition, 2007.

#### **REFERENCES :**

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8<sup>th</sup> Edition, 2014.
2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4<sup>th</sup> Edition, New Delhi, 2010.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3<sup>rd</sup> Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8<sup>th</sup> Edition, 2007.

**EI8075**

**FIBRE OPTICS AND LASER INSTRUMENTS**

**LT P C**

**3 0 0 3**

#### **AIM:**

To contribute to the knowledge of Fibre optics and Laser Instrumentation and its Industrial and Medical Application.

#### **COURSE OBJECTIVES**

- To expose the students to the basic concepts of optical fibres and their properties.
- To provide adequate knowledge about the Industrial applications of optical fibres.
- To expose the students to the Laser fundamentals.
- To provide adequate knowledge about Industrial application of lasers.
- To provide adequate knowledge about holography and Medical applications of Lasers.

#### **UNIT I OPTICAL FIBRES AND THEIR PROPERTIES**

**9**

Construction of optical fiber cable: Guiding mechanism in optical fiber and Basic component of optical fiber communication, -Principles of light propagation through a fibre: Total internal reflection, Acceptance angle ( $\theta_a$ ), Numerical aperture and Skew mode, -Different types of fibres and their properties: Single and multimode fibers and Step index and graded index fibers,- fibre characteristics: Mechanical characteristics and Transmission characteristics, - Absorption losses - Scattering losses - Dispersion - Connectors and splicers -Fibre termination - Optical sources: Light Emitting Diode (LED), - Optical detectors: PIN Diode.

**UNIT II INDUSTRIAL APPLICATION OF OPTICAL FIBRES 9**

Fibre optic sensors: Types of fiber optics sensor, Intrinsic sensor- Temperature/ Pressure sensor, Extrinsic sensors, Phase Modulated Fibre Optic Sensor and Displacementsensor (Extrinsic Sensor) - Fibre optic instrumentation system: Measurement of attenuation (by cut back method), Optical domain reflectometers, Fiber Scattering loss Measurement, Fiber Absorption Measurement, Fiber dispersion measurements, End reflection method and Near field scanning techniques – Different types of modulators: Electro-optic modulator (EOM) -Interferometric method of measurement of length – Moire fringes - Measurement of pressure, temperature, current, voltage, liquid level and strain.

**UNIT III LASER FUNDAMENTALS 9**

Fundamental characteristics of lasers - Level Lasers: Two-Level Laser, Three Level Laser, Quasi Three and four level lasers - Properties of laser: Monochromaticity, Coherence, Divergence and Directionality and Brightness -Laser modes - Resonator configuration - Q-switching and mode locking – Cavity damping – Types of lasers; – Gas lasers, solid lasers, liquid lasers and semiconductor lasers.

**UNIT IV INDUSTRIAL APPLICATION OF LASERS 9**

Laser for measurement of distance, Laser for measurement of length, Laser for measurement of velocity, Laser for measurement of acceleration, Laser for measurement of current, voltage and Laser for measurement of Atmospheric Effect: Types of LIDAR, Construction And Working, and LIDAR Applications – Material processing: Laser instrumentation for material processing, Powder Feeder, Laser Heating, Laser Welding, Laser Melting, Conduction Limited Melting and Key Hole Melting – Laser trimming of material: Process Of Laser Trimming, Types Of Trim, Construction And Working Advantages – Material Removal and vaporization: Process Of Material Removal.

**UNIT V HOLOGRAM AND MEDICAL APPLICATIONS 9**

Holography: Basic Principle, Holography vs. photography, Principle Of Hologram Recording, Condition For Recording A Hologram, Reconstructing and viewing the holographic image- Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser-Tissue Interactions Photochemical reactions, Thermalisation, collisional relaxation, Types of Interactions and Selecting an Interaction Mechanism – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES (COs):**

1. Understand the principle, transmission, dispersion and attenuation characteristics of optical fibers
2. Apply the gained knowledge on optical fibers for its use as communication medium and as sensor as well which have important applications in production, manufacturing industrial and biomedical applications.
3. Understand laser theory and laser generation system.
4. Students will gain ability to apply laser theory for the selection of lasers for a specific Industrial and medical application.

**TEXT BOOKS:**

1. J.M. Senior, 'Optical Fibre Communication - Principles and Practice', Prentice Hall of India, 1985.
2. J. Wilson and J.F.B. Hawkes, 'Introduction to Opto Electronics', Prentice Hall of India, 2001.
3. Eric Udd, William B., and Spillman, Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists ", John Wiley & Sons, 2011.

**REFERENCES:**

1. G. Keiser, 'Optical Fibre Communication', McGraw Hill, 1995.
2. M. Arumugam, 'Optical Fibre Communication and Sensors', Anuradha Agencies, 2002.
3. John F. Ready, "Industrial Applications of Lasers", Academic Press, Digitized in 2008.





**UNIT IV            SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT            9**

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - **Sustenance** -Maintenance and Repair - Enhancements - **Product EoL** - Obsolescence Management - Configuration Management - EoL Disposal

**UNIT V            BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY            9**

**The Industry** - Engineering Services Industry - Product Development in Industry versus Academia -**The IPD Essentials** - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the students will be able to:**

- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

**TEXTBOOKS:**

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

**REFERENCES:**

1. Hiriappa B, "Corporate Strategy - Managing the Business", Author House, 2013.
2. Peter F Drucker, "People and Performance", Butterworth - Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise Resource Planning – Concepts", Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

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| <b>EE8008</b> | <b>SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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**OBJECTIVES:** To impart knowledge about the following topics:

- The concept of system identification and adaptive control
- Black-box approach based system identification
- Batch and recursive identification
- Computer Controlled Systems
- Design concept for adaptive control schemes

**UNIT I NON-PARAMETRIC METHODS 9**

Non-parametric methods - Transient analysis - frequency analysis - Correlation analysis - Spectral analysis - Input signal design for identification

**UNIT II PARAMETRIC METHODS 9**

Least squares estimation – Analysis of the least squares estimate - Best linear unbiased estimate - Model parameterizations - Prediction error methods.

**UNIT III RECURSIVE IDENTIFICATION METHODS 9**

The recursive least square method - Model validation -Model structure determination - Introduction to closed loop system identification.

**UNIT IV ADAPTIVE CONTROL SCHEMES 9**

Introduction - Auto-tuning of PID controller using relay feedback approach - Types of adaptive control, Gain scheduling, Model reference adaptive control, Self-tuning controller - Design of gain scheduled adaptive controller - Applications of gain scheduling.

**UNIT V MODEL-REFERENCE ADAPTIVE SYSTEM (MRAS) and SELF-TUNING REGULATOR (STR) 9**

STR - Pole placement design - Indirect STR and direct STR - MRAC - MIT rule - Lyapunov theory - Relationship between MRAC and STR.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to understand various system identification techniques and features of adaptive control like STR and MRAC.
- Ability to understand the concept of system identification and adaptive control
- Ability to understand about Black-box approach based system identification
- Ability to get knowledge about batch and recursive identification
- Ability to study about computer controlled systems
- Ability to design concept for adaptive control schemes

**TEXT BOOKS:**

1. T. Soderstrom and PetreStoica, System Identification, Prentice Hall International (UK) Ltd. 1989
2. Karl J. Astrom and Bjorn Witten mark, Adaptive Control, Pearson Education, Second edition, Fifth impression, 2009.

**REFERENCES**

- 1 L. Ljung, System Identification - Theory for the User, 2nd edition, PTR Prentice Hall,

- Upper Saddle River, N.J., 1999.
- 2 K. S. Narendra and A. M. Annaswamy, Stability Adaptive Systems, Prentice-Hall, 1989.
  - 3 H. K. Khalil, Nonlinear Systems, Prentice Hall, 3<sup>rd</sup> edition, 2002.
  - 4 William S. Levine, "Control Systems Advanced Methods, the Control Handbook, CRC Press 2011.
  - 5 S. Sastry and M. Bodson, Adaptive Control, Prentice-Hall, 1989

**CS8491**

**COMPUTER ARCHITECTURE**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To learn the basic structure and operations of a computer.
- To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit.
- To learn the basics of pipelined execution.
- To understand parallelism and multi-core processors.
- To understand the memory hierarchies, cache memories and virtual memories.
- To learn the different ways of communication with I/O devices.

**UNIT I BASIC STRUCTURE OF A COMPUTER SYSTEM 9**

Functional Units - Basic Operational Concepts - Performance - Instructions: Language of the Computer - Operations, Operands - Instruction representation - Logical operations - decision making - MIPS Addressing.

**UNIT II ARITHMETIC FOR COMPUTERS 9**

Addition and Subtraction - Multiplication - Division - Floating Point Representation - Floating Point Operations - Subword Parallelism

**UNIT III PROCESSOR AND CONTROL UNIT 9**

A Basic MIPS implementation - Building a Datapath - Control Implementation Scheme - Pipelining - Pipelined datapath and control - Handling Data Hazards & Control Hazards - Exceptions.

**UNIT IV PARALLELISIM 9**

Parallel processing challenges - Flynn's classification - SISD, MIMD, SIMD, SPMD, and Vector Architectures - Hardware multithreading - Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.

**UNIT V MEMORY & I/O SYSTEMS 9**

Memory Hierarchy - memory technologies - cache memory - measuring and improving cache performance - virtual memory, TLB's - Accessing I/O Devices - Interrupts - Direct Memory Access - Bus structure - Bus operation - Arbitration - Interface circuits - USB.

**TOTAL : 45 PERIODS**

**OUTCOMES:****On Completion of the course, the students should be able to:**

- Understand the basics structure of computers, operations and instructions.
- Design arithmetic and logic unit.
- Understand pipelined execution and design control unit.
- Understand parallel processing architectures.
- Understand the various memory systems and I/O communication.

**TEXT BOOKS:**

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012.

**REFERENCES**

1. William Stallings, Computer Organization and Architecture - Designing for Performance, Eighth Edition, Pearson Education, 2010.
2. John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2012.
3. John L. Hennessey and David A. Patterson, Computer Architecture - A Quantitative Approach, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.

**EE8009****CONTROL OF ELECTRICAL DRIVES**

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**OBJECTIVES:** To impart knowledge about the following topics:

- To understand the DC drive control.
- To study and analyze the Induction motor drive control.
- To study and understand the Synchronous motor drive control.
- To study and analyze the SRM and BLDC motor drive control.
- To analyze and design the Digital control for drives.

**UNIT I CONTROL OF DC DRIVES****9**

Losses in electrical drive system, Energy efficient operation of drives, block diagram/ transfer function of self, separately excited DC motors --closed loop control-speed control-current control - constant torque/power operation - P, PI and PID controllers-response comparison.

**UNIT II CONTROL OF INDUCTION MOTOR DRIVE****9**

VSI and CSI fed induction motor drives-principles of V/f control-closed loop variable frequency PWM inverter with dynamic braking- static Scherbius drives- power factor considerations- modified Kramer drives-principle of vector control- implementation-block diagram, Design of closed loop operation of V/f control of Induction motor drive systems.

**UNIT III CONTROL OF SYNCHRONOUS MOTOR DRIVES****9**

Open loop VSI fed drive and its characteristics-Self control-Torque control -Torque angle

control -Power factor control-Brushless excitation systems-Field oriented control – Design of closed loop operation of Self control of Synchronous motor drive systems.

**UNIT IV CONTROL OF SRM AND BLDC MOTOR DRIVES 9**

SRM construction - Principle of operation - SRM drive design factors-Torque controlled SRM- Block diagram of Instantaneous Torque control using current controllers and flux controllers. Construction and Principle of operation of BLDC Machine -Sensing and logic switching scheme,-Sinusoidal and trapezoidal type of Brushless dc motors – Block diagram of current controlled Brushless dc motor drive.

**UNIT V DIGITAL CONTROL OF DC DRIVE 9**

Phase Locked Loop and micro-computer control of DC drives-Program flow chart for constant constant torque and constant horse power operations Speed detection and current sensing circuits and feedback elements.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to understand various control strategies and controllers for AC and DC Motor Drive systems.

**TEXT BOOKS:**

1. Dubey, G.K, Power semiconductor controlled devices, Prentice Hall International New jersey, 1989.
2. R.Krishnan,, Electric Motor Drives - Modeling, Analysis and ControlPrentice- Hall of India Pvt. Ltd., New Delhi, 2003.
3. Murphy, J.M.D, Turnbull F.G, Thyristor control of AC motors,, Pergamon press, Oxford, 1988.

**REFERENCES**

1. Bin Wu, High-Power Converters and AC Drives, Wiley-IEEE Press
2. Buxbaum, A.Schierau, and K.Staughen, A design of control systems for DC drives, Springer-Verlag, Berlin, 1990.
3. Bimal K. Bose, Modern Power Electronics and AC Drives, Pearson Education (Singapore) Pte. Ltd., New Delhi, 2003.
4. R. Krishnan, Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications, CRC press, 2001.
5. Werner Leonhard, Control of Electrical Drives, 3rd Edition, Springer, Sept., 2001.
6. R. Krishnan, Permanent Magnet Synchronous and Brushless DC Motor Drives, CRC press, 2001.

**EC8095**

**VLSI DESIGN**

|          |          |          |          |
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**OBJECTIVES:**

- Study the fundamentals of CMOS circuits and its characteristics.
- Learn the design and realization of combinational & sequential digital circuits.
- Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed
- Learn the different FPGA architectures and testability of VLSI circuits.

**UNIT I INTRODUCTION TO MOS TRANSISTOR 9**

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Characteristics, C-V Characteristics, Nonideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

**UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 9**

**Circuit Families:** Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls.

**Power:** Dynamic Power, Static Power, Low Power Architecture.

**UNIT III SEQUENTIAL CIRCUIT DESIGN 9**

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostability Sequential Circuits, Astability Sequential Circuits.

**Timing Issues :** Timing Classification Of Digital System, Synchronous Design.

**UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9**

**Arithmetic Building Blocks:** Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff.

**Designing Memory and Array structures:** Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

**UNIT V IMPLEMENTATION STRATEGIES AND TESTING 9**

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures.

Design for Testability: *Ad Hoc* Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**UPON COMPLETION OF THE COURSE, STUDENTS SHOULD ABILITY TO**

- Realize the concepts of digital building blocks using MOS transistor.
- Design combinational MOS circuits and power strategies.
- Design and construct Sequential Circuits and Timing systems.
- Design arithmetic building blocks and memory subsystems.
- Apply and implement FPGA design flow and testing.

**TEXT BOOKS:**

1. Neil H.E. Weste, David Money Harris "CMOS VLSI Design: A Circuits and Systems Perspective", 4<sup>th</sup> Edition, Pearson , 2017.(UNIT I,II,V)
2. Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic, "Digital Integrated Circuits:A Design perspective", Second Edition , Pearson , 2016.(UNIT III,IV)

**REFERENCES**

1. M.J. Smith, "Application Specific Integrated Circuits", Addison Wesley, 1997

2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim “CMOS Digital Integrated Circuits:Analysis & Design”,4<sup>th</sup> edition McGraw Hill Education,2013
3. Wayne Wolf, “Modern VLSI Design: System On Chip”, Pearson Education, 2007
4. R.Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India 2005.

**EE8010**

**POWER SYSTEMS TRANSIENTS**

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**OBJECTIVES:** To impart knowledge about the following topics:

- Generation of switching transients and their control using circuit - theoretical concept.
- Mechanism of lightning strokes and the production of lightning surges.
- Propagation, reflection and refraction of travelling waves.
- Voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

**UNIT I INTRODUCTION AND SURVEY 9**

Review and importance of the study of transients - causes for transients. RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients. Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.

**UNIT II SWITCHING TRANSIENTS 9**

Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit. Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes. Illustration for multiple restriking transients - ferro resonance.

**UNIT III LIGHTNING TRANSIENTS 9**

Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds - mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.

**UNIT IV TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS 9**

Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely’s lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves.

**UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM 9**

The short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines - over



voltage induced by faults -switching surges on integrated system Qualitative application of EMTP for transient computation.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to understand and analyze switching and lightning transients.
- Ability to acquire knowledge on generation of switching transients and their control.
- Ability to analyze the mechanism of lightning strokes.
- Ability to understand the importance of propagation, reflection and refraction of travelling waves.
- Ability to find the voltage transients caused by faults.
- Ability to understand the concept of circuit breaker action, load rejection on integrated power system.

**TEXT BOOKS:**

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, New York, 2<sup>nd</sup> Edition, 1991.
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., Second Edition, 2009.
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients - A statistical approach', PHI Learning Private Limited, Second Edition, 2010.

**REFERENCES**

1. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', McGraw Hill, Fifth Edition, 2013.
2. R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.
3. Y.Hase, Handbook of Power System Engineering," Wiley India, 2012.
4. J.L.Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and use," Wiley, 2012.
5. Akihiro ametani," Power System Transient theory and applications", CRC press, 2013.

**GE8077**

**TOTAL QUALITY MANAGEMENT**

**L T P C  
3 0 0 3**

**OBJECTIVE:**

- To facilitate the understanding of Quality Management principles and process.

**UNIT I 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 - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

**UNIT II TQM PRINCIPLES**

**9**

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

**UNIT III TQM TOOLS AND 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 IV TQM TOOLS AND TECHNIQUES II 9**  
 Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

**UNIT V QUALITY MANAGEMENT SYSTEM 9**  
 Introduction–Benefits of ISO Registration–ISO 9000 Series of Standards–Sector-Specific Standards– AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements–Implementation– Documentation–Internal Audits–Registration--**ENVIRONMENTAL MANAGEMENT SYSTEM:** Introduction–ISO 14000 Series Standards–Concepts of ISO 14001–Requirements of ISO 14001– Benefits of EMS.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

**TEXT BOOK:**

1. Dale H.Besterfield, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

**REFERENCES:**

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8<sup>th</sup> Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO9001-2015 standards

**EE8011 FLEXIBLE AC TRANSMISSION SYSTEMS L T P C**  
**3 0 0 3**

**OBJECTIVES:** To impart knowledge about the following topics:

- The start-of-art of the power system
- Performance of power systems with FACTS controllers.
- FACTS controllers for load flow and dynamic analysis

**UNIT I INTRODUCTION 9**

Real and reactive power control in electrical power transmission lines-loads & system compensation-Uncompensated transmission line-shunt and series compensation.

**UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS 9**

Voltage control by SVC-Advantages of slope in dynamic characteristics-Influence of SVC on system voltage-Design of SVC voltage regulator-TCR-FC-TCR-Modeling of SVC for power flow and fast transient stability- Applications: Enhancement of transient stability –

Steady state power transfer -Enhancement of power system damping.

**UNIT III THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS 9**

Operation of the TCSC-Different modes of operation-Modelling of TCSC, Variability reactance model- Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit-Enhancement of system damping.

**UNIT IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 9**

Static Synchronous Compensator (STATCOM)-Principle of operation-V-I Characteristics. Applications: Steady state power transfer-enhancement of transient stability-prevention of voltage instability. SSSC-operation of SSSC and the control of power flow-modelling of SSSC in load flow and transient stability studies- Dynamic voltage restorer(DVR).

**UNIT V ADVANCED FACTS CONTROLLERS 9**

Interline DVR(IDVR) - Unified Power flow controller (UPFC) - Interline power flow controller (IPFC) - Unified Power quality conditioner (UPQC).

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to understand, analyze and develop analytical model of FACTS controller for power system application.
- Ability to understand the concepts about load compensation techniques.
- Ability to acquire knowledge on facts devices.
- Ability to understand the start-of-art of the power system
- Ability to analyze the performance of steady state and transients of facts controllers.
- Ability to study about advanced FACTS controllers.

**TEXT BOOKS:**

1. R.Mohan Mathur, Rajiv K.Varma, "Thyristor-Based Facts Controllers for Electrical Transmission Systems", IEEE press and JohnWiley&Sons, Inc, 2002.
2. NarainG. Hingorani, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors, Delhi-110006, 2011.
3. T.J.E Miller, Power Electronics in power systems, John Wiley and sons.

**REFERENCES**

1. K.R. Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008
2. A.T.John, "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers (IEEE), 1999.
3. V.K.Sood, HVDC and FACTS controllers-Applications of Static Converters in Power System, APRIL 2004, Kluwer Academic Publishers, 2004.



- Cliffs, N.J., 1992
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill Inc., 2000.

## REFERENCES

1. Goldberg, "Genetic Algorithm in Search, Optimization and Machine learning", Addison Wesley Publishing Company Inc. 1989
2. Millon W.T., Sutton R.S. and Webrose P.J., "Neural Networks for Control", MIT press, 1992
3. Ethem Alpaydin, "Introduction to Machine learning (Adaptive Computation and Machine Learning series)", MIT Press, Second Edition, 2010.
4. Zhang Huaguang and Liu Derong, "Fuzzy Modeling and Fuzzy Control Series: Control Engineering", 2006

**EE8013**

**POWER SYSTEMS DYNAMICS**

|          |          |          |          |
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**OBJECTIVES:** To impart knowledge about the following topics:

- Basics of dynamics and stability problems
- Modeling of synchronous machines
- Excitation system and speed-governing controllers.
- Small signal stability of a single-machine infinite bus system with excitation system and power system stabilizer.
- Transient stability simulation of multi machine power system.

### **UNIT I INTRODUCTION**

**9**

Basics of system dynamics - numerical techniques - introduction to software packages to study the responses. Concept and importance of power system stability in the operation and design - distinction between transient and dynamic stability - complexity of stability problem in large system - necessity for reduced models - stability of interconnected systems.

### **UNIT II SYNCHRONOUS MACHINE MODELLING**

**9**

Synchronous machine - flux linkage equations - Park's transformation - per unit conversion - normalizing the equations - equivalent circuit - current space model - flux linkage state space model. Sub-transient and transient inductances - time constants. Simplified models (one axis and constant flux linkage) - steady state equations and phasor diagrams.

### **UNIT III MACHINE CONTROLLERS**

**9**

Exciter and voltage regulators - function and types of excitation systems - typical excitation system configuration - block diagram and state space representation of IEEE type 1 excitation system - saturation function - stabilizing circuit. Function of speed governing systems - block diagram and state space representation of IEEE mechanical hydraulic governor and electrical hydraulic governors for hydro turbines and steam turbines.

**UNIT IV      TRANSIENT STABILITY****9**

State equation for multi machine system with one axis model and simulation – modelling of multi machine power system with one axis machine model including excitation system and speed governing system and simulation using R-K method of fourth order (Gill's technique) for transient stability analysis - power system stabilizer. For all simulations, the algorithm and flow chart have to be discussed.

**UNIT V      DYNAMIC STABILITY****9**

System response to small disturbances - linear model of the unregulated synchronous machine and its modes of oscillation - regulated synchronous machine - distribution of power impact - linearization of the load equation for the one machine problem – simplified linear model - effect of excitation on dynamic stability - approximate system representation - supplementary stabilizing signals - dynamic performance measure - small signal performance measures.

**TOTAL : 45 PERIODS****OUTCOMES:**

- Ability to understand and analyze power system operation, stability, control and protection.
- Ability to get knowledge on the basics of dynamics and stability problems
- Ability to design and modelling of synchronous machines
- Ability to study about excitation system and speed-governing controllers.
- Ability to understand the concept of small signal stability of a single-machine infinite bus system with excitation system.
- Ability to analyze the transient stability simulation.

**TEXT BOOKS:**

1. P.M. Anderson and A.A.Fouad, 'Power System Control and Stability', Galgotia Publications, New Delhi, 2003.
2. P. Kundur, 'Power System Stability and Control', McGraw Hill Inc., USA, 1994.
3. R.Ramanujam, "Power System Dynamics - Analysis and Simulation", PHI, 2009.

**REFERENCES**

1. M.A.Pai and W.Sauer, 'Power System Dynamics and Stability', Pearson Education Asia, India, 2002.
2. James A.Momoh, Mohamed. E. El-Hawary. " Electric Systems, Dynamics and Stability with Artificial Intelligence applications", Marcel Dekker, USA First Edition, 2000.
3. C.A.Gross, "Power System Analysis," Wiley India, 2011.
4. B.M.Weedy, B.J.Lory, N.Jenkins, J.B.Ekanayake and G.Strbac," Electric Power Systems", Wiley India, 2013.
5. K.Umarao, "Computer Techniques and Models in Power System," I.K. International, 2007.

**OBJECTIVES:** To impart knowledge about the following topics:

- Modern power electronic converters and its applications in electric power utility.
- Resonant converters and UPS

**UNIT I DC-DC CONVERTERS 9**

Principles of step down and step up converters – Analysis and state space modeling of Buck, Boost, Buck- Boost and Cuk converters.

**UNIT II SWITCHED MODE POWER CONVERTERS 9**

Analysis and state space modeling of fly back, Forward, Push pull, Luo, Half bridge and full bridge converters- control circuits and PWM techniques.

**UNIT III RESONANT CONVERTERS 9**

Introduction- classification- basic concepts- Resonant switch- Load Resonant converters- ZVS , Clamped voltage topologies- DC link inverters with Zero Voltage Switching- Series and parallel Resonant inverters- Voltage control.

**UNIT IV DC-AC CONVERTERS 9**

Single phase and three phase inverters, control using various (sine PWM, SVPWM and PSPWM) techniques, various harmonic elimination techniques- Multilevel inverters- Concepts - Types: Diode clamped- Flying capacitor- Cascaded types- Applications.

**UNIT V POWER CONDITIONERS, UPS & FILTERS 9**

Introduction- Power line disturbances- Power conditioners -UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters - Design of inductor and transformer for PE applications – Selection of capacitors.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to analyze the state space model for DC - DC converters
- Ability to acquire knowledge on switched mode power converters.
- Ability to understand the importance of Resonant Converters.
- Ability to analyze the PWM techniques for DC-AC converters
- Ability to acquire knowledge on modern power electronic converters and its applications in electric power utility.
- Ability to acquire knowledge on filters and UPS

**TEXT BOOKS:**

1. Simon Ang, Alejandro Oliva, " Power-Switching Converters", Third Edition, CRC Press, 2010.
2. KjeldThorborg, "Power Electronics - In theory and Practice", Overseas Press, First Indian Edition 2005.
3. M.H. Rashid - Power Electronics handbook, Elsevier Publication, 2001.

**REFERENCES**

1. Philip T Krein, " Elements of Power Electronics", Oxford University Press
2. Ned Mohan, Tore.M.Undeland, William.P.Robbins, Power Electronics converters, Applications and design- Third Edition- John Wiley and Sons- 2006

3. M.H. Rashid - Power Electronics circuits, devices and applications- third edition Prentice Hall of India New Delhi, 2007.
4. Erickson, Robert W, "Fundamentals of Power Electronics", Springer, second edition, 2010.

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| <b>EE8015</b> | <b>ELECTRIC ENERGY GENERATION, UTILIZATION AND CONSERVATION</b> | <b>L</b><br><b>3</b> | <b>T</b><br><b>0</b> | <b>P</b><br><b>0</b> | <b>C</b><br><b>3</b> |
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**OBJECTIVES:**

To impart knowledge on the following Topics

- To study the generation, conservation of electrical power and energy efficient equipments.
- To understand the principle, design of illumination systems and energy efficiency lamps.
- To study the methods of industrial heating and welding.
- To understand the electric traction systems and their performance.

**UNIT I ILLUMINATION 9**

Importance of lighting - properties of good lighting scheme - laws of illumination - photometry - types of lamps - lighting calculations - basic design of illumination schemes for residential, commercial, street lighting, factory lighting and flood lighting - LED lighting and energy efficient lamps.

**UNIT II REFRIGERATION AND AIR CONDITIONING 9**

Refrigeration-Domestic refrigerator and water coolers - Air-Conditioning-Variou types of air-conditioning system and their applications, smart air conditioning units - Energy Efficient motors: Standard motor efficiency, need for efficient motors, Motor life cycle, Direct Savings and payback analysis, efficiency evaluation factor.

**UNIT III HEATING AND WELDING 9**

Role of electric heating for industrial applications - resistance heating - induction heating - dielectric heating - electric arc furnaces. Brief introduction to electric welding - welding generator, welding transformer and the characteristics.

**UNIT IV TRACTION 9**

Merits of electric traction - requirements of electric traction system - supply systems - mechanics of train movement - traction motors and control - braking - recent trends in electric traction.

**UNIT V DOMESTIC UTILIZATION OF ELECTRICAL ENERGY 9**

Domestic utilization of electrical energy - House wiring. Induction based appliances, Online and OFF line UPS, Batteries - Power quality aspects - nonlinear and domestic loads - Earthing - Domestic, Industrial and Substation.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- To understand the main aspects of generation, utilization and conservation.
- To identify an appropriate method of heating for any particular industrial application.
- To evaluate domestic wiring connection and debug any faults occurred.
- To construct an electric connection for any domestic appliance like refrigerator as well as to design a battery charging circuit for a specific household application.
- To realize the appropriate type of electric supply system as well as to evaluate the



performance of a traction unit.

- To understand the main aspects of Traction.

#### **TEXT BOOKS:**

1. Wadhwa, C.L. "Generation, Distribution and Utilization of Electrical Energy", New Age International Pvt. Ltd, 2003.
2. Dr. Uppal S.L. and Prof. S. Rao, 'Electrical Power Systems', Khanna Publishers, New Delhi, 15th Edition, 2014.
3. Energy Efficiency in Electric Utilities, BEE Guide Book, 2010

#### **REFERENCES**

1. Partab.H, "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co, New Delhi, 2004.
2. Openshaw Taylor.E, "Utilization of Electrical Energy in SI Units", Orient Longman Pvt. Ltd, 2003.
3. Gupta.J.B, "Utilization of Electric Power and Electric Traction", S.K.Kataria and Sons, 2002.
4. Cleaner Production - Energy Efficiency Manual for GERIAP, UNEP, Bangkok prepared by National Productivity Council.

**GE8076**

**PROFESSIONAL ETHICS IN ENGINEERING**

**LT P C**

**3 0 0 3**

#### **OBJECTIVES:**

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

#### **UNIT I HUMAN VALUES**

**10**

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 - Introduction to Yoga and meditation for professional excellence and stress management.

#### **UNIT II ENGINEERING ETHICS**

**9**

Senses of 'Engineering Ethics' - Variety of moral issues - Types of inquiry - Moral dilemmas - Moral Autonomy - Kohlberg's theory - Gilligan's theory - Consensus and Controversy - Models of professional roles - Theories about right action - Self-interest - Customs and Religion - Uses of Ethical Theories.

#### **UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION**

**9**

Engineering as Experimentation - Engineers as responsible Experimenters - Codes of Ethics - A Balanced Outlook on Law.

#### **UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS**

**9**

Safety and Risk - Assessment of Safety and Risk - Risk Benefit Analysis and Reducing Risk - Respect for Authority - Collective Bargaining - Confidentiality - Conflicts of Interest - Occupational Crime - Professional Rights - Employee Rights - Intellectual Property Rights (IPR) - Discrimination.

**UNIT V GLOBAL ISSUES****8**

Multinational Corporations - Environmental Ethics - Computer Ethics - Weapons Development - Engineers as Managers - Consulting Engineers - Engineers as Expert Witnesses and Advisors - Moral Leadership - Code of Conduct - Corporate Social Responsibility.

**TOTAL: 45 PERIODS****OUTCOMES:**

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

**TEXT BOOKS:**

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

**REFERENCES:**

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics - Concepts and Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd., New Delhi, 2013.
6. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011.

**Web sources:**

1. [www.onlineethics.org](http://www.onlineethics.org)
2. [www.nspe.org](http://www.nspe.org)
3. [www.globalethics.org](http://www.globalethics.org)
4. [www.ethics.org](http://www.ethics.org)

**MG8591****PRINCIPLES OF MANAGEMENT****LT P C  
3 0 0 3****OBJECTIVES:**

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization.

**UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS****9**

Definition of Management - Science or Art - Manager Vs Entrepreneur - types of managers - managerial roles and skills - Evolution of Management - Scientific, human relations, system and contingency approaches - Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment - Current trends and issues in Management.

**UNIT II PLANNING****9**

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives - policies - Planning premises - Strategic Management - Planning Tools and Techniques – Decision making steps and process.

**UNIT III ORGANISING****9**

Nature and purpose - Formal and informal organization - organization chart - organization structure - types - Line and staff authority - departmentalization - delegation of authority - centralization and decentralization - Job Design - Human Resource Management - HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

**UNIT IV DIRECTING****9**

Foundations of individual and group behaviour - motivation - motivation theories - motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication - process of communication - barrier in communication - effective communication - communication and IT.

**UNIT V CONTROLLING****9**

System and process of controlling - budgetary and non-budgetary control techniques - use of computers and IT in Management control - Productivity problems and management - control and performance - direct and preventive control – reporting.

**TOTAL: 45 PERIODS****OUTCOMES:**

- Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

**TEXT BOOKS:**

1. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, 6th Edition, Pearson Education, 2004.
2. Stephen P. Robbins & Mary Coulter, “Management”, Prentice Hall (India) Pvt. Ltd., 10<sup>th</sup> Edition, 2009.

**REFERENCES:**

1. Harold Koontz & Heinz Weihrich, “Essentials of Management”, Tata McGraw Hill, 1998.
2. Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.
3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management”, 7<sup>th</sup> Edition, Pearson Education, 2011.
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata McGraw Hill, 1999

**EE8016**

**ENERGY MANAGEMENT AND AUDITING**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:** To impart knowledge about the following topics:

- To impart concepts behind economic analysis and Load management.
- Energy management on various electrical equipments and metering.
- Concept of lighting systems and cogeneration.

**UNIT I INTRODUCTION 9**

Basics of Energy – Need for energy management – Energy accounting - Energy monitoring, targeting and reporting - Energy audit process.

**UNIT II ENERGY MANAGEMENT FOR MOTORS AND COGENERATION 9**

Energy management for electric motors - Transformer and reactors - Capacitors and synchronous machines, energy management by cogeneration - Forms of cogeneration - Feasibility of cogeneration - Electrical interconnection.

**UNIT III LIGHTING SYSTEMS 9**

Energy management in lighting systems - Task and the working space - Light sources - Ballasts - Lighting controls - Optimizing lighting energy - Power factor and effect of harmonics, lighting and energy standards.

**UNIT IV METERING FOR ENERGY MANAGEMENT 9**

Metering for energy management - Units of measure - Utility meters - Demand meters - Paralleling of current transformers - Instrument transformer burdens - Multi tasking solid state meters, metering location vs requirements, metering techniques and practical examples.

**UNIT V ECONOMIC ANALYSIS AND MODELS 9**

Economic analysis - Economic models - Time value of money - Utility rate structures - Cost of electricity - Loss evaluation, load management - Demand control techniques - Utility monitoring and control system - HVAC and energy management - Economic justification.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to understand the basics of Energy audit process.
- Ability to understand the basics of energy management by cogeneration
- Ability to acquire knowledge on Energy management in lighting systems
- Ability to impart concepts behind economic analysis and Load management.
- Ability to understand the importance of Energy management on various electrical equipment and metering.
- Ability to acquire knowledge on HVAC.

**TEXT BOOKS:**

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, Guide to Energy Management, Fifth Edition, The Fairmont Press, Inc., 2006
2. Eastop T.D & Croft D.R, Energy Efficiency for Engineers and Technologists,.Logman Scientific & Technical, ISBN-0-582-03184 , 1990.



**TEXT BOOKS:**

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 1997.
2. Reema Thareja, "Data Structures Using C", Second Edition, Oxford University Press, 2011

**REFERENCES:**

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Second Edition, Mcgraw Hill, 2002.
2. Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education, 1983.
3. Stephen G. Kochan, "Programming in C", 3rd edition, Pearson Education.
4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Second Edition, University Press, 2008

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| <b>EE8017</b> | <b>HIGH VOLTAGE DIRECT CURRENT TRANSMISSION</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:** To impart knowledge about the following topics:

- Planning of DC power transmission and comparison with AC power transmission.
- HVDC converters.
- HVDC system control.
- Harmonics and design of filters.
- Power flow in HVDC system under steady state.

**UNIT I INTRODUCTION 9**

DC Power transmission technology-Comparison of AC and DC transmission-Application of DC transmission-Description of DC transmission system-Planning for HVDC transmission-Modern trends in HVDC technology-DC breakers-Operating problems-HVDC transmission based on VSC -Types and applications of MTDC systems.

**UNIT II ANALYSIS OF HVDC CONVERTERS 9**

Line commutated converter -Analysis of Graetz circuit with and without overlap -Pulse number- Choice of converter configuration - Converter bridge characteristics- Analysis of a 12 pulse converters- Analysis of VSC topologies and firing schemes.

**UNIT III CONVERTER AND HVDC SYSTEM CONTROL 9**

Principles of DC link control-Converter control characteristics-System control hierarchy-Firing angle control- Current and extinction angle control-Starting and stopping of DC link -Power control -Higher level controllers -Control of VSC based HVDC link.

**UNIT IV REACTIVE POWER AND HARMONICS CONTROL 9**

Reactive power requirements in steady state-Sources of reactive power-SVC and STATCOM- Generation of harmonics -Design of AC and DC filters- Active filters.

**UNIT V POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9**

Per unit system for DC quantities-DC system model -Inclusion of constraints -Power flow analysis -case study

**TOTAL : 45 PERIODS**

## OUTCOMES:

- Ability to understand the principles and types of HVDC system.
- Ability to analyze and understand the concepts of HVDC converters.
- Ability to acquire knowledge on DC link control.
- Ability to understand the concepts of reactive power management, harmonics and power flow analysis.
- Ability to get knowledge about Planning of DC power transmission and comparison with AC power transmission.
- Ability to understand the importance of power flow in HVDC system under steady state.

## TEXT BOOKS:

1. Padiyar,K.R.,“HVDC power transmission system”, New Age International(P)Ltd. NewDelhi, Second Edition,2010.
2. Arrillaga,J.,“High Voltage Direct Current Transmission”, Peter Pregrinus, London,1983.

## REFERENCES

1. Kundur P.,“ Power System Stability and Control”, McGraw-Hill,1993.
2. Colin Adamson and Hingorani NG,“ High Voltage Direct Current Power Transmission”, Garraway Limited, London, 1960.
3. Edward Wilson Kimbark,“ Direct Current Transmission”, Vol.I, Wiley inter science, New York, London, Sydney,1971.

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|---------------|--|----------|----------|----------|----------|
| <b>EE8018</b> | <b>MICROCONTROLLER BASED SYSTEM DESIGN</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:** To impart knowledge about the following topics:

- Architecture of PIC microcontroller
- Interrupts and timers
- Peripheral devices for data communication and transfer
- Functional blocks of ARM processor
- Architecture of ARM processors

### **UNIT I INTRODUCTION TO PIC MICROCONTROLLER 9**

Introduction to PIC Microcontroller-PIC 16C6x and PIC16C7x Architecture-IC16cxx– Pipelining - Program Memory considerations - Register File Structure - Instruction Set - Addressing modes - Simple Operations.

### **UNIT II INTERRUPTS AND TIMER 9**

PIC micro controller Interrupts- External Interrupts-Interrupt Programming-Loop time subroutine Timers-Timer Programming- Front panel I/O-Soft Keys- State machines and key switches- Display of Constant and Variability strings.

### **UNIT III PERIPHERALS AND INTERFACING 9**

I<sup>2</sup>C Bus for Peripherals Chip Access- Bus operation-Bus subroutines- Serial EEPROM– Analog to Digital Converter-UART-Baud rate selection-Data handling circuit-Initialization -

LCD and keyboard Interfacing -ADC, DAC, and Sensor Interfacing.

**UNIT IV INTRODUCTION TO ARM PROCESSOR 9**

Architecture -ARM programmer's model -ARM Development tools- Memory Hierarchy - ARM Assembly Language Programming-Simple Examples-Architectural Support for Operating systems.

**UNIT V ARM ORGANIZATION 9**

3-Stage Pipeline ARM Organization- 5-Stage Pipeline ARM Organization-ARM Instruction Execution- ARM Implementation- ARM Instruction Set- ARM coprocessor interface- Architectural support for High Level Languages - Embedded ARM Applications.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to understand and apply computing platform and software for engineering problems.
- Ability to understand the concepts of Architecture of PIC microcontroller
- Ability to acquire knowledge on Interrupts and timers.
- Ability to understand the importance of Peripheral devices for data communication.
- Ability to understand the basics of sensor interfacing
- Ability to acquire knowledge in Architecture of ARM processors

**TEXT BOOKS:**

1. Peatman,J.B., "Design with PIC Micro Controllers" Pearson Education, 3<sup>rd</sup> Edition, 2004.
2. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication, 2000.

**REFERENCES**

1. Mazidi, M.A., "PIC Microcontroller" Rollin Mckinlay, Danny causey ,Prentice Hall of India, 2007.

**EE8019**

**SMART GRID**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:** To impart knowledge about the following topics:

- Smart Grid technologies, different smart meters and advanced metering infrastructure.
- The power quality management issues in Smart Grid.
- The high performance computing for Smart Grid applications

**UNIT I INTRODUCTION TO SMART GRID 9**

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, National and International Initiatives in Smart Grid.



**UNIT II SMART GRID TECHNOLOGIES 9**

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/VAR control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plugin Hybrid Electric Vehicles(PHEV).

**UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9**

Introduction to Smart Meters, Advanced Metering Infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.

**UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9**

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

**UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9**

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broad band over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Learners will develop more understanding on the concepts of Smart Grid and its present developments.
- Learners will study about different Smart Grid technologies.
- Learners will acquire knowledge about different smart meters and advanced metering infrastructure.
- Learners will have knowledge on power quality management in Smart Grids
- Learners will develop more understanding on LAN, WAN and Cloud Computing for Smart Grid applications.

**TEXT BOOKS:**

1. Stuart Borlase "Smart Grid: Infrastructure, Technology and Solutions", CRC Press 2012.
2. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley 2012.

**REFERENCES**

- Vehbi C. Güngör, Dilan Sahin, Taskin Kocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, "Smart Grid Technologies: Communication Technologies and Standards" IEEE Transactions On Industrial Informatics, Vol.7, No.4, November 2011.
- Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang "Smart Grid - The New and Improved Power Grid: A Survey", IEEE Transaction on Smart Grids, vol.14, 2012.
- James Momohe "Smart Grid: Fundamentals of Design and Analysis", Wiley-IEEE Press, 2012.

**OBJECTIVES:**

- To Introduce Fundamentals of Biomedical Engineering
- To study the communication mechanics in a biomedical system with few examples
- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- To have a basic knowledge in life assisting and therapeutic devices

**UNIT I                    FUNDAMENTALS OF BIOMEDICAL ENGINEERING                    9**

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors

**UNIT II                    NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC                    9**  
**PROCEDURES**

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood -measurement of blood pCO<sub>2</sub>, pO<sub>2</sub>, finger-tip oxymeter - ESR, GSR measurements.

**UNIT III                    ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS                    9**

Electrodes - Limb electrodes -floating electrodes - pregelled disposable electrodes - Micro, needle and surface electrodes - Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods - Typical waveforms - Electrical safety in medical environment, shock hazards - leakage current-Instruments for checking safety parameters of biomedical equipment.

**UNIT IV                    IMAGING MODALITIES AND ANALYSIS                    9**

Radio graphic and fluoroscopic techniques - Computer tomography - MRI - Ultrasonography - Endoscopy - Thermography -Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems.

**UNIT V                    LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES                    9**

Pacemakers - Defibrillators - Ventilators - Nerve and muscle stimulators - Diathermy - Heart - Lung machine - Audio meters - Dialysers - Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery -Orthopedic prostheses fixation.

**TOTAL :    45    PERIODS****OUTCOMES: At the end of the course students will have the**

- Ability to understand the philosophy of the heart, lung, blood circulation and respiration system.
- Ability to provide latest ideas on devices of non-electrical devices.
- Ability to gain knowledge on various sensing and measurement devices of electrical origin.
- Ability to understand the analysis systems of various organ types.
- Ability to bring out the important and modern methods of imaging techniques and their

analysis.

- Ability to explain the medical assistance/techniques, robotic and therapeutic equipments.

#### **TEXT BOOKS:**

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.
2. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi, 2<sup>nd</sup> edition, 2003
3. Joseph J Carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4<sup>th</sup> edition, 2012

#### **REFERENCES**

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
5. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.

**GE8073**

**FUNDAMENTALS OF NANOSCIENCE**

**L T P C  
3 0 0 3**

#### **OBJECTIVES:**

To learn about basis of nanomaterial science, preparation method, types and application

#### **UNIT I INTRODUCTION**

**8**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

#### **UNIT II GENERAL METHODS OF PREPARATION**

**9**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

#### **UNIT III NANOMATERIALS**

**12**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO<sub>2</sub>, MgO, ZrO<sub>2</sub>, NiO, nanoalumina, CaO, AgTiO<sub>2</sub>, Ferrites, Nanoclays- functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

#### UNIT IV CHARACTERIZATION TECHNIQUES

9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

#### UNIT V APPLICATIONS

7

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechnology: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

**TOTAL : 45 PERIODS**

#### OUTCOMES:

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial


#### TEXT BOOKS :

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

#### REFERENCES:

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.



  
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**PROGRAMME EDUCATIONAL OBJECTIVES:**

- PEO1: To enable graduates to pursue research, or have a successful career in academia or industries associated with Electronics and Communication Engineering, or as entrepreneurs.
- PEO2: To provide students with strong foundational concepts and also advanced techniques and tools in order to enable them to build solutions or systems of varying complexity.
- PEO3: To prepare students to critically analyze existing literature in an area of specialization and ethically develop innovative and research oriented methodologies to solve the problems identified.

**PROGRAMME OUTCOMES:**

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.



8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

#### **PROGRAM SPECIFIC OBJECTIVES (PSOs)**

1. To analyze, design and develop solutions by applying foundational concepts of electronics and communication engineering.
2. To apply design principles and best practices for developing quality products for scientific and business applications.
3. To adapt to emerging information and communication technologies (ICT) to innovate ideas and solutions to existing/novel problems.

**Contribution**

**1: Reasonable**

**2: Significant**

**3: Strong**

## MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme objective and the outcomes is given in the following table

| PROGRAMME EDUCATIONAL OBJECTIVES | PROGRAMME OUTCOMES |   |   |   |   |   |   |   |   |   |   |   |
|----------------------------------|--------------------|---|---|---|---|---|---|---|---|---|---|---|
|                                  | A                  | B | C | D | E | F | G | H | I | J | K | L |
| 1                                | 3                  | 3 | 2 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 3 | 1 |
| 2                                | 3                  | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| 3                                | 3                  | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 1 | 2 | 2 | 2 |

## MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Objectives and the outcomes is given in the following table

| PROGRAM SPECIFIC OBJECTIVES | PROGRAMME OUTCOMES |   |   |   |   |   |   |   |   |   |   |   |
|-----------------------------|--------------------|---|---|---|---|---|---|---|---|---|---|---|
|                             | A                  | B | C | D | E | F | G | H | I | J | K | L |
| 1                           | 3                  | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| 2                           | 3                  | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 1 | 3 | 3 | 3 |
| 3                           | 3                  | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 1 | 3 |

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**MAPPING OF COURSE OUTCOMES WITH PROGRAMME OUTCOMES:**

A broad relation between the Course Outcomes and Programme Outcomes is given in the following table

| COURSE OUTCOMES |   | PROGRAMME OUTCOMES |   |   |   |   |   |   |   |   |   |   |   |
|-----------------|---|--------------------|---|---|---|---|---|---|---|---|---|---|---|
| Sem             | Course Name                                       | a                  | b | c | d | e | f | g | h | i | j | k | l |
| I               | Communicative English                             |                    |   |   |   |   | √ | √ | √ | √ | √ | √ |   |
|                 | Engineering Mathematics – I                       | √                  | √ | √ | √ |   |   |   |   |   |   | √ | √ |
|                 | Engineering Physics                               | √                  | √ | √ | √ |   |   |   |   |   |   | √ | √ |
|                 | Engineering Chemistry                             | √                  | √ | √ | √ |   |   |   |   |   |   | √ | √ |
|                 | Problem Solving and Python Programming            | √                  | √ | √ | √ | √ |   |   |   |   |   | √ | √ |
|                 | Engineering Graphics                              | √                  |   |   |   |   |   |   |   |   | √ | √ | √ |
|                 | Problem Solving and Python Programming Laboratory | √                  | √ | √ | √ | √ |   |   |   |   |   | √ | √ |
|                 | Physics and Chemistry Laboratory                  | √                  | √ | √ | √ |   |   |   |   |   |   | √ | √ |
| II              | Technical English                                 |                    |   |   |   | √ | √ | √ | √ | √ | √ | √ | √ |
|                 | Engineering Mathematics – II                      | √                  | √ | √ | √ |   |   |   |   |   |   | √ | √ |
|                 | Physics for Electronics Engineering               | √                  | √ | √ | √ |   |   |   |   |   |   | √ | √ |
|                 | Basic Electrical and Instrumentation Engineering  | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                 | Circuit Analysis                                  | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                 | Electronic Devices                                | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                 | Circuits and Devices Laboratory                   | √                  | √ | √ | √ | √ |   |   |   |   |   | √ | √ |
|                 | Engineering Practices Laboratory                  | √                  | √ | √ | √ | √ |   |   |   |   |   | √ | √ |
| III             | Linear Algebra and Partial Differential Equations | √                  | √ | √ | √ | √ |   |   |   |   |   | √ | √ |
|                 | Fundamentals of Data Structures In C              | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                 | Electronic Circuits- I                            | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                 | Signals and Systems                               | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                 | Digital Electronics                               | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                 | Control System Engineering                        | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                 | Fundamentals of Data Structures in C Laboratory   | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                 | Analog and Digital Circuits Laboratory            | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                 | Interpersonal Skills/Listening & Speaking         |                    |   |   |   |   | √ |   | √ | √ | √ | √ | √ |
| IV              | Probability and Random Processes                  | √                  | √ | √ | √ | √ |   |   |   |   |   | √ | √ |
|                 | Electronic Circuits II                            | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                 | Communication Theory                              | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                 | Electromagnetic Fields                            | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                 | Linear Integrated Circuits                        | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                 | Environmental Science and Engineering             | √                  | √ |   | √ |   | √ | √ | √ |   |   | √ | √ |



| COURSE OUTCOMES            |   | PROGRAMME OUTCOMES |   |   |   |   |   |   |   |   |   |   |   |
|----------------------------|---|--------------------|---|---|---|---|---|---|---|---|---|---|---|
| Sem                        | Course Name                                     | a                  | b | c | d | e | f | g | h | i | j | k | l |
|                            | Circuits Design and Simulation Laboratory       | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            | Linear Integrated Circuits Laboratory           | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            |   |                    |   |   |   |   |   |   |   |   |   |   |   |
| V                          | Digital Communication                           | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            | Discrete-Time Signal Processing                 | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            | Computer Architecture and Organization          | √                  | √ | √ | √ |   | √ |   |   |   |   | √ | √ |
|                            | Communication Networks                          | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            | Professional Elective I                         |                    |   |   |   |   |   |   |   |   |   |   |   |
|                            | Open Elective I                                 |                    |   |   |   |   |   |   |   |   |   |   |   |
|                            | Digital Signal Processing Laboratory            | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            | Communication Systems Laboratory                | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            | Networks Laboratory                             | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            |   |                    |   |   |   |   |   |   |   |   |   |   |   |
| VI                         | Microprocessors and Microcontrollers            | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            | VLSI Design                                     | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            | Wireless Communication                          | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            | Principles of Management                        |                    |   |   |   |   | √ | √ | √ |   | √ | √ | √ |
|                            | Transmission Lines and RF Systems               | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            | Professional Elective -II                       |                    |   |   |   |   |   |   |   |   |   |   |   |
|                            | Microprocessors and Microcontrollers Laboratory | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            | VLSI Design Laboratory                          | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            | Technical Seminar                               |                    | √ |   | √ | √ | √ |   | √ | √ | √ | √ | √ |
| Professional Communication |   |                    |   |   |   | √ |   |   |   | √ |   | √ |   |
|                            |   |                    |   |   |   |   |   |   |   |   |   |   |   |
| VII                        | Antennas and Microwave Engineering              | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            | Optical Communication                           | √                  | √ | √ | √ |   | √ |   |   |   |   | √ | √ |
|                            | Embedded and Real Time Systems                  | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            | Ad hoc and Wireless Sensor Networks             | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            | Professional Elective -III                      |                    |   |   |   |   |   |   |   |   |   |   |   |
|                            | Open Elective - II                              |                    |   |   |   |   |   |   |   |   |   |   |   |
|                            | Embedded Laboratory                             | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            | Advanced Communication Laboratory               | √                  | √ | √ | √ | √ | √ |   |   |   |   | √ | √ |
|                            |   |                    |   |   |   |   |   |   |   |   |   |   |   |
| VIII                       | Professional Elective - IV                      |                    |   |   |   |   |   |   |   |   |   |   |   |
|                            | Professional Elective - V                       |                    |   |   |   |   |   |   |   |   |   |   |   |
|                            | Project Work                                    | √                  | √ | √ | √ | √ | √ |   | √ | √ | √ | √ | √ |

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**CHOICE BASED CREDIT SYSTEM**  
**I - VIII SEMESTERS CURRICULA AND SYLLABI**

**SEMESTER I**

| Sl. No            | COURSE CODE | COURSE TITLE                                      | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |           |           |
| 1.                | HS8151      | Communicative English                             | HS       | 4               | 4         | 0        | 0         | 4         |
| 2.                | MA8151      | Engineering Mathematics - I                       | BS       | 4               | 4         | 0        | 0         | 4         |
| 3.                | PH8151      | Engineering Physics                               | BS       | 3               | 3         | 0        | 0         | 3         |
| 4.                | CY8151      | Engineering Chemistry                             | BS       | 3               | 3         | 0        | 0         | 3         |
| 5.                | GE8151      | Problem Solving and Python Programming            | ES       | 3               | 3         | 0        | 0         | 3         |
| 6.                | GE8152      | Engineering Graphics                              | ES       | 6               | 2         | 0        | 4         | 4         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |           |           |
| 7.                | GE8161      | Problem Solving and Python Programming Laboratory | ES       | 4               | 0         | 0        | 4         | 2         |
| 8.                | BS8161      | Physics and Chemistry Laboratory                  | BS       | 4               | 0         | 0        | 4         | 2         |
| <b>TOTAL</b>      |             |   |          | <b>31</b>       | <b>19</b> | <b>0</b> | <b>12</b> | <b>25</b> |

**SEMESTER II**

| Sl. No            | COURSE CODE | COURSE TITLE                                     | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|--|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |  |          |                 |           |          |          |           |
| 1.                | HS8251      | Technical English                                | HS       | 4               | 4         | 0        | 0        | 4         |
| 2.                | MA8251      | Engineering Mathematics - II                     | BS       | 4               | 4         | 0        | 0        | 4         |
| 3.                | PH8253      | Physics for Electronics Engineering              | BS       | 3               | 3         | 0        | 0        | 3         |
| 4.                | BE8254      | Basic Electrical and Instrumentation Engineering | ES       | 3               | 3         | 0        | 0        | 3         |
| 5.                | EC8251      | Circuit Analysis                                 | PC       | 4               | 4         | 0        | 0        | 4         |
| 6.                | EC8252      | Electronic Devices                               | PC       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |  |          |                 |           |          |          |           |
| 7.                | EC8261      | Circuits and Devices Laboratory                  | PC       | 4               | 0         | 0        | 4        | 2         |
| 8.                | GE8261      | Engineering Practices Laboratory                 | ES       | 4               | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>      |             |  |          | <b>29</b>       | <b>21</b> | <b>0</b> | <b>8</b> | <b>25</b> |

### SEMESTER III

| SI. No            | COURSE CODE | COURSE TITLE                                      | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |           |           |
| 1.                | MA8352      | Linear Algebra and Partial Differential Equations | BS       | 4               | 4         | 0        | 0         | 4         |
| 2.                | EC8393      | Fundamentals of Data Structures In C              | ES       | 3               | 3         | 0        | 0         | 3         |
| 3.                | EC8351      | Electronic Circuits- I                            | PC       | 3               | 3         | 0        | 0         | 3         |
| 4.                | EC8352      | Signals and Systems                               | PC       | 4               | 4         | 0        | 0         | 4         |
| 5.                | EC8392      | Digital Electronics                               | PC       | 3               | 3         | 0        | 0         | 3         |
| 6.                | EC8391      | Control Systems Engineering                       | PC       | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |           |           |
| 7.                | EC8381      | Fundamentals of Data Structures in C Laboratory   | ES       | 4               | 0         | 0        | 4         | 2         |
| 8.                | EC8361      | Analog and Digital Circuits Laboratory            | PC       | 4               | 0         | 0        | 4         | 2         |
| 9.                | HS8381      | Interpersonal Skills/Listening &Speaking          | EEC      | 2               | 0         | 0        | 2         | 1         |
| <b>TOTAL</b>      |             |   |          | <b>30</b>       | <b>20</b> | <b>0</b> | <b>10</b> | <b>25</b> |

### SEMESTER IV

| SI. No            | COURSE CODE | COURSE TITLE                              | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |          |           |
| 1.                | MA8451      | Probability and Random Processes          | BS       | 4               | 4         | 0        | 0        | 4         |
| 2.                | EC8452      | Electronic Circuits II                    | PC       | 3               | 3         | 0        | 0        | 3         |
| 3.                | EC8491      | Communication Theory                      | PC       | 3               | 3         | 0        | 0        | 3         |
| 4.                | EC8451      | Electromagnetic Fields                    | PC       | 4               | 4         | 0        | 0        | 4         |
| 5.                | EC8453      | Linear Integrated Circuits                | PC       | 3               | 3         | 0        | 0        | 3         |
| 6.                | GE8291      | Environmental Science and Engineering     | HS       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |          |           |
| 7.                | EC8461      | Circuits Design and Simulation Laboratory | PC       | 4               | 0         | 0        | 4        | 2         |
| 8.                | EC8462      | Linear Integrated Circuits Laboratory     | PC       | 4               | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>      |             |   |          | <b>28</b>       | <b>20</b> | <b>0</b> | <b>8</b> | <b>24</b> |

### SEMESTER V

| Sl. No            | COURSE CODE | COURSE TITLE                           | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|--|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |  |          |                 |           |          |           |           |
| 1.                | EC8501      | Digital Communication                  | PC       | 3               | 3         | 0        | 0         | 3         |
| 2.                | EC8553      | Discrete-Time Signal Processing        | PC       | 4               | 4         | 0        | 0         | 4         |
| 3.                | EC8552      | Computer Architecture and Organization | PC       | 3               | 3         | 0        | 0         | 3         |
| 4.                | EC8551      | Communication Networks                 | PC       | 3               | 3         | 0        | 0         | 3         |
| 5.                |             | Professional Elective I                | PE       | 3               | 3         | 0        | 0         | 3         |
| 6.                |             | Open Elective I                        | OE       | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |  |          |                 |           |          |           |           |
| 7.                | EC8562      | Digital Signal Processing Laboratory   | PC       | 4               | 0         | 0        | 4         | 2         |
| 8.                | EC8561      | Communication Systems Laboratory       | PC       | 4               | 0         | 0        | 4         | 2         |
| 9.                | EC8563      | Communication Networks Laboratory      | PC       | 4               | 0         | 0        | 4         | 2         |
| <b>TOTAL</b>      |             |  |          | <b>31</b>       | <b>19</b> | <b>0</b> | <b>12</b> | <b>25</b> |

### SEMESTER VI

| Sl. No            | COURSE CODE | COURSE TITLE                                    | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |           |           |
| 1.                | EC8691      | Microprocessors and Microcontrollers            | PC       | 3               | 3         | 0        | 0         | 3         |
| 2.                | EC8095      | VLSI Design                                     | PC       | 3               | 3         | 0        | 0         | 3         |
| 3.                | EC8652      | Wireless Communication                          | PC       | 3               | 3         | 0        | 0         | 3         |
| 4.                | MG8591      | Principles of Management                        | HS       | 3               | 3         | 0        | 0         | 3         |
| 5.                | EC8651      | Transmission Lines and RF Systems               | PC       | 3               | 3         | 0        | 0         | 3         |
| 6.                |             | Professional Elective -II                       | PE       | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |           |           |
| 7.                | EC8681      | Microprocessors and Microcontrollers Laboratory | PC       | 4               | 0         | 0        | 4         | 2         |
| 8.                | EC8661      | VLSI Design Laboratory                          | PC       | 4               | 0         | 0        | 4         | 2         |
| 9.                | EC8611      | Technical Seminar                               | EEC      | 2               | 0         | 0        | 2         | 1         |
| 10.               | HS8581      | Professional Communication                      | EEC      | 2               | 0         | 0        | 2         | 1         |
| <b>TOTAL</b>      |             |   |          | <b>30</b>       | <b>18</b> | <b>0</b> | <b>12</b> | <b>24</b> |

### SEMESTER VII

| Sl.No             | COURSE CODE | COURSE TITLE                        | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|-------------------------------------|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |                                     |          |                 |           |          |          |           |
| 1.                | EC8701      | Antennas and Microwave Engineering  | PC       | 3               | 3         | 0        | 0        | 3         |
| 2.                | EC8751      | Optical Communication               | PC       | 3               | 3         | 0        | 0        | 3         |
| 3.                | EC8791      | Embedded and Real Time Systems      | PC       | 3               | 3         | 0        | 0        | 3         |
| 4.                | EC8702      | Ad hoc and Wireless Sensor Networks | PC       | 3               | 3         | 0        | 0        | 3         |
| 5.                |             | Professional Elective -III          | PE       | 3               | 3         | 0        | 0        | 3         |
| 6.                |             | Open Elective - II                  | OE       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |                                     |          |                 |           |          |          |           |
| 7.                | EC8711      | Embedded Laboratory                 | PC       | 4               | 0         | 0        | 4        | 2         |
| 8.                | EC8761      | Advanced Communication Laboratory   | PC       | 4               | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>      |             |                                     |          | <b>26</b>       | <b>18</b> | <b>0</b> | <b>8</b> | <b>22</b> |

### SEMESTER VIII

| Sl. No            | COURSE CODE | COURSE TITLE             | CATEGORY | CONTACT PERIODS | L        | T        | P         | C         |
|-------------------|-------------|--------------------------|----------|-----------------|----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |                          |          |                 |          |          |           |           |
| 1.                |             | Professional Elective IV | PE       | 3               | 3        | 0        | 0         | 3         |
| 2.                |             | Professional Elective V  | PE       | 3               | 3        | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |                          |          |                 |          |          |           |           |
| 3.                | EC8811      | Project Work             | EEC      | 20              | 0        | 0        | 20        | 10        |
| <b>TOTAL</b>      |             |                          |          | <b>26</b>       | <b>6</b> | <b>0</b> | <b>20</b> | <b>16</b> |

**TOTAL NO. OF CREDITS: 186**

### HUMANITIES AND SOCIALSCIENCES (HS)

| SI.NO | COURSE CODE | COURSE TITLE                          | CATEGORY | CONTACT PERIODS | L | T | P | C |
|-------|-------------|---------------------------------------|----------|-----------------|---|---|---|---|
| 1.    | HS8151      | Communicative English                 | HS       | 4               | 4 | 0 | 0 | 4 |
| 2.    | HS8251      | Technical English                     | HS       | 4               | 4 | 0 | 0 | 4 |
| 3.    | GE8291      | Environmental Science and Engineering | HS       | 3               | 3 | 0 | 0 | 3 |
| 4.    | MG8591      | Principles of Management              | HS       | 3               | 3 | 0 | 0 | 3 |

### BASIC SCIENCES (BS)

| SI.NO | COURSE CODE | COURSE TITLE                                      | CATEGORY | CONTACT PERIODS | L | T | P | C |
|-------|-------------|---|----------|-----------------|---|---|---|---|
| 1.    | MA8151      | Engineering Mathematics I                         | BS       | 4               | 4 | 0 | 0 | 4 |
| 2.    | PH8151      | Engineering Physics                               | BS       | 3               | 3 | 0 | 0 | 3 |
| 3.    | CY8151      | Engineering Chemistry                             | BS       | 3               | 3 | 0 | 0 | 3 |
| 4.    | BS8161      | Physics and Chemistry Laboratory                  | BS       | 4               | 0 | 0 | 4 | 2 |
| 5.    | MA8251      | Engineering Mathematics II                        | BS       | 4               | 4 | 0 | 0 | 4 |
| 6.    | PH8253      | Physics for Electronics Engineering               | BS       | 3               | 3 | 0 | 0 | 3 |
| 7.    | MA8352      | Linear Algebra and Partial Differential Equations | BS       | 4               | 4 | 0 | 0 | 4 |
| 8.    | MA8451      | Probability and Random Processes                  | BS       | 4               | 4 | 0 | 0 | 4 |

### ENGINEERING SCIENCES (ES)

| SI. NO | COURSE CODE | COURSE TITLE                                      | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|---|----------|-----------------|---|---|---|---|
| 1.     | GE8151      | Problem Solving and Python Programming            | ES       | 3               | 3 | 0 | 0 | 3 |
| 2.     | GE8152      | Engineering Graphics                              | ES       | 6               | 2 | 0 | 4 | 4 |
| 3.     | GE8161      | Problem Solving and Python Programming Laboratory | ES       | 4               | 0 | 0 | 4 | 2 |
| 4.     | BE8254      | Basic Electrical and Instrumentation Engineering  | ES       | 3               | 3 | 0 | 0 | 3 |
| 5.     | GE8261      | Engineering Practices Laboratory                  | ES       | 4               | 0 | 0 | 4 | 2 |
| 6.     | EC8393      | Fundamentals of Data Structures In C              | ES       | 3               | 3 | 0 | 0 | 3 |
| 7.     | EC8381      | Fundamentals of Data Structures in C Laboratory   | ES       | 4               | 0 | 0 | 4 | 2 |

**PROFESSIONAL CORE (PC)**

| SI.NO | COURSE CODE | COURSE TITLE                              | CATEGORY | CONTACT PERIODS | L | T | P | C |
|-------|-------------|---|----------|-----------------|---|---|---|---|
| 1.    | EC8251      | Circuit Analysis                          | PC       | 4               | 4 | 0 | 0 | 4 |
| 2.    | EC8252      | Electronic Devices                        | PC       | 3               | 3 | 0 | 0 | 3 |
| 3.    | EC8261      | Circuits and Devices Lab                  | PC       | 4               | 0 | 0 | 4 | 2 |
| 4.    | EC8351      | Electronic Circuits- I                    | PC       | 3               | 3 | 0 | 0 | 3 |
| 5.    | EC8352      | Signals and Systems                       | PC       | 4               | 4 | 0 | 0 | 4 |
| 6.    | EC8392      | Digital Electronics                       | PC       | 3               | 3 | 0 | 0 | 3 |
| 7.    | EC8391      | Control System Engineering                | PC       | 3               | 3 | 0 | 0 | 3 |
| 8.    | EC8361      | Analog and Digital Circuits Laboratory    | PC       | 4               | 0 | 0 | 4 | 2 |
| 9.    | EC8452      | Electronic Circuits II                    | PC       | 3               | 3 | 0 | 0 | 3 |
| 10.   | EC8491      | Communication Theory                      | PC       | 3               | 3 | 0 | 0 | 3 |
| 11.   | EC8451      | Electromagnetic Fields                    | PC       | 4               | 4 | 0 | 0 | 4 |
| 12.   | EC8453      | Linear Integrated Circuits                | PC       | 3               | 3 | 0 | 0 | 3 |
| 13.   | EC8461      | Circuits Design and Simulation Laboratory | PC       | 4               | 0 | 0 | 4 | 2 |
| 14.   | EC8462      | Linear Integrated Circuits Laboratory     | PC       | 4               | 0 | 0 | 4 | 2 |
| 15.   | EC8501      | Digital Communication                     | PC       | 3               | 3 | 0 | 0 | 3 |
| 16.   | EC8553      | Discrete-Time Signal Processing           | PC       | 4               | 4 | 0 | 0 | 4 |
| 17.   | EC8651      | Transmission Lines and RF Systems         | PC       | 3               | 3 | 0 | 0 | 3 |
| 18.   | EC8552      | Computer Architecture and Organization    | PC       | 3               | 3 | 0 | 0 | 3 |
| 19.   | EC8551      | Communication Networks                    | PC       | 3               | 3 | 0 | 0 | 3 |
| 20.   | EC8562      | Digital Signal Processing Laboratory      | PC       | 4               | 0 | 0 | 4 | 2 |
| 21.   | EC8561      | Communication Systems Laboratory          | PC       | 4               | 0 | 0 | 4 | 2 |
| 22.   | EC8563      | Communication Networks Laboratory         | PC       | 4               | 0 | 0 | 4 | 2 |
| 23.   | EC8691      | Microprocessors and Microcontrollers      | PC       | 3               | 3 | 0 | 0 | 3 |
| 24.   | EC8095      | VLSI Design                               | PC       | 3               | 3 | 0 | 0 | 3 |
| 25.   | EC8652      | Wireless Communication                    | PC       | 3               | 3 | 0 | 0 | 3 |
| 26.   | EC8661      | VLSI Design Laboratory                    | PC       | 4               | 0 | 0 | 4 | 2 |

|     |        |   |    |   |   |   |   |   |
|-----|--------|---|----|---|---|---|---|---|
| 27. | EC8681 | Microprocessors and Microcontrollers Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 28. | EC8701 | Antennas and Microwave Engineering              | PC | 3 | 3 | 0 | 0 | 3 |
| 29. | EC8751 | Optical Communication                           | PC | 3 | 3 | 0 | 0 | 3 |
| 30. | EC8791 | Embedded and Real Time Systems                  | PC | 3 | 3 | 0 | 0 | 3 |
| 31. | EC8702 | Ad hoc and Wireless Sensor Networks             | PC | 3 | 3 | 0 | 0 | 3 |
| 32. | EC8711 | Embedded Laboratory                             | PC | 4 | 0 | 0 | 4 | 2 |
| 33. | EC8761 | Advanced Communication Laboratory               | PC | 4 | 0 | 0 | 4 | 2 |



**PROFESSIONAL ELECTIVES (PE)\*  
SEMESTER V  
ELECTIVE I**

| Sl. No | COURSE CODE | COURSE TITLE                     | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|----------------------------------|----------|-----------------|---|---|---|---|
| 1.     | CS8392      | Object Oriented Programming      | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.     | EC8073      | Medical Electronics              | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.     | CS8493      | Operating Systems                | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.     | EC8074      | Robotics and Automation          | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.     | EC8075      | Nano Technology and Applications | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.     | GE8074      | Human Rights                     | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.     | GE8077      | Total Quality Management         | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VI  
ELECTIVE II**

| Sl. No | COURSE CODE | COURSE TITLE                              | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|---|----------|-----------------|---|---|---|---|
| 1.     | CS8792      | Cryptography and Network Security         | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.     | EC8091      | <u>Advanced Digital Signal Processing</u> | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.     | EC8001      | MEMS and NEMS                             | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.     | EC8002      | Multimedia Compression and Communication  | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.     | EC8003      | CMOS Analog IC Design                     | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.     | EC8004      | Wireless Networks                         | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.     | GE8075      | Intellectual Property Rights              | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VII  
ELECTIVE III**

| Sl. No | COURSE CODE | COURSE TITLE  | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|---|----------|-----------------|---|---|---|---|
| 1.     | EC8092      | Advanced Wireless Communication                     | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.     | EC8071      | Cognitive Radio                                     | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.     | GE8072      | Foundation Skills in Integrated Product Development | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.     | CS8082      | Machine Learning Techniques                         | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.     | EC8005      | Electronics Packaging and Testing                   | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.     | EC8006      | Mixed Signal IC Design                              | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.     | GE8071      | Disaster Management                                 | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VIII  
ELECTIVE IV**

| SI.No | COURSE CODE | COURSE TITLE                                    | CATEGORY | CONTACT PERIODS | L | T | P | C |
|-------|-------------|---|----------|-----------------|---|---|---|---|
| 1.    | EC8072      | Electro Magnetic Interference and Compatibility | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.    | EC8007      | Low power SoC Design                            | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.    | EC8008      | Photonic Networks                               | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.    | EC8009      | Compressive Sensing                             | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.    | EC8093      | Digital Image Processing                        | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.    | GE8076      | Professional Ethics in Engineering              | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VIII  
ELECTIVE V**

| SI.No | COURSE CODE | COURSE TITLE                     | CATEGORY | CONTACT PERIODS | L | T | P | C |
|-------|-------------|----------------------------------|----------|-----------------|---|---|---|---|
| 1.    | EC8010      | Video Analytics                  | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.    | EC8011      | DSP Architecture and Programming | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.    | EC8094      | Satellite Communication          | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.    | CS8086      | Soft Computing                   | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.    | IT8006      | Principles of Speech Processing  | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.    | GE8073      | Fundamentals of Nanoscience      | PE       | 3               | 3 | 0 | 0 | 3 |

**\*Professional Electives are grouped according to elective number as was done previously.**

**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

| S.NO | COURSE CODE | COURSE TITLE                              | CATEGORY | CONTACT PERIODS | L | T | P  | C  |
|------|-------------|---|----------|-----------------|---|---|----|----|
| 1.   | HS8381      | Interpersonal Skills/Listening & Speaking | EEC      | 2               | 0 | 0 | 2  | 1  |
| 2.   | EC8611      | Technical Seminar                         | EEC      | 2               | 0 | 0 | 2  | 1  |
| 3.   | HS8581      | Professional Communication                | EEC      | 2               | 0 | 0 | 2  | 1  |
| 4.   | EC8811      | Project Work                              | EEC      | 20              | 0 | 0 | 20 | 10 |

### SUMMARY

| S.NO. | SUBJECT AREA                  | CREDITS AS PER SEMESTER |           |           |           |           |           |           |           | CREDITS TOTAL | Percentage |
|-------|-------------------------------|-------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------------|------------|
|       |                               | I                       | II        | III       | IV        | V         | VI        | VII       | VIII      |               |            |
| 1.    | HS                            | 4                       | 4         |           | 3         |           | 3         |           |           | 14            | 7.56%      |
| 2.    | BS                            | 12                      | 7         | 4         | 4         |           |           |           |           | 27            | 14.6%      |
| 3.    | ES                            | 9                       | 5         | 5         |           |           |           |           |           | 19            | 10.27%     |
| 4.    | PC                            |                         | 9         | 15        | 17        | 19        | 16        | 16        |           | 92            | 50%        |
| 5.    | PE                            |                         |           |           |           | 3         | 3         | 3         | 6         | 15            | 8.10%      |
| 6.    | OE                            |                         |           |           |           | 3         |           | 3         |           | 6             | 3.24%      |
| 7.    | EEC                           |                         |           | 1         |           |           | 2         |           | 10        | 13            | 6.48%      |
|       | <b>Total</b>                  | <b>25</b>               | <b>25</b> | <b>25</b> | <b>24</b> | <b>25</b> | <b>24</b> | <b>22</b> | <b>16</b> | <b>186</b>    |            |
| 8.    | <b>Non Credit / Mandatory</b> |                         |           |           |           |           |           |           |           |               |            |

**OBJECTIVES:**

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

**UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 12**

**Reading-** short comprehension passages, practice in skimming-scanning and predicting- **Writing-** completing sentences- - developing hints. **Listening-** short texts- short formal and informal conversations. **Speaking-** introducing oneself - exchanging personal information- **Language development-** Wh- Questions- asking and answering-yes or no questions- parts of speech. **Vocabulary development--** prefixes- suffixes- articles.- count/ uncount nouns.

**UNIT II GENERAL READING AND FREE WRITING 12**

**Reading** - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register- **Writing** – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –**Listening-** telephonic conversations. **Speaking** – sharing information of a personal kind—greeting – taking leave- **Language development** – prepositions, conjunctions **Vocabulary development-** guessing meanings of words in context.

**UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 12**

**Reading-** short texts and longer passages (close reading) **Writing-** understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences **Listening** – listening to longer texts and filling up the table- product description- narratives from different sources. **Speaking-** asking about routine actions and expressing opinions. **Language development-** degrees of comparison- pronouns- direct vs indirect questions- **Vocabulary development** – single word substitutes- adverbs.

**UNIT IV READING AND LANGUAGE DEVELOPMENT 12**

**Reading-** comprehension-reading longer texts- reading different types of texts- magazines **Writing-** letter writing, informal or personal letters-e-mails-conventions of personal email- **Listening-** listening to dialogues or conversations and completing exercises based on them. **Speaking-** speaking about oneself- speaking about one's friend- **Language development-** Tenses- simple present-simple past- present continuous and past continuous- **Vocabulary development-** synonyms-antonyms- phrasal verbs

## UNIT V EXTENDED WRITING

12

**Reading-** longer texts- close reading –**Writing-** brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing-**Listening** – listening to talks- conversations- **Speaking** – participating in conversations- short group conversations-**Language development**-modal verbs- present/ past perfect tense - **Vocabulary development**-collocations- fixed and semi-fixed expressions.

**TOTAL: 60 PERIODS**

### OUTCOMES:

**At the end of the course, learners will be able to:**

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English
- Write short essays of a general kind and personal letters and emails in English.

### TEXT BOOKS:

1. Board of Editors. **Using English** A Coursebook for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015
2. Richards, C. Jack. **Interchange Students' Book-2** New Delhi: CUP, 2015.

### REFERENCES:

1. Bailey, Stephen. **Academic Writing: A practical guide for students**. New York: Rutledge,2011.
2. Means,L. Thomas and Elaine Langlois. **English & Communication For Colleges**. CengageLearning ,USA: 2007
3. Redston, Chris & Gillies Cunningham **Face2Face** (Pre-intermediate Student's Book & Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. **Speaking Effectively: Developing Speaking Skills for Business English**. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta. **Basic Communication Skills**, Foundation Books: 2013.

**OBJECTIVES :**

The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

**UNIT I DIFFERENTIAL CALCULUS****12**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

**UNIT II 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 – Lagrange's method of undetermined multipliers.

**UNIT III 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 IV 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.

**UNIT V DIFFERENTIAL EQUATIONS****12**

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

**TOTAL : 60 PERIODS****OUTCOMES:**

**After completing this course, students should demonstrate competency in the following skills:**

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Apply various techniques in solving differential equations.



**UNIT V CRYSTAL PHYSICS****9**

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

**TOTAL : 45 PERIODS****OUTCOMES:****Upon completion of this course,**

- the students will gain knowledge on the basics of properties of matter and its applications,
- the students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
- the students will understand the basics of crystals, their structures and different crystal growth techniques.

**TEXT BOOKS:**

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

**REFERENCES:**

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics". W.H. Freeman, 2007.

**CY8151****ENGINEERING CHEMISTRY****L T P C  
3 0 0 3****OBJECTIVES:**

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.



**UNIT I WATER AND ITS TREATMENT 9**

Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – numerical problems – boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment – Ion exchange process, zeolite process – desalination of brackish water - Reverse Osmosis.

**UNIT II SURFACE CHEMISTRY AND CATALYSIS 9**

Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – contact theory – kinetics of surface reactions, unimolecular reactions, Langmuir - applications of adsorption on pollution abatement. Catalysis: Catalyst – types of catalysis – criteria – autocatalysis – catalytic poisoning and catalytic promoters - acid base catalysis – applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation.

**UNIT III ALLOYS AND PHASE RULE 9**

Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel. Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.

**UNIT IV FUELS AND COMBUSTION 9**

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel. Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

**UNIT V ENERGY SOURCES AND STORAGE DEVICES 9**

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H<sub>2</sub>-O<sub>2</sub> fuel cell.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

**TEXT BOOKS:**

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

**REFERENCES:**

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

**GE8151****PROBLEM SOLVING AND PYTHON PROGRAMMING****L T P C  
3 0 0 3****OBJECTIVES:**

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures -- lists, tuples, dictionaries.
- To do input/output with files in Python.

**UNIT I                    ALGORITHMIC PROBLEM SOLVING                    9**

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

**UNIT II                    DATA, EXPRESSIONS, STATEMENTS                    9**

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

**UNIT III                    CONTROL FLOW, FUNCTIONS                    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. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

**UNIT IV                    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; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

**UNIT V                    FILES, MODULES, PACKAGES                    9**

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

Upon completion of the course, students will be able to

- Develop algorithmic solutions to simple computational problems
- Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python Programs.

**TEXT BOOKS:**

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2<sup>nd</sup> edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (<http://greenteapress.com/wp/think-python/>)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

**REFERENCES:**

1. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.
5. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.

**GE8152****ENGINEERING GRAPHICS****L T P C  
2 0 4 4****OBJECTIVES:**

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.

**CONCEPTS AND CONVENTIONS (Not for Examination)****1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

**UNIT I PLANE CURVES AND FREEHAND SKETCHING****7+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12**

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

**UNIT III PROJECTION OF SOLIDS 5+12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

**UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5+12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

**UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

**TOTAL: 90 PERIODS**

**OUTCOMES:**

**On successful completion of this course, the student will be able to:**

- Familiarize with the fundamentals and standards of Engineering graphics
- Perform freehand sketching of basic geometrical constructions and multiple views of objects.
- Project orthographic projections of lines and plane surfaces.
- Draw projections and solids and development of surfaces.
- Visualize and to project isometric and perspective sections of simple solids.

**TEXT BOOKS:**

1. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008.

**REFERENCES:**

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50<sup>th</sup> Edition, 2010.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy And Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2<sup>nd</sup> Edition, 2009.

**Publication of Bureau of Indian Standards:**

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.

3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

**Special points applicable to University Examinations on Engineering Graphics:**

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The
4. students will be permitted to use appropriate scale to fit solution within A3 size.
5. The examination will be conducted in appropriate sessions on the same day

**GE8161      PROBLEM SOLVING ANDPYTHON PROGRAMMING LABORATORY**

**L T P C  
0 0 4 2**

**OBJECTIVES**

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

**LIST OF PROGRAMS**

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

**PLATFORM NEEDED**

Python 3 interpreter for Windows/Linux

**OUTCOMES**

**Upon completion of the course, students will be able to:**

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

**TOTAL: 60 PERIODS**

BS8161

**PHYSICS AND CHEMISTRY LABORATORY**  
(Common to all branches of B.E. / B.Tech Programmes)

|   |   |   |   |
|---|---|---|---|
| L | T | P | C |
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**OBJECTIVES:**

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

**LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)**

- Determination of rigidity modulus – Torsion pendulum
- Determination of Young's modulus by non-uniform bending method
- (a) Determination of wavelength, and particle size using Laser  
(b) Determination of acceptance angle in an optical fiber.
- Determination of thermal conductivity of a bad conductor – Lee's Disc method.
- Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
- Determination of wavelength of mercury spectrum – spectrometer grating
- Determination of band gap of a semiconductor
- Determination of thickness of a thin wire – Air wedge method

**TOTAL: 30 PERIODS**

**OUTCOMES:**

Upon completion of the course, the students will be able to

- apply principles of elasticity, optics and thermal properties for engineering applications.

**CHEMISTRY LABORATORY: (Any seven experiments to be conducted)**

**OBJECTIVES:**

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
  - To acquaint the students with the determination of molecular weight of a polymer by viscometry.
- Estimation of HCl using  $\text{Na}_2\text{CO}_3$  as primary standard and Determination of alkalinity in water sample.
  - Determination of total, temporary & permanent hardness of water by EDTA method.
  - Determination of DO content of water sample by Winkler's method.
  - Determination of chloride content of water sample by argentometric method.
  - Estimation of copper content of the given solution by Iodometry.
  - Determination of strength of given hydrochloric acid using pH meter.
  - Determination of strength of acids in a mixture of acids using conductivity meter.
  - Estimation of iron content of the given solution using potentiometer.
  - Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
  - Estimation of sodium and potassium present in water using flame photometer.
  - Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
  - Pseudo first order kinetics-ester hydrolysis.
  - Corrosion experiment-weight loss method.
  - Determination of CMC.
  - Phase change in a solid.
  - Conductometric titration of strong acid vs strong base.

**OUTCOMES:**

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

**TOTAL: 30 PERIODS**

**TEXTBOOKS:**

- Vogel's Textbook of Quantitative Chemical Analysis (8<sup>TH</sup> edition, 2014)

**OBJECTIVES:**

**The Course prepares second semester engineering and Technology students to:**

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

**UNIT I INTRODUCTION TECHNICAL ENGLISH 12**

**Listening-** Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- **Speaking** –Asking for and giving directions- **Reading** – reading short technical texts from journals- newspapers- **Writing-** purpose statements – extended definitions – issue- writing instructions – checklists-recommendations-**Vocabulary Development-** technical vocabulary **Language Development** –subject verb agreement - compound words.

**UNIT II READING AND STUDY SKILLS 12**

**Listening-** Listening to longer technical talks and completing exercises based on them-**Speaking** – describing a process-**Reading** – reading longer technical texts- identifying the various transitions in a text- paragraphing- **Writing-** interpreting charts, graphs- **Vocabulary Development-** vocabulary used in formal letters/emails and reports **Language Development-** impersonal passive voice, numerical adjectives.

**UNIT III TECHNICAL WRITING AND GRAMMAR 12**

**Listening-** Listening to classroom lectures/ talks on engineering/technology -**Speaking** – introduction to technical presentations- **Reading** – longer texts both general and technical, practice in speed reading; **Writing-**Describing a process, use of sequence words- **Vocabulary Development-** sequence words- Misspelled words. **Language Development-** embedded sentences

**UNIT IV REPORT WRITING 12**

**Listening-** Listening to documentaries and making notes. **Speaking** – mechanics of presentations- **Reading** – reading for detailed comprehension- **Writing-** email etiquette- job application – cover letter –Résumé preparation( via email and hard copy)- analytical essays and issue based essays--**Vocabulary Development-** finding suitable synonyms-paraphrasing-. **Language Development-** clauses- if conditionals.

**UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 12**

**Listening-** TED/Ink talks; **Speaking** –participating in a group discussion -**Reading**– reading and understanding technical articles **Writing**– Writing reports- minutes of a meeting- accident and survey-**Vocabulary Development-** verbal analogies **Language Development-** reported speech

**TOTAL :60 PERIODS**

**OUTCOMES:**

**At the end of the course learners will be able to:**

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

**TEXT BOOKS:**

1. Board of editors. **Fluency in English A Course book for Engineering and Technology.** Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. **English for Technical Communication.** Cambridge University Press: New Delhi, 2016.

**REFERENCES:**

1. Raman, Meenakshi and Sharma, Sangeetha- **Technical Communication Principles and Practice.**Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. **Engineering English.** Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, **Project Work,** Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, **English for Presentations,** Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, **English & Communication For Colleges.** Cengage Learning, USA: 2007  
**Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading.**

**MA8251****ENGINEERING MATHEMATICS – II**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |

**OBJECTIVES :**

This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

**UNIT I            MATRICES****12**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

**UNIT II            VECTOR CALCULUS****12**

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

**UNIT III            ANALYTIC FUNCTIONS****12**

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions  $W = Z + C, CZ, \frac{1}{Z}, Z^2$  - Bilinear transformation.

**UNIT IV            COMPLEX INTEGRATION****12**

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.



**UNIT V LAPLACE TRANSFORMS****12**

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

**TOTAL: 60 PERIODS****OUTCOMES:**

**After successfully completing the course, the student will have a good understanding of the following topics and their applications:**

- Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
- Gradient, divergence and curl of a vector point function and related identities.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Analytic functions, conformal mapping and complex integration.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

**TEXT BOOKS :**

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10<sup>th</sup> Edition, New Delhi, 2016.

**REFERENCES :**

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7<sup>th</sup> Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3<sup>rd</sup> Edition, 2007.
3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4<sup>th</sup> Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

**PH8253****PHYSICS FOR ELECTRONICS ENGINEERING**

(Common to BME, ME, CC, ECE, EEE, E&amp;I, ICE)

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|---|---|---|---|
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**OBJECTIVES:**

- To understand the essential principles of Physics of semiconductor device and Electron transport properties. Become proficient in magnetic, dielectric and optical properties of materials and nano devices.

**UNIT I ELECTRICAL PROPERTIES OF MATERIALS****9**

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Wiedemann-Franz law – Success and failures - electrons in metals – Particle in a three dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential: Bloch theorem – metals and insulators - Energy bands in solids– tight binding approximation - Electron effective mass – concept of hole.

**UNIT II SEMICONDUCTOR PHYSICS 9**

Intrinsic Semiconductors – Energy band diagram – direct and indirect semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Carrier transport: Velocity-electric field relations – drift and diffusion transport - Einstein's relation – Hall effect and devices – Zener and avalanche breakdown in p-n junctions - Ohmic contacts – tunnel diode - Schottky diode – MOS capacitor - power transistor.

**UNIT III MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS 9**

Magnetism in materials – magnetic field and induction – magnetization - magnetic permeability and susceptibility–types of magnetic materials – microscopic classification of magnetic materials - Ferromagnetism: origin and exchange interaction- saturation magnetization and Curie temperature – Domain Theory. Dielectric materials: Polarization processes – dielectric loss – internal field – Clausius-Mosotti relation- dielectric breakdown – high-k dielectrics.

**UNIT IV OPTICAL PROPERTIES OF MATERIALS 9**

Classification of optical materials – carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and Semiconductors (concepts only) - photo current in a P- N diode – solar cell –photo detectors - LED – Organic LED – Laser diodes – excitons - quantum confined Stark effect – quantum dot laser.

**UNIT V NANO-ELECTRONIC DEVICES 9**

Introduction - electron density in bulk material – Size dependence of Fermi energy– quantum confinement – quantum structures - Density of states in quantum well, quantum wire and quantum dot structures –Zener-Bloch oscillations – resonant tunneling – quantum interference effects – mesoscopic structures: conductance fluctuations and coherent transport – Coulomb blockade effects - Single electron phenomena and Single electron Transistor – magnetic semiconductors– spintronics - Carbon nanotubes: Properties and applications.

**TOTAL :45 PERIODS**

**OUTCOMES:**

**At the end of the course, the students will be able to**

- Gain knowledge on classical and quantum electron theories, and energy band structures,
- Acquire knowledge on basics of semiconductor physics and its applications in various devices,
- Get knowledge on magnetic and dielectric properties of materials,
- Have the necessary understanding on the functioning of optical materials for optoelectronics,
- Understand the basics of quantum structures and their applications in spintronics and carbon electronics..

**TEXT BOOKS:**

1. Kasap, S.O. "Principles of Electronic Materials and Devices", McGraw-Hill Education, 2007.
2. Umesh K Mishra & Jasprit Singh, "Semiconductor Device Physics and Design", Springer, 2008.
3. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials". Narosa Publishing House, 2009.

**REFERENCES:**

1. Garcia, N. & Damask, A. "Physics for Computer Science Students". Springer-Verlag, 2012.
2. Hanson, G.W. "Fundamentals of Nanoelectronics". Pearson Education, 2009
3. Rogers, B., Adams, J. & Pennathur, S. "Nanotechnology: Understanding Small Systems". CRC Press, 2014

**OBJECTIVES:**

To impart knowledge on

- Operation of Three phase electrical circuits and power measurement
- Working principles of Electrical Machines
- Working principle of Various measuring instruments

**UNIT I AC CIRCUITS AND POWER SYSTEMS****9**

Three phase power supply – Star connection – Delta connection – Balanced and Unbalanced Loads- Power equation – Star Delta Conversion – Three Phase Power Measurement - Transmission & Distribution of electrical energy – Over head Vs Underground system – Protection of power system – types of tariff – power factor improvement

**UNIT II TRANSFORMER****9**

Introduction - Ideal Transformer – Accounting For Finite Permeability And Core Loss – Circuit Model Of Transformer – Per Unit System – Determination Of Parameters Of Circuit Model Of Transformer – Voltage Regulation – Name Plate Rating – Efficiency – Three Phase Transformers - Auto Transformers

**UNIT III DC MACHINES****9**

Introduction – Constructional Features– Motoring and generation principle - Emf And Torque equation – Circuit Model – Methods of Excitation and magnetisation characteristics – Starting and Speed Control – Universal Motor

**UNIT IV AC MACHINES****9**

Principle of operation of three-phase induction motors – Construction –Types – Equivalent circuit, Single phase Induction motors -Construction– Types–starting and speed control methods. Alternator- working principle–Equation of induced EMF – Voltage regulation, Synchronous motors- working principle-starting methods -- Torque equation – Stepper Motors – Brushless DC Motors

**UNIT V MEASUREMENT AND INSTRUMENTATION****9**

Type of Electrical and electronic instruments – Classification- Types of indicating Instruments – Principles of Electrical Instruments –Multimeters, Oscilloscopes- Static and Dynamic Characteristics of Measurement – Errors in Measurement – Transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect and Mechanical

**TOTAL: 45 PERIODS****OUTCOMES:**

**At the end of the course the students will be able to**

- Understand the concept of three phase power circuits and measurement.
- Comprehend the concepts in electrical generators, motors and transformers
- Choose appropriate measuring instruments for given application

**TEXT BOOKS:**

1. D P Kothari and I.J Nagarath, “Basic Electrical and Electronics Engineering”, McGraw Hill Education(India) Private Limited, Third Reprint ,2016
2. Giorgio Rizzoni, “Principles and Applications of Electrical Engineering”, McGraw Hill Education(India) Private Limited, 2010
3. S.K.Bhattacharya “Basic Electrical and Electronics Engineering”, Pearson India, 2011

**REFERENCES:**

1. Del Toro ,”Electrical Engineering Fundamentals”, Pearson Education, New Delhi, 2015.
2. Leonard S Bobrow, “ Foundations of Electrical Engineering”, Oxford University Press, 2013
3. Rajendra Prasad ,”Fundamentals of Electrical engineering”, Prentice Hall of India, 2006.
4. Mittle N., “Basic Electrical Engineering”, Tata McGraw Hill Edition, 24<sup>th</sup> reprint 2016
5. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, “Basic Electrical Engineering”, McGraw Hill Education(India) Private Limited, 2009

**OBJECTIVES:**

- To introduce the basic concepts of DC and AC circuits behavior
- To study the transient and steady state response of the circuits subjected to step and sinusoidal excitations.
- To introduce different methods of circuit analysis using Network theorems, duality and topology.

**UNIT I BASIC CIRCUITS ANALYSIS AND NETWORK TOPOLOGY 12**

Ohm's Law – Kirchhoff's laws – Mesh current and node voltage method of analysis for D.C and A.C. circuits - Network terminology - Graph of a network - Incidence and reduced incidence matrices – Trees –Cutsets - Fundamental cutsets - Cutset matrix – Tie sets - Link currents and Tie set schedules -Twig voltages and Cutset schedules, Duality and dual networks.

**UNIT II NETWORK THEOREMS FOR DC AND AC CIRCUITS 12**

Network theorems -Superposition theorem, Thevenin's theorem, Norton's theorem, Reciprocity theorem, Millman's theorem, and Maximum power transfer theorem ,application of Network theorems- Network reduction: voltage and current division, source transformation – star delta conversion.

**UNIT III RESONANCE AND COUPLED CIRCUITS 12**

Resonance - Series resonance - Parallel resonance - Variation of impedance with frequency - Variation in current through and voltage across L and C with frequency – Bandwidth - Q factor - Selectivity. Self inductance - Mutual inductance - Dot rule - Coefficient of coupling - Analysis of multiwinding coupled circuits - Series, Parallel connection of coupled inductors - Single tuned and double tuned coupled circuits.

**UNITIV TRANSIENT ANALYSIS 12**

Natural response-Forced response - Transient response of RC, RL and RLC circuits to excitation by Step Signal, Impulse Signal and exponential sources - Complete response of RC, RL and RLC Circuits to sinusoidal excitation.

**UNIT V TWO PORT NETWORKS 12**

Two port networks, Z parameters, Y parameters, Transmission (ABCD) parameters, Hybrid(H) Parameters, Interconnection of two port networks, Symmetrical properties of T and  $\pi$  networks.

**TOTAL : 60 PERIODS****OUTCOMES:**

**At the end of the course, the student should be able to:**

- Develop the capacity to analyze electrical circuits, apply the circuit theorems in real time
- Design and understand and evaluate the AC and DC circuits.

**TEXT BOOKS:**

1. William H. Hayt, Jr. Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuit Analysis", McGraw Hill Science Engineering, Eighth Edition, 11<sup>th</sup> Reprint 2016.
2. Joseph Edminister and Mahmood Nahvi, "Electric Circuits", Schaum's Outline Series, Tata McGraw Hill Publishing Company, New Delhi, Fifth Edition Reprint 2016.

**REFERENCES:**

1. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Fifth Edition, McGraw Hill, 9<sup>th</sup> Reprint 2015.
2. A.Bruce Carlson, "Cicuits: Engineering Concepts and Analysis of Linear Electric Circuits", Cengage Learning, India Edition 2<sup>nd</sup> Indian Reprint 2009.
3. Allan H.Robbins, Wilhelm C.Miller, "Circuit Analysis Theory and Practice", Cengage Learning, Fifth Edition, 1<sup>st</sup> Indian Reprint 2013.

**OBJECTIVES:**

- To acquaint the students with the construction, theory and operation of the basic electronic devices such as PN junction diode, Bipolar and Field effect Transistors, Power control devices, LED, LCD and other Opto-electronic devices

**UNIT I SEMICONDUCTOR DIODE****9**

PN junction diode, Current equations, Energy Band diagram, Diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion Capacitances, Switching Characteristics, Breakdown in PN Junction Diodes.

**UNIT II BIPOLAR JUNCTION TRANSISTORS****9**

NPN -PNP -Operations-Early effect-Current equations – Input and Output characteristics of CE, CB, CC - Hybrid - $\pi$  model - h-parameter model, Ebers Moll Model- Gummel Poon-model, Multi Emitter Transistor.

**UNIT III FIELD EFFECT TRANSISTORS****9**

JFETs – Drain and Transfer characteristics,-Current equations-Pinch off voltage and its significance- MOSFET- Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET- Characteristics – Comparison of MOSFET with JFET.

**UNIT IV SPECIAL SEMICONDUCTOR DEVICES****9**

Metal-Semiconductor Junction- MESFET, FINFET, PINFET, CNTFET, DUAL GATE MOSFET, Schottky barrier diode-Zener diode-Varactor diode –Tunnel diode- Gallium Arsenide device, LASER diode, LDR.

**UNIT V POWER DEVICES AND DISPLAY DEVICES****9**

UJT, SCR, Diac, Triac, Power BJT- Power MOSFET- DMOS-VMOS. LED, LCD, Photo transistor, Opto Coupler, Solar cell, CCD.

**TOTAL : 45 PERIODS****OUTCOMES:****At the end of the course the students will be able to:**

- Explain the V-I characteristic of diode, UJT and SCR
- Describe the equivalence circuits of transistors
- Operate the basic electronic devices such as PN junction diode, Bipolar and Field effect Transistors, Power control devices, LED, LCD and other Opto-electronic devices

**TEXT BOOKS:**

- Donald A Neaman, "Semiconductor Physics and Devices", Fourth Edition, Tata Mc GrawHill Inc. 2012.
- Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, "Electronic Devices and circuits", Third Edition, Tata McGraw- Hill, 2008.

**REFERENCES:**

- Robert Boylestad and Louis Nashelsky, "Electron Devices and Circuit Theory" Pearson Prentice Hall, 10th edition, July 2008.
- R.S.Sedha, " A Text Book of Applied Electronics" S.Chand Publications, 2006.
- Yang, "Fundamentals of Semiconductor devices", McGraw Hill International Edition, 1978.

**OBJECTIVES:**

- To learn the characteristics of basic electronic devices such as Diode, BJT, FET, SCR
  - To understand the working of RL, RC and RLC circuits
  - To gain hand on experience in Thevinin & Norton theorem, KVL & KCL, and Super Position Theorems
1. Characteristics of PN Junction Diode
  2. Zener diode Characteristics & Regulator using Zener diode
  3. Common Emitter input-output Characteristics
  4. Common Base input-output Characteristics
  5. FET Characteristics
  6. SCR Characteristics
  7. Clipper and Clamper & FWR
  8. Verifications Of Thevinin & Norton theorem
  9. Verifications Of KVL & KCL
  10. Verifications Of Super Position Theorem
  11. verifications of maximum power transfer & reciprocity theorem
  12. Determination Of Resonance Frequency of Series & Parallel RLC Circuits
  13. Transient analysis of RL and RC circuits

**LABORATORY REQUIREMENTS**

|  |                         |
|--|-------------------------|
| BC 107, BC 148, 2N2646, BFW10            | - 25 each               |
| 1N4007, Zener diodes                     | - 25 each               |
| Resistors, Capacitors, Inductors         | - sufficient quantities |
| Bread Boards                             | - 15 Nos                |
| CRO (30MHz)                              | - 15 Nos.               |
| Function Generators (3MHz)               | - 10 Nos.               |
| Dual Regulated Power Supplies ( 0 – 30V) | - 10 Nos.               |

**TOTAL : 60 PERIODS****OUTCOMES:****At the end of the course, the student should be able to:**

- Analyze the characteristics of basic electronic devices
- Design RL and RC circuits
- Verify Thevinin & Norton theorem KVL & KCL, and Super Position Theorems

**OBJECTIVES:**

To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

**GROUP A (CIVIL & MECHANICAL)****I CIVIL ENGINEERING PRACTICE****13****Buildings:**

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

**Plumbing Works:**

- (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
- (b) Study of pipe connections requirements for pumps and turbines.
- (c) Preparation of plumbing line sketches for water supply and sewage works.
- (d) Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

- (e) Demonstration of plumbing requirements of high-rise buildings.

**Carpentry using Power Tools only:**

- (a) Study of the joints in roofs, doors, windows and furniture.
- (b) Hands-on-exercise:  
Wood work, joints by sawing, planing and cutting.

**II MECHANICAL ENGINEERING PRACTICE****18****Welding:**

- (a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
- (b) Gas welding practice

**Basic Machining:**

- (a) Simple Turning and Taper turning
- (b) Drilling Practice

**Sheet Metal Work:**

- (a) Forming & Bending:
- (b) Model making – Trays and funnels.
- (c) Different type of joints.

**Machine assembly practice:**

- (a) Study of centrifugal pump
- (b) Study of air conditioner

**Demonstration on:**

- (a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
- (b) Foundry operations like mould preparation for gear and step cone pulley.
- (c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

**GROUP B (ELECTRICAL & ELECTRONICS)****III ELECTRICAL ENGINEERING PRACTICE****13**

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

**IV ELECTRONICS ENGINEERING PRACTICE****16**

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.

2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**On successful completion of this course, the student will be able to**

- Fabricate carpentry components and pipe connections including plumbing works.
- Use welding equipments to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundry and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

**CIVIL**

- |   |          |
|---|----------|
| 1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. | 15 Sets. |
| 2. Carpentry vice (fitted to work bench)  | 15 Nos.  |
| 3. Standard woodworking tools   | 15 Sets. |
| 4. Models of industrial trusses, door joints, furniture joints  | 5 each   |
| 5. Power Tools: (a) Rotary Hammer   | 2 Nos    |
| (b) Demolition Hammer   | 2 Nos    |
| (c) Circular Saw  | 2 Nos    |
| (d) Planer  | 2 Nos    |
| (e) Hand Drilling Machine   | 2 Nos    |
| (f) Jigsaw  | 2 Nos    |

**MECHANICAL**

- |   |           |
|---|-----------|
| 1. Arc welding transformer with cables and holders                            | 5 Nos.    |
| 2. Welding booth with exhaust facility  | 5 Nos.    |
| 3. Welding accessories like welding shield, chipping hammer, wire brush, etc. | 5 Sets.   |
| 4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.    | 2 Nos.    |
| 5. Centre lathe   | 2 Nos.    |
| 6. Hearth furnace, anvil and smithy tools                                     | 2 Sets.   |
| 7. Moulding table, foundry tools  | 2 Sets.   |
| 8. Power Tool: Angle Grinder  | 2 Nos     |
| 9. Study-purpose items: centrifugal pump, air-conditioner                     | One each. |

**ELECTRICAL**

- |   |         |
|---|---------|
| 1. Assorted electrical components for house wiring                  | 15 Sets |
| 2. Electrical measuring instruments                                 | 10 Sets |
| 3. Study purpose items: Iron box, fan and regulator, emergency lamp | 1 each  |
| 4. Megger (250V/500V)   | 1 No.   |
| 5. Power Tools: (a) Range Finder                                    | 2 Nos   |
| (b) Digital Live-wire detector                                      | 2 Nos   |



## **ELECTRONICS**

- |   |         |
|---|---------|
| 1. Soldering guns   | 10 Nos. |
| 2. Assorted electronic components for making circuits                 | 50 Nos. |
| 3. Small PCBs   | 10 Nos. |
| 4. Multimeters  | 10 Nos. |
| 5. Study purpose items: Telephone, FM radio, low-voltage power supply |         |

**MA8352      LINEAR ALGEBRA AND PARTIAL DIFFERENTIAL EQUATIONS      L T P C**  
**4 0 0 4**

### **OBJECTIVES:**

- To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
- To understand the concepts of vector space, linear transformations and diagonalization.
- To apply the concept of inner product spaces in orthogonalization.
- To understand the procedure to solve partial differential equations.
- To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

### **UNIT I      VECTOR SPACES      12**

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.

### **UNIT II      LINEAR TRANSFORMATION AND DIAGONALIZATION      12**

Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of a linear transformations - Eigenvalues and eigenvectors - Diagonalizability.

### **UNIT III      INNER PRODUCT SPACES      12**

Inner product, norms - Gram Schmidt orthogonalization process - Adjoint of linear operations - Least square approximation.

### **UNIT IV      PARTIAL DIFFERENTIAL EQUATIONS      12**

Formation – Solutions of first order equations – Standard types and equations reducible to standard types – Singular solutions – Lagrange's linear equation – Integral surface passing through a given curve – Classification of partial differential equations - Solution of linear equations of higher order with constant coefficients – Linear non-homogeneous partial differential equations.

### **UNIT V      FOURIER SERIES SOLUTIONS OF PARTIAL DIFFERENTIAL EQUATIONS      12**

Dirichlet's conditions – General Fourier series – Half range sine and cosine series - Method of separation of variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates.

**TOTAL: 60 PERIODS**

### **OUTCOMES:**

**Upon successful completion of the course, students should be able to:**

- Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
- Demonstrate accurate and efficient use of advanced algebraic techniques.
- Demonstrate their mastery by solving non - trivial problems related to the concepts and by proving simple theorems about the statements proven by the text.
- Able to solve various types of partial differential equations.  
Able to solve engineering problems using Fourier series.

**TEXTBOOKS:**

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.
2. Friedberg, A.H., Insel, A.J. and Spence, L., "Linear Algebra", Prentice Hall of India, New Delhi, 2004.

**REFERENCES:**

1. Burden, R.L. and Faires, J.D, "Numerical Analysis", 9<sup>th</sup> Edition, Cengage Learning, 2016.
2. James, G. "Advanced Modern Engineering Mathematics", Pearson Education, 2007.
3. Kolman, B. Hill, D.R., "Introductory Linear Algebra", Pearson Education, New Delhi, First Reprint, 2009.
4. Kumaresan, S., "Linear Algebra – A Geometric Approach", Prentice – Hall of India, New Delhi, Reprint, 2010.
5. Lay, D.C., "Linear Algebra and its Applications", 5<sup>th</sup> Edition, Pearson Education, 2015.
6. O'Neil, P.V., "Advanced Engineering Mathematics", Cengage Learning, 2007.
7. Strang, G., "Linear Algebra and its applications", Thomson (Brooks/Cole), New Delhi, 2005.
8. Sundarapandian, V. "Numerical Linear Algebra", Prentice Hall of India, New Delhi, 2008.

**EC8393****FUNDAMENTALS OF DATA STRUCTURES IN C****L T P C****3 0 0 3****OBJECTIVES:**

- To learn the features of C
- To learn the linear and non-linear data structures
- To explore the applications of linear and non-linear data structures
- To learn to represent data using graph data structure
- To learn the basic sorting and searching algorithms

**UNIT I C PROGRAMMING BASICS****9**

Structure of a C program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in C – Managing Input and Output operations – Decision Making and Branching – Looping statements. Arrays – Initialization – Declaration – One dimensional and Two-dimensional arrays. Strings- String operations – String Arrays. Simple programs- sorting-searching – matrix operations.

**UNIT II FUNCTIONS, POINTERS, STRUCTURES AND UNIONS****9**

Functions – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic. Structures and unions - definition – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

**UNIT III LINEAR DATA STRUCTURES****9**

Arrays and its representations – Stacks and Queues – Linked lists – Linked list-based implementation of Stacks and Queues – Evaluation of Expressions – Linked list based polynomial addition.

**UNIT IV NON-LINEAR DATA STRUCTURES****9**

Trees – Binary Trees – Binary tree representation and traversals –Binary Search Trees – Applications of trees. Set representations - Union-Find operations. Graph and its representations – Graph Traversals.

**UNIT V SEARCHING AND SORTING ALGORITHMS****9**

Linear Search – Binary Search. Bubble Sort, Insertion sort – Merge sort – Quick sort - Hash tables – Overflow handling.

**TOTAL: 45 PERIODS**

**OUTCOMES:****Upon completion of the course, students will be able to:**

- Implement linear and non-linear data structure operations using C
- Suggest appropriate linear / non-linear data structure for any given data set.
- Apply hashing concepts for a given problem
- Modify or suggest new data structure for an application
- Appropriately choose the sorting algorithm for an application

**TEXTBOOKS:**

1. Pradip Dey and Manas Ghosh, —Programming in C, Second Edition, Oxford University Press, 2011.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, —Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

**REFERENCES:**

1. Mark Allen Weiss, —Data Structures and Algorithm Analysis in C, Second Edition, Pearson Education, 1996
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, —Data Structures and Algorithms, Pearson Education, 1983.
3. Robert Kruse, C.L.Tondo, Bruce Leung, Shashi Mogalla , — Data Structures and Program Design in C, Second Edition, Pearson Education, 2007
4. Jean-Paul Tremblay and Paul G. Sorenson, —An Introduction to Data Structures with Applications, Second Edition, Tata McGraw-Hill, 1991.

**EC8351****ELECTRONIC CIRCUITS I****L  
3****T  
0****P  
0****C  
3****OBJECTIVES:**

- To understand the methods of biasing transistors
- To design and analyze single stage and multistage amplifier circuits
- To analyze the frequency response of small signal amplifiers
- To design and analyze the regulated DC power supplies.
- To troubleshoot and fault analysis of power supplies.

**UNIT I      BIASING OF DISCRETE BJT, JFET AND MOSFET****9**

BJT– Need for biasing - DC Load Line and Bias Point – DC analysis of Transistor circuits - Various biasing methods of BJT – Bias Circuit Design - Thermal stability - Stability factors - Bias compensation techniques using Diode, thermistor and sensistor – Biasing BJT Switching Circuits- JFET - DC Load Line and Bias Point - Various biasing methods of JFET - JFET Bias Circuit Design - MOSFET Biasing - Biasing FET Switching Circuits.

**UNIT II      BJT AMPLIFIERS****9**

Small Signal Hybrid  $\pi$  equivalent circuit of BJT – Early effect - Analysis of CE, CC and CB amplifiers using Hybrid  $\pi$  equivalent circuits - AC Load Line Analysis- Darlington Amplifier - Bootstrap technique - Cascade, Cascode configurations - Differential amplifier, Basic BJT differential pair – Small signal analysis and CMRR.

**UNIT III      SINGLE STAGE FET, MOSFET AMPLIFIERS****9**

Small Signal Hybrid  $\pi$  equivalent circuit of FET and MOSFET - Analysis of CS, CD and CG amplifiers using Hybrid  $\pi$  equivalent circuits - Basic FET differential pair- BiCMOS circuits.

**UNIT IV FREQUENCY RESPONSE OF AMPLIFIERS****9**

Amplifier frequency response – Frequency response of transistor amplifiers with circuit capacitors – BJT frequency response – short circuit current gain - cut off frequency –  $\alpha$ ,  $\beta$  and unity gain bandwidth – Miller effect - frequency response of FET - High frequency analysis of CE and MOSFET CS amplifier - Transistor Switching Times.

**UNIT V POWER SUPPLIES AND ELECTRONIC DEVICE TESTING****9**

Linear mode power supply - Rectifiers - Filters - Half-Wave Rectifier Power Supply - Full-Wave Rectifier Power Supply - Voltage regulators: Voltage regulation - Linear series, shunt and switching Voltage Regulators - Over voltage protection - BJT and MOSFET – Switched mode power supply (SMPS) - Power Supply Performance and Testing - Troubleshooting and Fault Analysis, Design of Regulated DC Power Supply.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**After studying this course, the student should be able to:**

- Acquire knowledge of
  - Working principles, characteristics and applications of BJT and FET
  - Frequency response characteristics of BJT and FET amplifiers
- Analyze the performance of small signal BJT and FET amplifiers - single stage and multi stage amplifiers
- Apply the knowledge gained in the design of Electronic circuits

**TEXT BOOKS:**

1. Donald. A. Neamen, Electronic Circuits Analysis and Design, 3<sup>rd</sup> Edition, Mc Graw Hill Education (India) Private Ltd., 2010. (Unit I-IV)
2. Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 11<sup>th</sup> Edition, Pearson Education, 2013. (Unit V)

**REFERENCES**

1. Millman J, Halkias.C.and Sathyabrada Jit, Electronic Devices and Circuits, 4<sup>th</sup> Edition, Mc Graw Hill Education (India) Private Ltd., 2015.
2. Salivahanan and N. Suresh Kumar, Electronic Devices and Circuits, 4<sup>th</sup> Edition, , Mc Graw Hill Education (India) Private Ltd., 2017.
3. Floyd, Electronic Devices, Ninth Edition, Pearson Education, 2012.
4. David A. Bell, Electronic Devices & Circuits, 5<sup>th</sup> Edition, Oxford University Press, 2008.
5. Anwar A. Khan and Kanchan K. Dey, A First Course on Electronics, PHI, 2006.
6. Rashid M, Microelectronics Circuits, Thomson Learning, 2007.

**EC8352****SIGNALS AND SYSTEMS**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |

**OBJECTIVES:**

- To understand the basic properties of signal & systems
- To know the methods of characterization of LTI systems in time domain
- To analyze continuous time signals and system in the Fourier and Laplace domain
- To analyze discrete time signals and system in the Fourier and Z transform domain

**UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS****12**

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids\_ Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

**UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 12**  
Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and properties

**UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 12**  
Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

**UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 12**  
Baseband signal Sampling – Fourier Transform of discrete time signals (DTFT) – Properties of DTFT - Z Transform & Properties

**UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 12**  
Impulse response – Difference equations-Convolution sum- Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- To be able to determine if a given system is linear/causal/stable
- Capable of determining the frequency components present in a deterministic signal
- Capable of characterizing LTI systems in the time domain and frequency domain
- To be able to compute the output of an LTI system in the time and frequency domains

**TEXT BOOK:**

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, 2015.(Unit 1-V)

**REFERENCES**

1. B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford, 2009.
2. R.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals & Systems - Continuous and Discrete”, Pearson, 2007.
3. John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.

**EC8392**

**DIGITAL ELECTRONICS**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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**OBJECTIVES:**

- To present the Digital fundamentals, Boolean algebra and its applications in digital systems
- To familiarize with the design of various combinational digital circuits using logic gates
- To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits
- To explain the various semiconductor memories and related technology
- To introduce the electronic circuits involved in the making of logic gates



**OBJECTIVES:**

- To introduce the components and their representation of control systems
- To learn various methods for analyzing the time response, frequency response and stability of the systems.
- To learn the various approach for the state variable analysis.

**UNIT I      SYSTEMS COMPONENTS AND THEIR REPRESENTATION      9**

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-Synchronous -Multivariable control system

**UNIT II      TIME RESPONSE ANALYSIS      9**

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 III      FREQUENCY RESPONSE AND SYSTEM ANALYSIS      9**

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 IV      CONCEPTS OF STABILITY ANALYSIS      9**

Concept of stability-Bounded - Input Bounded - Output stability-Routh stability criterion-Relative stability-Root locus concept-Guidelines for sketching root locus-Nyquist stability criterion.

**UNIT V      CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS      9**

State variable representation-Conversion of state variable models to transfer functions-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:45 PERIODS****OUTCOMES:****Upon completion of the course, the student should be able to:**

- Identify the various control system components and their representations.
- Analyze the various time domain parameters.
- Analysis the various frequency response plots and its system.
- Apply the concepts of various system stability criterions.
- Design various transfer functions of digital control system using state variable models.

**TEXT BOOK:**

1. M.Gopal, "Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012.

**REFERENCES:**

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5<sup>th</sup> Edition, 2007.
2. K. Ogata, 'Modern Control Engineering', 5th edition, PHI, 2012.
3. S.K.Bhattacharya, Control System Engineering, 3rd Edition, Pearson, 2013.
4. Benjamin.C.Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition,1995.

**OBJECTIVES:**

- To understand and implement basic data structures using C
- To apply linear and non-linear data structures in problem solving.
- To learn to implement functions and recursive functions by means of data structures
- To implement searching and sorting algorithms

**LIST OF EXERCISES**

1. Basic C Programs – looping, data manipulations, arrays
2. Programs using strings – string function implementation
3. Programs using structures and pointers
4. Programs involving dynamic memory allocations
5. Array implementation of stacks and queues
6. Linked list implementation of stacks and queues
7. Application of Stacks and Queues
8. Implementation of Trees, Tree Traversals
9. Implementation of Binary Search trees
10. Implementation of Linear search and binary search
11. Implementation Insertion sort, Bubble sort, Quick sort and Merge Sort
12. Implementation Hash functions, collision resolution technique

**TOTAL:60 PERIODS****OUTCOMES:****Upon completion of the course, the students will be able to:**

- Write basic and advanced programs in C
- Implement functions and recursive functions in C
- Implement data structures using C
- Choose appropriate sorting algorithm for an application and implement it in a modularized way

**OBJECTIVES:****The student should be made to:**

- Study the Frequency response of CE, CB and CC Amplifier
- Learn the frequency response of CS Amplifiers
- Study the Transfer characteristics of differential amplifier
- Perform experiment to obtain the bandwidth of single stage and multistage amplifiers
- Perform SPICE simulation of Electronic Circuits
- Design and implement the Combinational and sequential logic circuits

**LIST OF ANALOG EXPERIMENTS:**

1. Design of Regulated Power supplies
2. Frequency Response of CE, CB, CC and CS amplifiers
3. Darlington Amplifier
4. Differential Amplifiers - Transfer characteristics, CMRR Measurement
5. Cascode and Cascade amplifiers
6. Determination of bandwidth of single stage and multistage amplifiers
7. Analysis of BJT with Fixed bias and Voltage divider bias using Spice
8. Analysis of FET, MOSFET with fixed bias, self-bias and voltage divider bias using simulation software like Spice



9. Analysis of Cascode and Cascade amplifiers using Spice
10. Analysis of Frequency Response of BJT and FET using Spice

#### LIST OF DIGITAL EXPERIMENTS

1. Design and implementation of code converters using logic gates(i) BCD to excess-3 code and vice versa (ii) Binary to gray and vice-versa
2. Design and implementation of 4 bit binary Adder/ Subtractor and BCD adder using IC 7483
3. Design and implementation of Multiplexer and De-multiplexer using logic gates
4. Design and implementation of encoder and decoder using logic gates
5. Construction and verification of 4 bit ripple counter and Mod-10 / Mod-12 Ripple counters
6. Design and implementation of 3-bit synchronous up/down counter

**TOTAL : 60 PERIODS**

#### OUTCOMES:

**On completion of this laboratory course, the student should be able to:**

- Design and Test rectifiers, filters and regulated power supplies.
- Design and Test BJT/JFET amplifiers.
- Differentiate cascode and cascade amplifiers.
- Analyze the limitation in bandwidth of single stage and multi stage amplifier
- Measure CMRR in differential amplifier
- Simulate and analyze amplifier circuits using PSpice.
- Design and Test the digital logic circuits.

#### LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS, 2 STUDENTS / EXPERIMENT:

##### S.NO

##### EQUIPMENTS FOR ANALOG LAB

- 1 CRO/DSO (30MHz) – 15 Nos.
- 2 Signal Generator /Function Generators (3 MHz) – 15 Nos
- 3 Dual Regulated Power Supplies ( 0 – 30V) – 15 Nos.
- 4 Standalone desktop PCs with SPICE software – 15 Nos.
- 5 Transistor/FET (BJT-NPN-PNP and NMOS/PMOS) – 50 Nos
- 6 Components and Accessories: Resistors, Capacitors, Inductors, diodes, Zener Diodes, Bread Boards, Transformers.
- 7 SPICE Circuit Simulation Software: (any public domain or commercial software)

##### S.NO

##### EQUIPMENTS FOR DIGITAL LAB

- 1 Dual power supply/ single mode power supply - 15 Nos
- 2 IC Trainer Kit - 15 Nos
- 3 Bread Boards - 15 Nos
- 4 Seven segment display -15 Nos
- 5 Multimeter - 15 Nos
- 6 ICs each 50 Nos  
7400/ 7402 / 7404 / 7486 / 7408 / 7432 / 7483 / 74150 /  
74151 / 74147 / 7445 / 7476/7491/ 555 / 7494 / 7447 / 74180 /  
7485 / 7473 / 74138 / 7411 / 7474

HS8381

**INTERPERSONAL SKILLS/LISTENING&SPEAKING**

| L | T | P | C |
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**OBJECTIVES:**

**The Course will enable learners to:**

- Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities.
- improve general and academic listening skills
- Make effective presentations.

**UNIT I**

Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.

**UNIT II**

Listen to a process information- give information, as part of a simple explanation - conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.

**UNIT III**

Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist- listen for detail

**UNIT IV**

Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures conversational speech listening to and participating in conversations - persuade.

**UNIT V**

Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.

**TOTAL :30PERIODS**

**OUTCOMES:**

**At the end of the course Learners will be able to:**

- Listen and respond appropriately.
- Participate in group discussions
- Make effective presentations
- Participate confidently and appropriately in conversations both formal and informal

## TEXT BOOKS:

1. Brooks, Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.
2. Richards, C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010

## REFERENCES

1. Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
3. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.
4. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
5. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014

**MA8451**

## **PROBABILITY AND RANDOM PROCESSES**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |

### **OBJECTIVES :**

- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in IT fields.
- To understand the concept of correlation and spectral densities.
- To understand the significance of linear systems with random inputs.

### **UNIT I      PROBABILITY AND RANDOM VARIABLES**

**12**

Probability – Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

### **UNIT II      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 III      RANDOM PROCESSES**

**12**

Classification – Stationary process – Markov process - Markov chain - Poisson process – Random telegraph process.

### **UNIT IV      CORRELATION AND SPECTRAL DENSITIES**

**12**

Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties.

### **UNIT V      LINEAR SYSTEMS WITH RANDOM INPUTS**

**12**

Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.

**TOTAL : 60 PERIODS**

**OUTCOMES:**

**Upon successful completion of the course, students should be able to:**

- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept random processes in engineering disciplines.
- Understand and apply the concept of correlation and spectral densities.
- The students will have an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable. Able to analyze the response of random inputs to linear time invariant systems.

**TEXT BOOKS:**

1. Ibe, O.C., "Fundamentals of Applied Probability and Random Processes ", 1<sup>st</sup> Indian Reprint, Elsevier, 2007.
2. Peebles, P.Z., "Probability, Random Variables and Random Signal Principles ", Tata McGraw Hill, 4<sup>th</sup> Edition, New Delhi, 2002.

**REFERENCES:**

1. Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3<sup>rd</sup> Indian Edition, 2012.
2. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes ", Tata McGraw Hill Edition, New Delhi, 2004.
3. Miller. S.L. and Childers. D.G., "Probability and Random Processes with Applications to Signal Processing and Communications ", Academic Press, 2004.
4. Stark. H. and Woods. J.W., "Probability and Random Processes with Applications to Signal Processing ", Pearson Education, Asia, 3<sup>rd</sup> Edition, 2002.
5. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2<sup>nd</sup> Edition, 2012.

**EC8452****ELECTRONIC CIRCUITS II**

| L | T | P | C |
|---|---|---|---|
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**OBJECTIVES:**

- To give a comprehensive exposure to all types of amplifiers and oscillators constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits
- To study about feedback amplifiers and oscillators principles
- To design oscillators.
- To study about turned amplifier.
- To understand the analysis and design of LC and RC oscillators, amplifiers, multi vibrators, power amplifiers and DC convertors.

**UNIT I FEEDBACK AMPLIFIERS AND STABILITY****9**

Feedback Concepts – gain with feedback – effect of feedback on gain stability, distortion, bandwidth, input and output impedances; topologies of feedback amplifiers – analysis of series-series, shunt-shunt and shunt-series feedback amplifiers-stability problem-Gain and Phase-margins-Frequency compensation.

|   |  |                   |
|---|--|-------------------|
| <b>UNIT II</b>  | <b>OSCILLATORS</b>                             | <b>9</b>          |
| Barkhausen criterion for oscillation – phase shift, Wien bridge - Hartley & Colpitt's oscillators – Clapp oscillator-Ring oscillators and crystal oscillators – oscillator amplitude stabilization.   |  |                   |
| <b>UNIT III</b>   | <b>TUNED AMPLIFIERS</b>                        | <b>9</b>          |
| Coil losses, unloaded and loaded Q of tank circuits, small signal tuned amplifiers – Analysis of capacitor coupled single tuned amplifier – double tuned amplifier - effect of cascading single tuned and double tuned amplifiers on bandwidth – Stagger tuned amplifiers - Stability of tuned amplifiers – Neutralization - Hazeltine neutralization method. |  |                   |
| <b>UNIT IV</b>  | <b>WAVE SHAPING AND MULTIVIBRATOR CIRCUITS</b> | <b>9</b>          |
| Pulse circuits – attenuators – RC integrator and differentiator circuits – diode clampers and clippers –Multivibrators - Schmitt Trigger- UJT Oscillator.   |  |                   |
| <b>UNIT V</b>   | <b>POWER AMPLIFIERS AND DC CONVERTERS</b>      | <b>9</b>          |
| Power amplifiers- class A-Class B-Class AB-Class C-Power MOSFET-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design   |  |                   |
| <b>TOTAL:</b>   |  | <b>45 PERIODS</b> |

**OUTCOMES:**

**Upon completion of the course, the student should be able to:**

- Analyze different types of amplifier, oscillator and multivibrator circuits
- Design BJT amplifier and oscillator circuits
- Analyze transistorized amplifier and oscillator circuits
- Design and analyze feedback amplifiers
- Design LC and RC oscillators, tuned amplifiers, wave shaping circuits, multivibrators, power amplifier and DC convertors.

**TEXT BOOKS:**

1. Sedra and Smith, "Micro Electronic Circuits"; Sixth Edition, Oxford University Press, 2011. (UNIT I, III,IV,V)
2. Jacob Millman, 'Microelectronics', McGraw Hill, 2nd Edition, Reprinted, 2009. (UNIT I,II,IV,V)

**REFERENCES:**

1. Robert L. Boylestad and Louis Nasheresky, "Electronic Devices and Circuit Theory", 10th Edition, Pearson Education / PHI, 2008
2. David A. Bell, "Electronic Devices and Circuits", Fifth Edition, Oxford University Press, 2008.
3. Millman J. and Taub H., "Pulse Digital and Switching Waveforms", TMH, 2000.
4. Millman and Halkias. C., Integrated Electronics, TMH, 2007.

**OBJECTIVES:**

- To introduce the concepts of various analog modulations and their spectral characteristics
- To understand the properties of random process
- To know the effect of noise on communication systems
- To know the principles of sampling & quantization

**UNIT I AMPLITUDE MODULATION****9**

Amplitude Modulation- DSBSC, DSBFC, SSB, VSB - Modulation index, Spectra, Power relations and Bandwidth – AM Generation – Square law and Switching modulator, DSBSC Generation – Balanced and Ring Modulator, SSB Generation – Filter, Phase Shift and Third Methods, VSB Generation – Filter Method, Hilbert Transform, Pre-envelope & complex envelope –comparison of different AM techniques, Superheterodyne Receiver

**UNIT II ANGLE MODULATION****9**

Phase and frequency modulation, Narrow Band and Wide band FM – Modulation index, Spectra, Power relations and Transmission Bandwidth - FM modulation –Direct and Indirect methods, FM Demodulation – FM to AM conversion, FM Discriminator - PLL as FM Demodulator.

**UNIT III RANDOM PROCESS****9**

Random variables, Random Process, Stationary Processes, Mean, Correlation & Covariance functions, Power Spectral Density, Ergodic Processes, Gaussian Process, Transmission of a Random Process Through a LTI filter.

**UNIT IV NOISE CHARACTERIZATION****9**

Noise sources – Noise figure, noise temperature and noise bandwidth – Noise in cascaded systems. Representation of Narrow band noise –In-phase and quadrature, Envelope and Phase – Noise performance analysis in AM & FM systems – Threshold effect, Pre-emphasis and de-emphasis for FM.

**UNIT V SAMPLING & QUANTIZATION****9**

Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - quantization noise - Logarithmic Companding –PAM, PPM, PWM, PCM – TDM, FDM.

**TOTAL: 45 PERIODS****OUTCOMES:****At the end of the course, the student should be able to:**

- Design AM communication systems
- Design Angle modulated communication systems
- Apply the concepts of Random Process to the design of Communication systems
- Analyze the noise performance of AM and FM systems
- Gain knowledge in sampling and quantization

**TEXT BOOKS:**

1. J.G.Proakis, M.Salehi, "Fundamentals of Communication Systems", Pearson Education 2014. (UNIT I-IV)
2. Simon Haykin, "Communication Systems", 4th Edition, Wiley, 2014.(UNIT I-V)

**REFERENCES:**

1. B.P.Lathi, "Modern Digital and Analog Communication Systems", 3rd Edition, Oxford University Press, 2007.
2. D.Roody, J.Coolen, —Electronic Communications, 4th edition PHI 2006
3. A.Papoulis, "Probability, Random variables and Stochastic Processes", McGraw Hill, 3<sup>rd</sup> edition, 1991.
4. B.Sklar, "Digital Communications Fundamentals and Applications", 2nd Edition Pearson Education 2007
5. H P Hsu, Schaum Outline Series - "Analog and Digital Communications" TMH 2006
6. Couch.L., "Modern Communication Systems", Pearson, 2001.

**EC8451****ELECTROMAGNETIC FIELDS**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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**OBJECTIVES:**

- To gain conceptual and basic mathematical understanding of electric and magnetic fields in free space and in materials
- To understand the coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations
- To understand wave propagation in lossless and in lossy media
- To be able to solve problems based on the above concepts

**UNIT I INTRODUCTION****12**

Electromagnetic model, Units and constants, Review of vector algebra, Rectangular, cylindrical and spherical coordinate systems, Line, surface and volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Null identities, Helmholtz's theorem

**UNIT II ELECTROSTATICS****12**

Electric field, Coulomb's law, Gauss's law and applications, Electric potential, Conductors in static electric field, Dielectrics in static electric field, Electric flux density and dielectric constant, Boundary conditions, Capacitance, Parallel, cylindrical and spherical capacitors, Electrostatic energy, Poisson's and Laplace's equations, Uniqueness of electrostatic solutions, Current density and Ohm's law, Electromotive force and Kirchhoff's voltage law, Equation of continuity and Kirchhoff's current law

**UNIT III MAGNETOSTATICS****12**

Lorentz force equation, Law of no magnetic monopoles, Ampere's law, Vector magnetic potential, Biot-Savart law and applications, Magnetic field intensity and idea of relative permeability, Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance and inductors, Magnetic energy, Magnetic forces and torques

**UNIT IV TIME-VARYING FIELDS AND MAXWELL'S EQUATIONS****12**

Faraday's law, Displacement current and Maxwell-Ampere law, Maxwell's equations, Potential functions, Electromagnetic boundary conditions, Wave equations and solutions, Time-harmonic fields

**UNIT V PLANE ELECTROMAGNETIC WAVES****12**

Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity, Electromagnetic power flow and Poynting vector, Normal incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary

**TOTAL:60 PERIODS**





#### **UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS**

**9**

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters, Sigma – Delta converters.

#### **UNIT V WAVEFORM GENERATORS AND SPECIAL FUNCTION ICs**

**9**

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop – Out(LDO) Regulators - Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC.

**TOTAL:45 PERIODS**

#### **OUTCOMES:**

**Upon completion of the course, the student should be able to:**

- Design linear and non linear applications of OP – AMPS
- Design applications using analog multiplier and PLL
- Design ADC and DAC using OP – AMPS
- Generate waveforms using OP – AMP Circuits
- Analyze special function ICs

#### **TEXT BOOKS:**

1. D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd., 2018, Fifth Edition. (Unit I – V)
2. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, 4th Edition, Tata Mc Graw-Hill, 2016 (Unit I – V)

#### **REFERENCES:**

1. Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, 4th Edition, Prentice Hall / Pearson Education, 2015.
2. Robert F.Coughlin, Frederick F.Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, Sixth Edition, PHI, 2001.
3. B.S.Sonde, “System design using Integrated Circuits” , 2nd Edition, New Age Pub, 2001.
4. Gray and Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley International,5<sup>th</sup> Edition, 2009.
5. William D.Stanley, “Operational Amplifiers with Linear Integrated Circuits”, Pearson Education,4<sup>th</sup> Edition,2001.
6. S.Salivahanan & V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”, TMH,2<sup>nd</sup> Edition, 4<sup>th</sup> Reprint, 2016.

**OBJECTIVES:**

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

**UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY****14**

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

**UNIT II ENVIRONMENTAL POLLUTION****8**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

**UNIT III NATURAL RESOURCES****10**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

**UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT****7**

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

**UNIT V HUMAN POPULATION AND THE ENVIRONMENT****6**

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

**TOTAL: 45 PERIODS****OUTCOMES:**

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

**TEXTBOOKS:**

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2<sup>nd</sup> edition, Pearson Education, 2004.

**REFERENCES :**

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015.
3. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
4. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.

|               |  |          |          |          |          |
|---------------|--|----------|----------|----------|----------|
| <b>EC8461</b> | <b>CIRCUITS DESIGN AND SIMULATION LABORATORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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**OBJECTIVES:**

- To gain hands on experience in designing electronic circuits
- To learn simulation software used in circuit design
- To learn the fundamental principles of amplifier circuits
- To differentiate feedback amplifiers and oscillators.
- To differentiate the operation of various multivibrators

## DESIGN AND ANALYSIS OF THE FOLLOWING CIRCUITS

1. Series and Shunt feedback amplifiers-Frequency response, Input and output impedance
2. RC Phase shift oscillator and Wien Bridge Oscillator
3. Hartley Oscillator and Colpitts Oscillator
4. Single Tuned Amplifier
5. RC Integrator and Differentiator circuits
6. Astable and Monostable multivibrators
7. Clippers and Clampers

### SIMULATION USING SPICE (Using Transistor):

1. Tuned Collector Oscillator
2. Twin -T Oscillator / Wein Bridge Oscillator
3. Double and Stagger tuned Amplifiers
4. Bistable Multivibrator
5. Schmitt Trigger circuit with Predictable hysteresis
6. Analysis of power amplifier

**TOTAL: 60 PERIODS**

### OUTCOMES:

**On completion of this laboratory course, the student should be able to:**

- Analyze various types of feedback amplifiers
- Design oscillators, tuned amplifiers, wave-shaping circuits and multivibrators
- Design and simulate feedback amplifiers, oscillators, tuned amplifiers, wave-shaping circuits and multivibrators using SPICE Tool.

### LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS / 2 STUDENTS PER EXPERIMENT:

| S.NO | EQUIPMENTS                                    |          |
|------|---|----------|
| 1    | CRO (Min 30MHz)                               | - 15 Nos |
| 2    | Signal Generator /Function Generators (2 MHz) | - 15 Nos |
| 3    | Dual Regulated Power Supplies (0 – 30V)       | - 15 Nos |
| 4    | Digital Multimeter                            | - 15 Nos |
| 5    | Digital LCR Meter                             | - 2 Nos  |
| 6    | Standalone desktops PC                        | - 15 Nos |
| 7    | Transistor/FET (BJT-NPN-PNP and NMOS/PMOS)    | - 50 Nos |

### Components and Accessories:

Transistors, Resistors, Capacitors, Inductors, diodes, Zener Diodes, Bread Boards, Transformers.  
SPICE Circuit Simulation Software: (any public domain or commercial software)

**OBJECTIVES:**

- To understand the basics of linear integrated circuits and available ICs
- To understand the characteristics of the operational amplifier.
- To apply operational amplifiers in linear and nonlinear applications.
- To acquire the basic knowledge of special function IC.
- To use SPICE software for circuit design

**DESIGN AND TESTING OF THE FOLLOWING CIRCUITS**

1. Inverting, Non inverting and differential amplifiers.
2. Integrator and Differentiator.
3. Instrumentation amplifier
4. Active low-pass, High-pass and band-pass filters.
5. Astable & Monostable multivibrators using Op-amp
6. Schmitt Trigger using op-amp.
7. Phase shift and Wien bridge oscillators using Op-amp.
8. Astable and Monostable multivibrators using NE555 Timer.
9. PLL characteristics and its use as Frequency Multiplier, Clock synchronization
10. R-2R Ladder Type D- A Converter using Op-amp.
11. DC power supply using LM317 and LM723.
12. Study of SMPS

**SIMULATION USING SPICE:**

1. Active low-pass, High-pass and band-pass filters using Op-amp
2. Astable and Monostable multivibrators using NE555 Timer.
3. A/ D converter
4. Analog multiplier

**TOTAL: 60 PERIODS****OUTCOMES:****On completion of this laboratory course, the student should be able to:**

- Design amplifiers, oscillators, D-A converters using operational amplifiers.
- Design filters using op-amp and performs an experiment on frequency response.
- Analyze the working of PLL and describe its application as a frequency multiplier.
- Design DC power supply using ICs.
- Analyze the performance of filters, multivibrators, A/D converter and analog multiplier using SPICE.

**LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS / 2 STUDENTS PER EXPERIMENT:**

| S.NO | EQUIPMENTS                                    |           |
|------|---|-----------|
| 1    | CRO/DSO (Min 30MHz)                           | -- 15 Nos |
| 2    | Signal Generator /Function Generators (2 MHz) | - 15 Nos  |
| 3    | Dual Regulated Power Supplies (0 – 30V)       | -- 15 Nos |
| 4    | Digital Multimeter                            | -- 15 Nos |
| 5    | IC Tester                                     | -- 5 Nos  |
| 6    | Standalone desktops PC                        | -- 15 Nos |
| 7    | Components and Accessories                    | - 50 Nos  |

**Components and Accessories:**

Transistors, Resistors, Capacitors, diodes, Zener diodes, Bread Boards, Transformers, wires, Power transistors, Potentiometer, A/D and D/A convertors, LEDs .

**Note:** Op-Amps  $\mu$ A741, LM 301, LM311, LM 324, LM317, LM723, 7805, 7812, 2N3524, 2N3525, 2N3391, AD 633, LM 555, LM 565 may be used.

|               |                              |          |          |          |          |
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| <b>EC8501</b> | <b>DIGITAL COMMUNICATION</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                              | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To study the limits set by Information Theory
- To study the various waveform coding schemes
- To learn the various baseband transmission schemes
- To understand the various band pass signaling schemes
- To know the fundamentals of channel coding

**UNIT I INFORMATION THEORY 9**

Discrete Memoryless source, Information, Entropy, Mutual Information - Discrete Memoryless channels – Binary Symmetric Channel, Channel Capacity - Hartley - Shannon law - Source coding theorem - Shannon - Fano & Huffman codes.

**UNIT II WAVEFORM CODING & REPRESENTATION 9**

Prediction filtering and DPCM - Delta Modulation - ADPCM & ADM principles-Linear Predictive Coding- Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ – Bipolar NRZ - Manchester

**UNIT III BASEBAND TRANSMISSION & RECEPTION 9**

ISI – Nyquist criterion for distortion less transmission – Pulse shaping – Correlative coding - Eye pattern – Receiving Filters- Matched Filter, Correlation receiver, Adaptive Equalization

**UNIT IV DIGITAL MODULATION SCHEME 9**

Geometric Representation of signals - Generation, detection, PSD & BER of Coherent BPSK, BFSK & QPSK - QAM - Carrier Synchronization - Structure of Non-coherent Receivers - Principle of DPSK.

**UNIT V ERROR CONTROL CODING 9**

Channel coding theorem - Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes - Viterbi Decoder.

**TOTAL:45 PERIODS****OUTCOMES:**

**Upon completion of the course, the student should be able to**

- Design PCM systems
- Design and implement base band transmission schemes
- Design and implement band pass signaling schemes
- Analyze the spectral characteristics of band pass signaling schemes and their noise performance
- Design error control coding schemes

**TEXT BOOK:**

1. S. Haykin, "Digital Communications", John Wiley, 2005 (Unit I –V)

**REFERENCES**

1. B. Sklar, "Digital Communication Fundamentals and Applications", 2nd Edition, Pearson Education, 2009
2. B.P.Lathi, "Modern Digital and Analog Communication Systems" 3rd Edition, Oxford University Press 2007.
3. H P Hsu, Schaum Outline Series - "Analog and Digital Communications", TMH 2006
4. J.G Proakis, "Digital Communication", 4th Edition, Tata Mc Graw Hill Company, 2001.

**EC8553****DISCRETE-TIME SIGNAL PROCESSING**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |

**OBJECTIVES:**

- To learn discrete fourier transform, properties of DFT and its application to linear filtering
- 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
- To understand the effects of finite precision representation on digital filters
- To understand the fundamental concepts of multi rate signal processing and its applications
- To introduce the concepts of adaptive filters and its application to communication engineering

**UNIT I DISCRETE FOURIER TRANSFORM 12**

Review of signals and systems, 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). Linear filtering using FFT.

**UNIT II INFINITE IMPULSE RESPONSE FILTERS 12**

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 12**

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 12**

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 INTRODUCTION TO DIGITAL SIGNAL PROCESSORS****12**

DSP functionalities - circular buffering – DSP architecture – Fixed and Floating point architecture principles – Programming – Application examples.

**TOTAL:60PERIODS****OUTCOMES:****At the end of the course, the student should be able to**

- Apply DFT for the analysis of digital signals and systems
- Design IIR and FIR filters
- Characterize the effects of finite precision representation on digital filters
- Design multirate filters
- Apply adaptive filters appropriately in communication systems

**TEXT BOOK:**

1. John G. Proakis & Dimitris G. Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth Edition, Pearson Education / Prentice Hall, 2007. (UNIT I – V)

**REFERENCES:**

1. Emmanuel C. Ifeakor & Barrie. W. Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002.
2. A. V. Oppenheim, R.W. Schaffer and J.R. Buck, "Discrete-Time Signal Processing", 8th Indian Reprint, Pearson, 2004.
3. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Tata Mc Graw Hill, 2007.
4. Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2006.

**EC8552****COMPUTER ARCHITECTURE AND ORGANIZATION****L T P C  
3 0 0 3****OBJECTIVES:**

- To make students understand the basic structure and operation of digital computer
- To familiarize with implementation of fixed point and floating-point arithmetic operations
- To study the design of data path unit and control unit for processor
- To understand the concept of various memories and interfacing
- To introduce the parallel processing technique

**UNIT I COMPUTER ORGANIZATION & INSTRUCTIONS****9**

Basics of a computer system: Evolution, Ideas, Technology, Performance, Power wall, Uniprocessors to Multiprocessors. Addressing and addressing modes. Instructions: Operations and Operands, Representing instructions, Logical operations, control operations.

**UNIT II ARITHMETIC****9**

Fixed point Addition, Subtraction, Multiplication and Division. Floating Point arithmetic, High performance arithmetic, Subword parallelism

**UNIT III THE PROCESSOR****9**

Introduction, Logic Design Conventions, Building a Datapath - A Simple Implementation scheme - An Overview of Pipelining - Pipelined Datapath and Control. Data Hazards: Forwarding versus Stalling, Control Hazards, Exceptions, Parallelism via Instructions.



**UNIT IV MEMORY AND I/O ORGANIZATION 9**

Memory hierarchy, Memory Chip Organization, Cache memory, Virtual memory. Parallel Bus Architectures, Internal Communication Methodologies, Serial Bus Architectures, Mass storage, Input and Output Devices.

**UNIT V ADVANCED COMPUTER ARCHITECTURE 9**

Parallel processing architectures and challenges, Hardware multithreading, Multicore and shared memory multiprocessors, Introduction to Graphics Processing Units, Clusters and Warehouse scale computers - Introduction to Multiprocessor network topologies.

**TOTAL:45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to**

- Describe data representation, instruction formats and the operation of a digital computer
- Illustrate the fixed point and floating-point arithmetic for ALU operation
- Discuss about implementation schemes of control unit and pipeline performance
- Explain the concept of various memories, interfacing and organization of multiple processors
- Discuss parallel processing technique and unconventional architectures

**TEXT BOOKS:**

1. David A. Patterson and John L. Hennessey, "Computer Organization and Design", Fifth edition, Morgan Kauffman / Elsevier, 2014. (UNIT I-V)
2. Miles J. Murdocca and Vincent P. Heuring, "Computer Architecture and Organization: An Integrated approach", Second edition, Wiley India Pvt Ltd, 2015 (UNIT IV,V)

**REFERENCES**

1. V. Carl Hamacher, Zvonko G. Varanescic and Safat G. Zaky, "Computer Organization", Fifth edition, Mc Graw-Hill Education India Pvt Ltd, 2014.
2. William Stallings "Computer Organization and Architecture", Seventh Edition, Pearson Education, 2006.
3. Govindarajalu, "Computer Architecture and Organization, Design Principles and Applications", Second edition, McGraw-Hill Education India Pvt Ltd, 2014.

|               |                               |          |          |          |          |
|---------------|-------------------------------|----------|----------|----------|----------|
| <b>EC8551</b> | <b>COMMUNICATION NETWORKS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                               | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

**The student should be made to:**

- Understand the division of network functionalities into layers.
- Be familiar with the components required to build different types of networks
- Be exposed to the required functionality at each layer
- Learn the flow control and congestion control algorithms

**UNIT I FUNDAMENTALS & LINK LAYER 9**

Overview of Data Communications- Networks – Building Network and its types– Overview of Internet - Protocol Layering - OSI Mode – Physical Layer – Overview of Data and Signals - introduction to Data Link Layer - Link layer Addressing- Error Detection and Correction

**UNIT II MEDIA ACCESS & INTERNETWORKING 9**

Overview of Data link Control and Media access control - Ethernet (802.3) - Wireless LANs – Available Protocols – Bluetooth – Bluetooth Low Energy – WiFi – 6LowPAN–Zigbee - Network layer services – Packet Switching – IPV4 Address – Network layer protocols ( IP, ICMP, Mobile IP)

**UNIT III ROUTING 9**

Routing - Unicast Routing – Algorithms – Protocols – Multicast Routing and its basics – Overview of Intradomain and interdomain protocols – Overview of IPv6 Addressing – Transition from IPv4 to IPv6

**UNIT IV TRANSPORT LAYER 9**

Introduction to Transport layer –Protocols- User Datagram Protocols (UDP) and Transmission Control Protocols (TCP) –Services – Features – TCP Connection – State Transition Diagram – Flow, Error and Congestion Control - Congestion avoidance (DECbit, RED) – QoS – Application requirements

**UNIT V APPLICATION LAYER 9**

Application Layer Paradigms – Client Server Programming – World Wide Web and HTTP - DNS- - Electronic Mail (SMTP, POP3, IMAP, MIME) – Introduction to Peer to Peer Networks – Need for Cryptography and Network Security – Firewalls.

**TOTAL:45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Identify the components required to build different types of networks
- Choose the required functionality at each layer for given application
- Identify solution for each functionality at each layer
- Trace the flow of information from one node to another node in the network

**TEXT BOOK:**

1. Behrouz A. Forouzan, “Data communication and Networking”, Fifth Edition, Tata McGraw – Hill, 2013 (UNIT I –V)

**REFERENCES**

1. James F. Kurose, Keith W. Ross, “Computer Networking - A Top-Down Approach Featuring the Internet”, Seventh Edition, Pearson Education, 2016.
2. Nader. F. Mir,“ Computer and Communication Networks”, Pearson Prentice Hall Publishers, 2<sup>nd</sup> Edition, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, Mc Graw Hill Publisher, 2011.
4. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers, 2011.

**EC8562                      DIGITAL SIGNAL PROCESSING LABORATORY                      L   T   P   C**  
**0   0   4   2**

**OBJECTIVES:**

**The student should be made:**

- To perform basic signal processing operations such as Linear Convolution, Circular Convolution, Auto Correlation, Cross Correlation and Frequency analysis in MATLAB
- To implement FIR and IIR filters in MATLAB and DSP Processor
- To study the architecture of DSP processor
- To design a DSP system to demonstrate the Multi-rate and Adaptive signal processing concepts.

**LIST OF EXPERIMENTS: MATLAB / EQUIVALENT SOFTWARE PACKAGE**

1. Generation of elementary Discrete-Time sequences
2. Linear and Circular convolutions
3. Auto correlation and Cross Correlation
4. Frequency Analysis using DFT
5. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation
6. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations

**DSP PROCESSOR BASED IMPLEMENTATION**

1. Study of architecture of Digital Signal Processor
2. Perform MAC operation using various addressing modes
3. Generation of various signals and random noise
4. Design and demonstration of FIR Filter for Low pass, High pass, Band pass and Band stop filtering
5. Design and demonstration of Butter worth and Chebyshev IIR Filters for Low pass, High pass, Band pass and Band stop filtering
6. Implement an Up-sampling and Down-sampling operation in DSP Processor

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Carryout basic signal processing operations
- Demonstrate their abilities towards MATLAB based implementation of various DSP systems
- Analyze the architecture of a DSP Processor
- Design and Implement the FIR and IIR Filters in DSP Processor for performing filtering operation over real-time signals
- Design a DSP system for various applications of DSP

**EC8561                      COMMUNICATION SYSTEMS LABORATORY                      L   T   P   C**  
**0   0   4   2**

**OBJECTIVES:**

**The student should be made:**

- To visualize the effects of sampling and TDM
- To Implement AM & FM modulation and demodulation
- To implement PCM & DM
- To simulate Digital Modulation schemes
- To simulate Error control coding schemes

## LIST OF EXPERIMENTS:

1. Signal Sampling and reconstruction
2. Time Division Multiplexing
3. AM Modulator and Demodulator
4. FM Modulator and Demodulator
5. Pulse Code Modulation and Demodulation
6. Delta Modulation and Demodulation
7. Line coding schemes
8. Simulation of ASK, FSK, and BPSK generation schemes
9. Simulation of DPSK, QPSK and QAM generation schemes
10. Simulation of signal constellations of BPSK, QPSK and QAM
11. Simulation of ASK, FSK and BPSK detection schemes
12. Simulation of Linear Block and Cyclic error control coding schemes
13. Simulation of Convolutional coding scheme
14. Communication link simulation

**TOTAL: 60 PERIODS**

## OUTCOMES:

**At the end of the course, the student should be able to:**

- Simulate & validate the various functional modules of a communication system
- Demonstrate their knowledge in base band signaling schemes through implementation of digital modulation schemes
- Apply various channel coding schemes & demonstrate their capabilities towards the improvement of the noise performance of communication system
- Simulate end-to-end communication Link

## LAB Requirements for a Batch of 30 students (3 students per experiment):

- i) Kits for Signal Sampling, TDM, AM, FM, PCM, DM and Line Coding Schemes
- ii) CROs/DSOs – 15 Nos, Function Generators – 15 Nos.
- iii) MATLAB or equivalent software package for simulation experiments
- iv) PCs - 15 Nos

**EC8563**

**COMMUNICATION NETWORKS LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

## OBJECTIVES:

**The student should be made to:**

- Learn to communicate between two desktop computers
- Learn to implement the different protocols
- Be familiar with IP Configuration
- Be familiar with the various routing algorithms
- Be familiar with simulation tools

## LIST OF EXPERIMENTS:

1. Implementation of Error Detection / Error Correction Techniques
2. Implementation of Stop and Wait Protocol and sliding window
3. Implementation and study of Goback-N and selective repeat protocols
4. Implementation of High Level Data Link Control
5. Implementation of IP Commands such as ping, Traceroute, nslookup.
6. Implementation of IP address configuration.
7. To create scenario and study the performance of network with CSMA / CA protocol and compare with CSMA/CD protocols.
8. Network Topology - Star, Bus, Ring

9. Implementation of distance vector routing algorithm
10. Implementation of Link state routing algorithm
11. Study of Network simulator (NS) and simulation of Congestion Control Algorithms using NS
12. Implementation of Encryption and Decryption Algorithms using any programming language

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Communicate between two desktop computers
- Implement the different protocols
- Program using sockets.
- Implement and compare the various routing algorithms
- Use the simulation tool.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

**SOFTWARE**

- C / Python / Java / Equivalent Compiler
- MATLAB SOFTWARE (Few experiments can be practiced with MATLAB)
- Standard LAN Trainer Kits 4 Nos
- Network simulator like NS2/ NS3 / Glomosim/OPNET/ 30 Equivalent

**HARDWARE**

Standalone Desktops 30 Nos

**EC8691**

**MICROPROCESSORS AND MICROCONTROLLERS**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To understand the Architecture of 8086 microprocessor.
- To learn the design aspects of I/O and Memory Interfacing circuits.
- To interface microprocessors with supporting chips.
- To study the Architecture of 8051 microcontroller.
- To design a microcontroller based system

**UNIT I THE 8086 MICROPROCESSOR**

**9**

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

**UNIT II 8086 SYSTEM BUS STRUCTURE**

**9**

8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

**UNIT III I/O INTERFACING**

**9**

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

**UNIT IV MICROCONTROLLER****9**

Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Assembly language programming.

**UNIT V INTERFACING MICROCONTROLLER****9**

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors

**TOTAL: 45 PERIODS****OUTCOMES:**

**At the end of the course, the students should be able to:**

- Understand and execute programs based on 8086 microprocessor.
- Design Memory Interfacing circuits.
- Design and interface I/O circuits.
- Design and implement 8051 microcontroller based systems.

**TEXT BOOKS:**

1. Yu-Cheng Liu, Glenn A.Gibson, “Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design”, Second Edition, Prentice Hall of India, 2007. (UNIT I-III)
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson education, 2011. (UNIT IV-V)

**REFERENCES:**

1. Doughlas V.Hall, “Microprocessors and Interfacing, Programming and Hardware”,TMH,2012
2. A.K.Ray,K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" 3<sup>rd</sup> edition, Tata McGrawHill, 2012

**EC8095****VLSI DESIGN**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- Study the fundamentals of CMOS circuits and its characteristics.
- Learn the design and realization of combinational & sequential digital circuits.
- Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed
- Learn the different FPGA architectures and testability of VLSI circuits.

**UNIT I INTRODUCTION TO MOS TRANSISTOR****9**

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

**UNIT II COMBINATIONAL MOS LOGIC CIRCUITS****9**

**Circuit Families:** Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls.

**Power:** Dynamic Power, Static Power, Low Power Architecture.

**UNIT III SEQUENTIAL CIRCUIT DESIGN 9**

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits.

**Timing Issues :** Timing Classification Of Digital System, Synchronous Design.

**UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9**

**Arithmetic Building Blocks:** Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff.

**Designing Memory and Array structures:** Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

**UNIT V IMPLEMENTATION STRATEGIES AND TESTING 9**

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: *Ad Hoc* Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**UPON COMPLETION OF THE COURSE, STUDENTS SHOULD be ABLE TO**

- Realize the concepts of digital building blocks using MOS transistor.
- Design combinational MOS circuits and power strategies.
- Design and construct Sequential Circuits and Timing systems.
- Design arithmetic building blocks and memory subsystems.
- Apply and implement FPGA design flow and testing.

**TEXT BOOKS:**

1. Neil H.E. Weste, David Money Harris "CMOS VLSI Design: A Circuits and Systems Perspective", 4<sup>th</sup> Edition, Pearson , 2017 (UNIT I,II,V)
2. Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic, "Digital Integrated Circuits:A Design perspective", Second Edition , Pearson , 2016.(UNIT III,IV)

**REFERENCES**

1. M.J. Smith, "Application Specific Integrated Circuits", Addison Wesley, 1997
2. Sung-Mo kang, Yusuf Iblebici, Chulwoo Kim "CMOS Digital Integrated Circuits:Analysis & Design", 4<sup>th</sup> edition McGraw Hill Education,2013
3. Wayne Wolf, "Modern VLSI Design: System On Chip", Pearson Education, 2007
4. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India 2005.

**EC8652**

**WIRELESS COMMUNICATION**

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**OBJECTIVES:**

- To study the characteristic of wireless channel
- To understand the design of a cellular system
- To study the various digital signaling techniques and multipath mitigation techniques
- To understand the concepts of multiple antenna techniques

**UNIT I WIRELESS CHANNELS 9**

Large scale path loss – Path loss models: Free Space and Two-Ray models -Link Budget design – Small scale fading- Parameters of mobile multipath channels – Time dispersion parameters-Coherence bandwidth – Doppler spread & Coherence time, fading due to Multipath time delay spread – flat fading – frequency selective fading – Fading due to Doppler spread – fast fading – slow fading.

**UNIT II CELLULAR ARCHITECTURE 9**

Multiple Access techniques - FDMA, TDMA, CDMA – Capacity calculations–Cellular concept- Frequency reuse - channel assignment- hand off- interference & system capacity-trunking & grade of service – Coverage and capacity improvement.

**UNIT III DIGITAL SIGNALING FOR FADING CHANNELS 9**

Structure of a wireless communication link, Principles of Offset-QPSK, p/4-DQPSK, Minimum Shift Keying, Gaussian Minimum Shift Keying, Error performance in fading channels, OFDM principle – Cyclic prefix, Windowing, PAPR.

**UNIT IV MULTIPATH MITIGATION TECHNIQUES 9**

Equalisation – Adaptive equalization, Linear and Non-Linear equalization, Zero forcing and LMS Algorithms. Diversity – Micro and Macro diversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver.

**UNIT V MULTIPLE ANTENNA TECHNIQUES 9**

MIMO systems – spatial multiplexing -System model -Pre-coding - Beam forming - transmitter diversity, receiver diversity- Channel state information-capacity in fading and non-fading channels.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**The student should be able to:**

- Characterize a wireless channel and evolve the system design specifications
- Design a cellular system based on resource availability and traffic demands
- Identify suitable signaling and multipath mitigation techniques for the wireless channel and system under consideration.

**TEXT BOOKS:**

1. Rappaport,T.S., —Wireless communicationsII, Pearson Education, Second Edition, 2010.(UNIT I, II, IV)
2. Andreas.F. Molisch, —Wireless CommunicationsII, John Wiley – India, 2006. (UNIT III,V)

**REFERENCES:**

1. Wireless Communication –Andrea Goldsmith, Cambridge University Press, 2011
2. Van Nee, R. and Ramji Prasad, —OFDM for wireless multimedia communications, Artech House, 2000
3. David Tse and Pramod Viswanath, —Fundamentals of Wireless Communication, Cambridge University Press, 2005.
4. Upena Dalal, —Wireless CommunicationII, Oxford University Press, 2009.



**OBJECTIVE:**

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization .

**UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9**

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations, system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

**UNIT II PLANNING 9**

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

**UNIT III ORGANISING 9**

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management

**UNIT IV DIRECTING 9**

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication –communication and IT.

**UNIT V CONTROLLING 9**

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

**TOTAL: 45 PERIODS****OUTCOME:**

- Upon completion of the course, students will be able to have clear understanding
- Managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

**TEXTBOOKS:**

1. Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India) Pvt. Ltd., 10<sup>th</sup> Edition, 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", Pearson Education, 6th Edition, 2004.

**REFERENCES:**

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management" Pearson Education, 7th Edition, 2011.
2. Robert Kreitner & Mamata Mohapatra, " Management", Biztantra, 2008.
3. Harold Koontz & Heinz Wehrich "Essentials of management" Tata McGraw Hill,1998.
4. Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 1999

**OBJECTIVES:**

- To introduce the various types of transmission lines and its characteristics
- To give thorough understanding about high frequency line, power and impedance measurements
- To impart technical knowledge in impedance matching using smith chart
- To introduce passive filters and basic knowledge of active RF components
- To get acquaintance with RF system transceiver design

**UNIT I TRANSMISSION LINE THEORY 9**

General theory of Transmission lines - the transmission line - general solution - The infinite line - Wavelength, velocity of propagation - Waveform distortion - the distortion-less line - Loading and different methods of loading - Line not terminated in  $Z_0$  - Reflection coefficient - calculation of current, voltage, power delivered and efficiency of transmission - Input and transfer impedance - Open and short circuited lines - reflection factor and reflection loss.

**UNIT II HIGH FREQUENCY TRANSMISSION LINES 9**

Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage and current on the dissipation-less line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance of the dissipation-less line - Open and short circuited lines - Power and impedance measurement on lines - Reflection losses - Measurement of VSWR and wavelength.

**UNIT III IMPEDANCE MATCHING IN HIGH FREQUENCY LINES 9**

Impedance matching: Quarter wave transformer - Impedance matching by stubs - Single stub and double stub matching - Smith chart - Solutions of problems using Smith chart - Single and double stub matching using Smith chart.

**UNIT IV WAVEGUIDES 9**

General Wave behavior along uniform guiding structures – Transverse Electromagnetic Waves, Transverse Magnetic Waves, Transverse Electric Waves – TM and TE Waves between parallel plates. Field Equations in rectangular waveguides, TM and TE waves in rectangular waveguides, Bessel Functions, TM and TE waves in Circular waveguides.

**UNIT V RF SYSTEM DESIGN CONCEPTS 9**

Active RF components: Semiconductor basics in RF, bipolar junction transistors, RF field effect transistors, High electron mobility transistors Basic concepts of RF design, Mixers, Low noise amplifiers, voltage control oscillators, Power amplifiers, transducer power gain and stability considerations.

**TOTAL:45 PERIODS****OUTCOMES:**

**Upon completion of the course, the student should be able to:**

- Explain the characteristics of transmission lines and its losses
- Write about the standing wave ratio and input impedance in high frequency transmission lines
- Analyze impedance matching by stubs using smith charts
- Analyze the characteristics of TE and TM waves
- Design a RF transceiver system for wireless communication

**TEXT BOOKS:**

1. John D Ryder, "Networks, lines and fields", 2nd Edition, Prentice Hall India, 2015. (UNIT I-IV)
2. Mathew M. Radmanesh, "Radio Frequency & Microwave Electronics", Pearson Education Asia, Second Edition, 2002. (UNIT V)

**REFERENCES:**

1. Reinhold Ludwig and Powel Bretchko, "RF Circuit Design – Theory and Applications", Pearson Education Asia, First Edition, 2001.
2. D. K. Misra, "Radio Frequency and Microwave Communication Circuits- Analysis and Design", John Wiley & Sons, 2004.
3. E.C.Jordan and K.G. Balmain, —Electromagnetic Waves and Radiating Systems Prentice Hall of India, 2006.
4. G.S.N Raju, "Electromagnetic Field Theory and Transmission Lines Pearson Education, First edition 2005.

**EC8681****MICROPROCESSORS AND MICROCONTROLLERS LABORATORY****L T P C****0 0 4 2****OBJECTIVES:**

- To Introduce ALP concepts, features and Coding methods
- Write ALP for arithmetic and logical operations in 8086 and 8051
- Differentiate Serial and Parallel Interface
- Interface different I/Os with Microprocessors
- Be familiar with MASM

**LIST OF EXPERIMENTS:****8086 Programs using kits and MASM**

1. Basic arithmetic and Logical operations
2. Move a data block without overlap
3. Code conversion, decimal arithmetic and Matrix operations.
4. Floating point operations, string manipulations, sorting and searching
5. Password checking, Print RAM size and system date
6. Counters and Time Delay

**Peripherals and Interfacing Experiments**

7. Traffic light controller
8. Stepper motor control
9. Digital clock
10. Key board and Display
11. Printer status
12. Serial interface and Parallel interface
13. A/D and D/A interface and Waveform Generation

**8051 Experiments using kits and MASM**

14. Basic arithmetic and Logical operations
15. Square and Cube program, Find 2's complement of a number
16. Unpacked BCD to ASCII

**TOTAL: 60 PERIODS****OUTCOMES:****At the end of the course, the student should be able to:**

- Write ALP Programmes for fixed and Floating Point and Arithmetic operations
- Interface different I/Os with processor
- Generate waveforms using Microprocessors
- Execute Programs in 8051
- Explain the difference between simulator and Emulator

## LAB EQUIPMENT FOR A BATCH OF 30 STUDENTS:

### HARDWARE:

8086 development kits - 30 nos  
Interfacing Units - Each 10 nos  
Microcontroller - 30 nos

### SOFTWARE:

Intel Desktop Systems with MASM - 30 nos  
8086 Assembler  
8051 Cross Assembler

EC8661

VLSI DESIGN LABORATORY

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### OBJECTIVES:

#### The student should be made:

- To learn Hardware Descriptive Language(Verilog/VHDL)
- To learn the fundamental principles of VLSI circuit design in digital and analog domain
- To familiarize fusing of logical modules on FPGAs
- To provide hands on design experience with professional design (EDA) platforms

### LIST OF EXPERIMENTS:

#### Part I: Digital System Design using HDL & FPGA (24 Periods)

1. Design an Adder (Min 8 Bit) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
2. Design a Multiplier (4 Bit Min) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
3. Design an ALU using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
4. Design a Universal Shift Register using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
5. Design Finite State Machine (Moore/Mealy) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA
6. Design Memories using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA

Compare pre synthesis and post synthesis simulation for experiments 1 to 6.

Requirements: Xilinx ISE/Altera Quartus/ equivalent EDA Tools along with Xilinx/Altera/equivalent FPGA Boards

#### Part-II Digital Circuit Design (24 Periods)

7. Design and simulate a CMOS inverter using digital flow
  8. Design and simulate a CMOS Basic Gates & Flip-Flops
  9. Design and simulate a 4-bit synchronous counter using a Flip-Flops
- Manual/Automatic Layout Generation and Post Layout Extraction for experiments 7 to 9
- Analyze the power, area and timing for experiments 7 to 9 by performing Pre Layout and Post Layout Simulations.

### Part-III Analog Circuit Design (12 Periods)

10. Design and Simulate a CMOS Inverting Amplifier.
11. Design and Simulate basic Common Source, Common Gate and Common Drain Amplifiers.  
Analyze the input impedance, output impedance, gain and bandwidth for experiments 10 and 11 by performing Schematic Simulations.  
Design and simulate simple 5 transistor differential amplifier. Analyze Gain,
12. Bandwidth and CMRR by performing Schematic Simulations.

Requirements: Cadence/Synopsis/ Mentor Graphics/Tanner/equivalent EDA Tools

**TOTAL :60 PERIODS**

#### OUTCOMES:

**At the end of the course, the student should be able to:**

- Write HDL code for basic as well as advanced digital integrated circuit
- Import the logic modules into FPGA Boards
- Synthesize Place and Route the digital IPs
- Design, Simulate and Extract the layouts of Digital & Analog IC Blocks using EDA tools

#### LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

| S.NO | EQUIPMENT   | REQUIRED        |
|------|---|-----------------|
| 1    | Xilinx ISE/Altera Quartus/ equivalent EDA Tools               | 10 User License |
| 2    | Xilinx/Altera/equivalent FPGA Boards                          | 10 no           |
| 3    | Cadence/Synopsis/ Mentor Graphics/Tanner/equivalent EDA Tools | 10 User License |
| 4    | Personal Computer   | 30 no           |

**OBJECTIVES:****The course aims to:**

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

**UNIT I**

Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs

**UNIT II**

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentations

**UNIT III**

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -- questioning and clarifying –GD strategies- activities to improve GD skills

**UNIT IV**

Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview – FAQs related to job interviews

**UNIT V**

Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes

**TOTAL : 30 PERIODS**

**OUTCOMES:****At the end of the course Learners will be able to:**

- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

**Recommended Software**

1. Open Source Software
2. Win English

**REFERENCES:**

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
3. Interact English Lab Manual for Undergraduate Students,. OrientBlackSwan: Hyderabad, 2016.
4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
5. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010.

**OBJECTIVES:**

- To enable the student to understand the basic principles in antenna and microwave system design
- To enhance the student knowledge in the area of various antenna designs.
- To enhance the student knowledge in the area of microwave components and antenna for practical applications.

**UNIT I INTRODUCTION TO MICROWAVE SYSTEMS AND ANTENNAS 9**

Microwave frequency bands, Physical concept of radiation, Near- and far-field regions, Fields and Power Radiated by an Antenna, Antenna Pattern Characteristics, Antenna Gain and Efficiency, Aperture Efficiency and Effective Area, Antenna Noise Temperature and G/T, Impedance matching, Friis transmission equation, Link budget and link margin, Noise Characterization of a microwave receiver.

**UNIT II RADIATION MECHANISMS AND DESIGN ASPECTS 9**

Radiation Mechanisms of Linear Wire and Loop antennas, Aperture antennas, Reflector antennas, Microstrip antennas and Frequency independent antennas, Design considerations and applications.

**UNIT III ANTENNA ARRAYS AND APPLICATIONS 9**

Two-element array, Array factor, Pattern multiplication, Uniformly spaced arrays with uniform and non-uniform excitation amplitudes, Smart antennas.

**UNIT IV PASSIVE AND ACTIVE MICROWAVE DEVICES 9**

Microwave Passive components: Directional Coupler, Power Divider, Magic Tee, attenuator, resonator, Principles of Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes, Microwave tubes: Klystron, TWT, Magnetron.

**UNIT V MICROWAVE DESIGN PRINCIPLES 9**

Impedance transformation, Impedance Matching, Microwave Filter Design, RF and Microwave Amplifier Design, Microwave Power amplifier Design, Low Noise Amplifier Design, Microwave Mixer Design, Microwave Oscillator Design

**TOTAL: 45 PERIODS****OUTCOMES:****The student should be able to:**

- Apply the basic principles and evaluate antenna parameters and link power budgets
- Design and assess the performance of various antennas
- Design a microwave system given the application specifications

**TEXTBOOKS:**

1. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation: Fourth Edition, Tata McGraw-Hill, 2006. (UNIT I, II, III)
2. David M. Pozar, "Microwave Engineering", Fourth Edition, Wiley India, 2012.(UNIT I,IV,V)

**REFERENCES:**

1. Constantine A.Balanis, "Antenna Theory Analysis and Design", Third edition, John Wiley India Pvt Ltd., 2005.
2. R.E.Collin, "Foundations for Microwave Engineering", Second edition, IEEE Press, 2001

EC8751

**OBJECTIVES:**

- To study about the various optical fiber modes, configuration and transmission characteristics of optical fibers
- To learn about the various optical sources, detectors and transmission techniques
- To explore various idea about optical fiber measurements and various coupling techniques
- To enrich the knowledge about optical communication systems and networks

**UNIT I INTRODUCTION TO OPTICAL FIBERS 9**

Introduction-general optical fiber communication system- basic optical laws and definitions-optical modes and configurations -mode analysis for optical propagation through fibers-modes in planar wave guide-modes in cylindrical optical fiber-transverse electric and transverse magnetic modes- fiber materials-fiber fabrication techniques-fiber optic cables-classification of optical fiber-single mode fiber-graded index fiber.

**UNIT II TRANSMISSION CHARACTERISTIC OF OPTICAL FIBER 9**

Attenuation-absorption --scattering losses-bending losses-core and cladding losses-signal dispersion –inter symbol interference and bandwidth-intra model dispersion-material dispersion- waveguide dispersion-polarization mode dispersion-intermodal dispersion-dispersion optimization of single mode fiber-characteristics of single mode fiber-R-I Profile-cutoff wave length-dispersion calculation-mode field diameter.

**UNIT III OPTICAL SOURCES AND DETECTORS 9**

**Sources:** Intrinsic and extrinsic material-direct and indirect band gaps-LED-LED structures-surface emitting LED-Edge emitting LED-quantum efficiency and LED power-light source materials-modulation of LED-LASER diodes-modes and threshold conditions-Rate equations-external quantum efficiency-resonant frequencies-structures and radiation patterns-single mode laser-external modulation-temperature effort.

**Detectors:** PIN photo detector-Avalanche photo diodes-Photo detector noise-noisesources-SNR-detector response time-Avalanche multiplication noise-temperature effects-comparisons of photo detectors.

**UNIT IV OPTICAL RECEIVER, MEASUREMENTS AND COUPLING 9**

Fundamental receiver operation-preamplifiers-digital signal transmission-error sources-Front end amplifiers-digital receiver performance-probability of error-receiver sensitivity-quantum limit.

Optical power measurement-attenuation measurement-dispersion measurement- Fiber Numerical Aperture Measurements- Fiber cut- off Wave length Measurements- Fiber diameter measurements-Source to Fiber Power Launching-Lensing Schemes for Coupling Management-Fiber to Fiber Joints-LED Coupling to Single Mode Fibers-Fiber Splicing-Optical Fiber connectors.

**UNIT V OPTICAL COMMUNICATION SYSTEMS AND NETWORKS 9**

System design consideration Point – to –Point link design –Link power budget –rise time budget, WDM –Passive DWDM Components-Elements of optical networks-SONET/SDH-Optical Interfaces-SONET/SDH Rings and Networks-High speed light wave Links-OADM configuration-Optical ETHERNET-Soliton.

**TOTAL:45 PERIODS**



**OUTCOMES:****At the end of the course, the student should be able to:**

- Realize basic elements in optical fibers, different modes and configurations.
- Analyze the transmission characteristics associated with dispersion and polarization techniques.
- Design optical sources and detectors with their use in optical communication system.
- Construct fiber optic receiver systems, measurements and coupling techniques.
- Design optical communication systems and its networks.

**TEXT BOOKS:**

1. P Chakrabarti, "Optical Fiber Communication", McGraw Hill Education (India) Private Limited, 2016 (UNIT I, II, III)
2. Gred Keiser, "Optical Fiber Communication", McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013. (UNIT I, IV, V)

**REFERENCES:**

1. John M.Senior, "Optical fiber communication", Pearson Education, second edition.2007.
2. Rajiv Ramaswami, "Optical Networks " , Second Edition, Elsevier , 2004.
3. J.Gower, "Optical Communication System", Prentice Hall of India, 2001.
4. Govind P. Agrawal, "Fiber-optic communication systems", third edition, John Wiley & sons, 2004.

**EC8791****EMBEDDED AND REAL TIME SYSTEMS**

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**OBJECTIVES:****The student should be made to:**

- Understand the concepts of embedded system design and analysis
- Learn the architecture and programming of ARM processor
- Be exposed to the basic concepts of embedded programming
- Learn the real time operating systems

**UNIT I INTRODUCTION TO EMBEDDED SYSTEM DESIGN****9**

Complex systems and micro processors– Embedded system design process –Design example: Model train controller- Design methodologies- Design flows - Requirement Analysis – Specifications-System analysis and architecture design – Quality Assurance techniques - Designing with computing platforms – consumer electronics architecture – platform-level performance analysis.

**UNIT II ARM PROCESSOR AND PERIPHERALS****9**

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.

**UNIT III EMBEDDED PROGRAMMING****9**

Components for embedded programs- Models of programs- Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size- Program validation and testing.

**UNIT IV REAL TIME SYSTEMS 9**

Structure of a Real Time System — Estimating program run times – Task Assignment and Scheduling – Fault Tolerance Techniques – Reliability, Evaluation – Clock Synchronisation.

**UNIT V PROCESSES AND OPERATING SYSTEMS 9**

Introduction – Multiple tasks and multiple processes – Multirate systems- Preemptive real-time operating systems- Priority based scheduling- Interprocess communication mechanisms – Evaluating operating system performance- power optimization strategies for processes – Example Real time operating systems-POSIX-Windows CE. - Distributed embedded systems – MPSoCs and shared memory multiprocessors. – Design Example - Audio player, Engine control unit – Video accelerator.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Describe the architecture and programming of ARM processor
- Outline the concepts of embedded systems
- Explain the basic concepts of real time operating system design
- Model real-time applications using embedded-system concepts

**TEXT BOOKS:**

1. Marilyn Wolf, “Computers as Components - Principles of Embedded Computing System Design”, Third Edition “Morgan Kaufmann Publisher (An imprint from Elsevier), 2012. (UNIT I, II, III, V)
2. Jane W.S.Liu,” Real Time Systems”, Pearson Education, Third Indian Reprint, 2003.(UNIT IV)

**REFERENCES:**

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. David. E. Simon, “An Embedded Software Primer”, 1st Edition, Fifth Impression, Addison-Wesley Professional, 2007.
4. Raymond J.A. Buhr, Donald L.Bailey, “An Introduction to Real-Time Systems- From Design to Networking with C/C++”, Prentice Hall, 1999.
5. C.M. Krishna, Kang G. Shin, “Real-Time Systems”, International Editions, Mc Graw Hill 1997
6. K.V.K.K.Prasad, “Embedded Real-Time Systems: Concepts, Design & Programming”, Dream Tech Press, 2005.
7. Sriram V Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, Tata Mc Graw Hill, 2004.

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| <b>EC8702</b> | <b>AD HOC AND WIRELESS SENSOR NETWORKS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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**OBJECTIVES:**

**The student should be made to:**

- Learn Ad hoc network and Sensor Network fundamentals
- Understand the different routing protocols
- Have an in-depth knowledge on sensor network architecture and design issues
- Understand the transport layer and security issues possible in Ad hoc and Sensor networks
- Have an exposure to mote programming platforms and tools

**UNIT I AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS 9**

Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking, Ad hoc wireless Internet, Issues in Designing a Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols, Table Driven Routing Protocols - Destination Sequenced Distance Vector (DSDV), On-Demand Routing protocols –Ad hoc On-Demand Distance Vector Routing (AODV).

**UNIT II SENSOR NETWORKS – INTRODUCTION & ARCHITECTURES 9**

Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, WSN application examples, Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Network Architecture - Sensor Network Scenarios, Transceiver Design Considerations, Optimization Goals and Figures of Merit.

**UNIT III WSN NETWORKING CONCEPTS AND PROTOCOLS 9**

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, The Mediation Device Protocol, Contention based protocols - PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols- Energy Efficient Routing, Challenges and Issues in Transport layer protocol.

**UNIT IV SENSOR NETWORK SECURITY 9**

Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks.

**UNIT V SENSOR NETWORK PLATFORMS AND TOOLS 9**

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms – TinyOS, nesC, CONTIKIOS, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes – State centric programming.

**TOTAL:45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student would be able to:**

- Know the basics of Ad hoc networks and Wireless Sensor Networks
- Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement
- Apply the knowledge to identify appropriate physical and MAC layer protocols
- Understand the transport layer and security issues possible in Ad hoc and sensor networks.
- Be familiar with the OS used in Wireless Sensor Networks and build basic modules

**TEXT BOOKS:**

1. C. Siva Ram Murthy and B. S. Manoj, "Ad Hoc Wireless Networks Architectures and Protocols", Prentice Hall, PTR, 2004. (UNIT I)
2. Holger Karl , Andreas willig, "Protocol and Architecture for Wireless Sensor Networks", John wiley publication, Jan 2006.(UNIT II-V)

**REFERENCES:**

1. Feng Zhao, Leonidas Guibas, "Wireless Sensor Networks: an information processing approach", Elsevier publication, 2004.
2. Charles E. Perkins, "Ad Hoc Networking", Addison Wesley, 2000.
3. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, "Wireless sensor networks: a survey", computer networks, Elsevier, 2002, 394 - 422.

**EC8711****EMBEDDED LABORATORY**

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**OBJECTIVES:****The student should be made to:**

- Learn the working of ARM processor
- Understand the Building Blocks of Embedded Systems
- Learn the concept of memory map and memory interface
- Write programs to interface memory, I/Os with processor
- Study the interrupt performance

**LIST OF EXPERIMENTS:**

1. Study of ARM evaluation system
2. Interfacing ADC and DAC.
3. Interfacing LED and PWM.
4. Interfacing real time clock and serial port.
5. Interfacing keyboard and LCD.
6. Interfacing EPROM and interrupt.
7. Mailbox.
8. Interrupt performance characteristics of ARM and FPGA.
9. Flashing of LEDS.
10. Interfacing stepper motor and temperature sensor.
11. Implementing zigbee protocol with ARM.

**TOTAL: 60 PERIODS****OUTCOMES:****At the end of the course, the student should be able to:**

- Write programs in ARM for a specific Application
- Interface memory, A/D and D/A convertors with ARM system
- Analyze the performance of interrupt
- Write program for interfacing keyboard, display, motor and sensor.
- Formulate a mini project using embedded system

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS (3 students per batch)**

Embedded trainer kits with ARM board 10 Nos

Embedded trainer kits suitable for wireless communication 10 Nos

Adequate quantities of Hardware, software and consumables

**OBJECTIVES:****The student should be made to:**

- Understand the working principle of optical sources, detector, fibers
- Develop understanding of simple optical communication link
- Understand the measurement of BER, Pulse broadening
- Understand and capture an experimental approach to digital wireless communication
- Understand actual communication waveforms that will be sent and received across wireless channel

**LIST OF OPTICAL EXPERIMENTS**

1. Measurement of connector, bending and fiber attenuation losses.
2. Numerical Aperture and Mode Characteristics of Fibers.
3. DC Characteristics of LED and PIN Photo diode.
4. Fiber optic Analog and Digital Link Characterization - frequency response(analog), eye diagram and BER (digital)

**LIST OF WIRELESS COMMUNICATION EXPERIMENTS**

1. Wireless Channel Simulation including fading and Doppler effects
2. Simulation of Channel Estimation, Synchronization & Equalization techniques
3. Analysing Impact of Pulse Shaping and Matched Filtering using Software Defined Radios
4. OFDM Signal Transmission and Reception using Software Defined Radios

**LIST OF MICROWAVE EXPERIMENTS**

1. VSWR and Impedance Measurement and Impedance Matching
2. Characterization of Directional Couplers, Isolators, Circulators
3. Gunn Diode Characteristics
4. Microwave IC – Filter Characteristics

**TOTAL: 60 PERIODS****OUTCOMES:****On completion of this lab course, the student would be able to**

- Analyze the performance of simple optical link by measurement of losses and Analyzing the mode characteristics of fiber
- Analyze the Eye Pattern, Pulse broadening of optical fiber and the impact on BER
- Estimate the Wireless Channel Characteristics and Analyze the performance of Wireless Communication System
- Understand the intricacies in Microwave System design

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS 3 STUDENTS PER EXPERIMENT:**

| <b>S.NO</b> | <b>NAME OF THE EQUIPMENT</b>   | <b>REQUIRED</b> |
|-------------|--|-----------------|
| 1           | Trainer kit for carrying out LED and PIN diode characteristics, Digital multi meter, optical power meter   | 2 Nos           |
| 2           | Trainer kit for determining the mode characteristics, losses in optical fiber  | 2 Nos           |
| 3           | Trainer kit for analyzing Analog and Digital link performance, 2 Mbps PRBS Data source, 10 MHz signal generator, 20 MHz Digital storage Oscilloscope | 2 Nos           |
| 4           | Kit for measuring Numerical aperture and Attenuation of fiber  | 2 Nos           |
| 5           | Advanced Optical fiber trainer kit for PC to PC communication, BER Measurement, Pulse broadening.  | 2 Nos           |
| 6           | MM/SM Glass and plastic fiber patch chords with ST/SC/E2000 connectors   | 2 sets          |
| 7           | LEDs with ST / SC / E2000 receptacles – 650 / 850 nm   | 2 sets          |
| 8           | PIN PDs with ST / SC / E2000 receptacles – 650 / 850 nm  | 2 sets          |
| 9           | Digital Communications Teaching Bundle (LabVIEW/MATLAB/Equivalent software tools)  | 10 Users        |
| 10          | Software Define Radio Transceiver Platform with antennas and accessories   | 2 Nos           |

**EC8811****PROJECT WORK****L T P C****0 0 20 10****OBJECTIVES:**

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL: 300 PERIODS**

**OUTCOME:**

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

**CS8392****OBJECT ORIENTED PROGRAMMING****L T P C****3 0 0 3****OBJECTIVES:**

- To understand Object Oriented Programming concepts and basic characteristics of Java
- To know the principles of packages, inheritance and interfaces
- To define exceptions and use I/O streams
- To develop a java application with threads and generics classes
- To design and build simple Graphical User Interfaces

**UNIT I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 10**

Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance - Polymorphism- OOP in Java – Characteristics of Java – The Java Environment - Java Source File -Structure – Compilation. Fundamental Programming Structures in Java – Defining classes in Java – constructors, methods -access specifiers - static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays , Packages - JavaDoc comments.

**UNIT II INHERITANCE AND INTERFACES 9**

Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces - Object cloning -inner classes, Array Lists - Strings

**UNIT III EXCEPTION HANDLING AND I/O 9**

Exceptions - exception hierarchy - throwing and catching exceptions - built in exceptions, creating own exception, Stack Trace Elements.

Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files

**UNIT IV MULTITHREADING AND GENERIC PROGRAMMING 8**

Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter thread communication, daemon threads, thread groups.

Generic Programming – Generic classes – generic methods – Bounded Types – Restrictions and Limitations.

**UNIT V EVENT DRIVEN PROGRAMMING 9**

Graphics programming - Frame – Components - working with 2D shapes - Using color, fonts, and images - Basics of event handling - event handlers - adapter classes - actions - mouse events - AWT event hierarchy - Introduction to Swing – layout management - Swing Components – Text Fields , Text Areas – Buttons- Check Boxes – Radio Buttons – Lists- choices- Scrollbars – Windows –Menus – Dialog Boxes.

**TOTAL: 45 PERIODS****OUTCOMES:****Upon completion of the course, students will be able to:**

- Develop Java programs using OOP principles
- Develop Java programs with the concepts inheritance and interfaces
- Build Java applications using exceptions and I/O streams
- Develop Java applications with threads and generics classes
- Develop interactive Java programs using swings

**TEXT BOOKS:**

1. Herbert Schildt, "Java The complete reference", 8<sup>th</sup> Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary Cornell, "Core Java Volume –I Fundamentals", 9<sup>th</sup> Edition, Prentice Hall, 2013.

**REFERENCES:**

1. Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3<sup>rd</sup> Edition, Pearson, 2015.
2. Steven Holzner, "Java 2 Black book", Dreamtech press, 2011.
3. Timothy Budd, "Understanding Object-oriented programming with Java", Updated Edition, Pearson Education, 2000.

**EC8073****MEDICAL ELECTRONICS**

|          |          |          |          |
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**OBJECTIVES:****The student should be made:**

- To gain knowledge about the various physiological parameters both electrical and non electrical and the methods of recording and also the method of transmitting these parameters
- To study about the various assist devices used in the hospitals
- To gain knowledge about equipment used for physical medicine and the various recently developed diagnostic and therapeutic techniques.

**UNIT I ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING 9**

Sources of bio medical signals, Bio-potentials, Biopotential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics

**UNIT II BIO-CHEMICAL AND NON ELECTRICAL PARAMETER MEASUREMENT 9**

pH, PO<sub>2</sub>, PCO<sub>2</sub>, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.

**UNIT III ASSIST DEVICES 9**

Cardiac pacemakers, DC Defibrillator, Dialyser, Ventilators, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems.

**UNIT IV PHYSICAL MEDICINE AND BIOTELEMETRY 9**

Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry.

**UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION 9**

Telemedicine, Insulin Pumps, Radio pill, Endomicroscopy, Brain machine interface, Lab on a chip.

**TOTAL:45 PERIODS****OUTCOMES:****On successful completion of this course, the student should be able to:**

- Know the human body electro- physiological parameters and recording of bio-potentials
- Comprehend the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.
- Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators
- Comprehend physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies, and bio-telemetry principles and methods
- Know about recent trends in medical instrumentation



**TEXT BOOK:**

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007. (UNIT I – V)

**REFERENCES:**

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.

**CS8493****OPERATING SYSTEMS****L T P C  
3 0 0 3****OBJECTIVES:**

- To understand the basic concepts and functions of operating systems.
- To understand Processes and Threads
- To analyze Scheduling algorithms.
- To understand the concept of Deadlocks.
- To analyze various memory management schemes.
- To understand I/O management and File systems.
- To be familiar with the basics of Linux system and Mobile OS like iOS and Android.

**UNIT I OPERATING SYSTEM OVERVIEW****7**

Computer System Overview-Basic Elements, Instruction Execution, Interrupts, Memory Hierarchy, Cache Memory, Direct Memory Access, Multiprocessor and Multicore Organization. Operating system overview-objectives and functions, Evolution of Operating System.- Computer System Organization Operating System Structure and Operations- System Calls, System Programs, OS Generation and System Boot.

**UNIT II PROCESS MANAGEMENT****11**

Processes - Process Concept, Process Scheduling, Operations on Processes, Interprocess Communication; CPU Scheduling - Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling, Real time scheduling; Threads- Overview, Multithreading models, Threading issues; Process Synchronization - The critical-section problem, Synchronization hardware, Mutex locks, Semaphores, Classic problems of synchronization, Critical regions, Monitors; Deadlock - System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock.

**UNIT III STORAGE MANAGEMENT****9**

Main Memory – Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, 32 and 64 bit architecture Examples; Virtual Memory – Background, Demand Paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.

**UNIT IV FILE SYSTEMS AND I/O SYSTEMS****9**

Mass Storage system – Overview of Mass Storage Structure, Disk Structure, Disk Scheduling and Management, swap space management; File-System Interface - File concept, Access methods, Directory Structure, Directory organization, File system mounting, File Sharing and Protection; File System Implementation- File System Structure, Directory implementation, Allocation Methods, Free Space Management, Efficiency and Performance, Recovery; I/O Systems – I/O Hardware, Application I/O interface, Kernel I/O subsystem, Streams, Performance.

**UNIT V CASE STUDY****9**

Linux System - Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, Input-Output Management, File System, Interprocess Communication; Mobile OS - iOS and Android - Architecture and SDK Framework, Media Layer, Services Layer, Core OS Layer, File System.

**TOTAL: 45 PERIODS****OUTCOMES:****At the end of the course, the students should be able to:**

- Analyze various scheduling algorithms.
- Understand deadlock, prevention and avoidance algorithms.
- Compare and contrast various memory management schemes.
- Understand the functionality of file systems.
- Perform administrative tasks on Linux Servers and compare iOS and Android Operating Systems.

**TEXT BOOK :**

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc., 2012.

**REFERENCES :**

1. Ramaz Elmasri, A. Gil Carrick, David Levine, "Operating Systems – A Spiral Approach", Tata McGraw Hill Edition, 2010.
2. Achyut S.Godbole, Atul Kahate, " Operating Systems", McGraw Hill Education, 2016.
3. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, Pearson Education, 2004.
4. Gary Nutt, "Operating Systems", Third Edition, Pearson Education, 2004.
5. Harvey M. Deital, "Operating Systems", Third Edition, Pearson Education, 2004.
6. Daniel P Bovet and Marco Cesati, "Understanding the Linux kernel", 3rd edition, O'Reilly, 2005.
7. Neil Smyth, "iPhone iOS 4 Development Essentials – Xcode", Fourth Edition, Payload media, 2011.

**EC8074****ROBOTICS AND AUTOMATION**

|          |          |          |          |
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| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:****The student should be made:**

- To understand the basic concepts associated with the design, functioning, applications and social aspects of robots
- To study about the electrical drive systems and sensors used in robotics for various applications
- To learn about analyzing robot kinematics, dynamics through different methodologies and study various design aspects of robot arm manipulator and end-effector
- To learn about various motion planning techniques and the associated control architecture
- To understand the implications of AI and other trending concepts of robotics

**UNIT I FOUNDATION FOR BEGINNERS****9**

Introduction -- brief history, definition, anatomy, types, classification, specification and need based applications; role and need of robots for the immediate problems of the society, future of mankind and automation-ethical issues; industrial scenario local and global, case studies on mobile robot research platform and industrial serial arm manipulator

**UNIT II BUILDING BLOCKS OF A ROBOT 9**

Types of electric motors - DC, Servo, Stepper; specification, drives for motors - speed & direction control and circuitry, Selection criterion for actuators, direct drives, non-traditional actuators; Sensors for localization, navigation, obstacle avoidance and path planning in known and unknown environments – optical, inertial, thermal, chemical, biosensor, other common sensors; Case study on choice of sensors and actuators for maze solving robot and self driving cars

**UNIT III KINEMATICS, DYNAMICS AND DESIGN OF ROBOTS & END-EFFECTORS 9**

Robot kinematics - Geometric approach for 2R, 3R manipulators, homogenous transformation using D-H representation, kinematics of WMR, Lagrangian formulation for 2R robot dynamics; Mechanical design aspects of a 2R manipulator, WMR; End-effector - common types and design case study.

**UNIT IV NAVIGATION, PATH PLANNING AND CONTROL ARCHITECTURE 9**

Mapping & Navigation – SLAM, Path planning for serial manipulators; types of control architectures - Cartesian control, Force control and hybrid position/force control, Behaviour based control, application of Neural network, fuzzy logic, optimization algorithms for navigation problems, programming methodologies of a robot

**UNIT V AI AND OTHER RESEARCH TRENDS IN ROBOTICS 9**

Application of Machine learning - AI, Expert systems; Tele-robotics and Virtual Reality, Micro & Nanorobots, Unmanned vehicles, Cognitive robotics, Evolutionary robotics, Humanoids

**TOTAL:45 PERIODS****OUTCOMES:****The student should be able to:**

- Explain the concepts of industrial robots in terms of classification, specifications and coordinate systems, along with the need and application of robots & automation
- Examine different sensors and actuators for applications like maze solving and self driving cars.
- Design a 2R robot & an end-effector and solve the kinematics and dynamics of motion for robots.
- Explain navigation and path planning techniques along with the control architectures adopted for robot motion planning.
- Describe the impact and progress in AI and other research trends in the field of robotics

**TEXT BOOKS:**

1. Saeed. B. Niku, Introduction to Robotics, Analysis, system, Applications, Pearson educations, 2002
2. Roland Siegwart, Illah Reza Nourbakhsh, Introduction to Autonomous Mobile Robots, MIT Press, 2011

**REFERENCES:**

1. Richard David Klafner, Thomas A. Chmielewski, Michael Negin, Robotic engineering: an integrated approach, Prentice Hall, 1989
2. Craig, J. J., Introduction to Robotics: Mechanics and Control, 2nd Edition, Addison-Wesley, 1989.
3. K.S. Fu, R.C. Gonzalez and C.S.G. Lee, Robotics: Control, Sensing, Vision and Intelligence, McGraw-Hill, 1987.
4. Wesley E Snyder R, Industrial Robots, Computer Interfacing and Control, Prentice Hall International Edition, 1988.
5. Robin Murphy, Introduction to AI Robotics, MIT Press, 2000
6. Ronald C. Arkin, Behavior-based Robotics, MIT Press, 1998
7. N. P. Padhy, Artificial Intelligence and Intelligent Systems, Oxford University Press, 2005
8. Stefano Nolfi, Dario Floreano, Evolutionary Robotics – The Biology, Intelligence and

Technology of Self-Organizing Machines (Intelligent Robotics and Autonomous Agents series), MIT Press, 2004.

**EC8075**

**NANOTECHNOLOGY AND APPLICATIONS**

**L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To provide a broad view of the nascent field of nanoscience and nanotechnology to undergraduates
- To explore the basics of nanomaterial synthesis and characterization.
- To introduce the applications of nanotechnology

**UNIT I INTRODUCTION TO NANOTECHNOLOGY 9**

Basic Structure of Nanoparticles- Kinetics in Nanostructured Materials- Zero dimensional, size and shape of nanoparticles; one-dimensional and two dimensional nanostructures- clusters of metals and semiconductors, bio nano-particles.

**UNIT II FABRICATION AND CHARACTERIZATION OF NANOMATERIALS 9**

Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes); Gas, liquid, and solid –phase synthesis of nanomaterials; Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning. Bio-synthesis of nanomaterials.

**UNIT III PROPERTIES AND MEASUREMENT OF NANOMATERIALS 9**

Optical Properties: Absorption, Fluorescence, and Resonance; Methods for the measurement of nanomaterials; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging.

**UNIT IV NANO STRUCTURES 9**

Carbon Nanotubes, Fullerenes, Nanowires, Quantum Dots. Applications of nanostructures. Reinforcement in Ceramics, Drug delivery, Giant magnetoresistance, etc. Cells response to Nanostructures.

**UNIT V APPLICATIONS OF NANOTECHNOLOGY 9**

Nano electronics, Nano sensors, Nanotechnology in Diagnostics applications, Environmental and Agricultural Applications of nanotechnology, Nano technology for energy systems

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Describe the basic science behind the properties of materials.
- Interpret the creation, characterization, and manipulation of nanoscale materials.
- Comprehend the exciting applications of nanotechnology at the leading edge of scientific research
- Apply their knowledge of nanotechnology to identify how they can be exploited for new applications.

**TEXT BOOKS:**

1. Springer Handbook of Nanotechnology by Bharat Bhushan 2004.(Unit I – V)
2. Encyclopedia of Nanotechnology - Hari Singh Nalwa 2004. (Unit I – V)

**REFERENCES:**

1. Nanomaterials, Nanotechnologies and Design: an Introduction to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann, 2009.
2. Handbook of Nanophase and Nanostructured Materials (in four volumes), Eds: Z.L. Wang, Y. Liu, Z. Zhang, Kluwer Academic/Plenum Publishers, 2003.
3. Handbook of Nanoceramics and their Based Nanodevices (Vol. 2) Edited by Tseung-Yuen Tseng and Hari Singh Nalwa, American Scientific Publishers.

**GE8074****HUMAN RIGHTS****L T P C****3 0 0 3****OBJECTIVE:**

- To sensitize the Engineering students to various aspects of Human Rights.

**UNIT I****9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

**UNIT II****9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

**UNIT III****9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

**UNIT IV****9**

Human Rights in India – Constitutional Provisions / Guarantees.

**UNIT V****9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

**TOTAL : 45 PERIODS****OUTCOME :**

- Engineering students will acquire the basic knowledge of human rights.

**REFERENCES:**

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

**GE8077****TOTAL QUALITY MANAGEMENT****L T P C****3 0 0 3****OBJECTIVE:**

- To facilitate the understanding of Quality Management principles and process.

**UNIT I 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 - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

**UNIT II TQM PRINCIPLES 9**

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

**UNIT III TQM TOOLS AND 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 IV TQM TOOLS AND TECHNIQUES II 9**

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

**UNIT V QUALITY MANAGEMENT SYSTEM 9**

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration- **ENVIRONMENTAL MANAGEMENT SYSTEM:** Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

**TEXT BOOK:**

1. Dale H.Besterfield, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

**REFERENCES:**

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8<sup>th</sup> Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO9001-2015 standards

|               |  |          |          |          |          |
|---------------|--|----------|----------|----------|----------|
| <b>CS8792</b> | <b>CRYPTOGRAPHY AND NETWORK SECURITY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To understand Cryptography Theories, Algorithms and Systems.
- To understand necessary Approaches and Techniques to build protection mechanisms in order to secure computer networks.

|   |  |                         |
|---|--|-------------------------|
| <b>UNIT I</b>   | <b>INTRODUCTION</b>                          | <b>9</b>                |
| Security trends - Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies - Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography).- Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis. |  |                         |
| <b>UNIT II</b>  | <b>SYMMETRIC CRYPTOGRAPHY</b>                | <b>9</b>                |
| MATHEMATICS OF SYMMETRIC KEY CRYPTOGRAPHY: Algebraic structures - Modular arithmetic-Euclid’s algorithm- Congruence and matrices - Groups, Rings, Fields- Finite fields- SYMMETRIC KEY CIPHERS: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard - RC4 – Key distribution.    |  |                         |
| <b>UNIT III</b>   | <b>PUBLIC KEY CRYPTOGRAPHY</b>               | <b>9</b>                |
| MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY: Primes – Primality Testing – Factorization – Euler’s totient function, Fermat’s and Euler’s Theorem - Chinese Remainder Theorem – Exponentiation and logarithm - ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange - ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.   |  |                         |
| <b>UNIT IV</b>  | <b>MESSAGE AUTHENTICATION AND INTEGRITY</b>  | <b>9</b>                |
| Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications - Kerberos, X.509   |  |                         |
| <b>UNIT V</b>   | <b>SECURITY PRACTICE AND SYSTEM SECURITY</b> | <b>9</b>                |
| Electronic Mail security – PGP, S/MIME – IP security – Web Security - SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls.  |  |                         |
|   |  | <b>TOTAL 45 PERIODS</b> |

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Understand the fundamentals of networks security, security architecture, threats and vulnerabilities
- Apply the different cryptographic operations of symmetric cryptographic algorithms
- Apply the different cryptographic operations of public key cryptography
- Apply the various Authentication schemes to simulate different applications.
- Understand various Security practices and System security standards

**TEXT BOOK:**

1. William Stallings, Cryptography and Network Security: Principles and Practice, PHI 3rd Edition, 2006.

**REFERENCES**

1. C K Shyamala, N Harini and Dr. T R Padmanabhan: Cryptography and Network Security, Wiley India Pvt.Ltd
2. BehrouzA.Foruzan, Cryptography and Network Security, Tata McGraw Hill 2007.
3. Charlie Kaufman, Radia Perlman, and Mike Speciner, Network Security: PRIVATE Communication in a PUBLIC World, Prentice Hall, ISBN 0-13-046019-2

**OBJECTIVES:**

- To learn and understand the concepts of stationary and non-stationary random signals and analysis & characterization of discrete-time random processes
- To enunciate the significance of estimation of power spectral density of random processes
- To introduce the principles of optimum filters such as Wiener and Kalman filters
- To introduce the principles of adaptive filters and their applications to communication engineering
- To introduce the concepts of multi-resolution analysis

**UNIT I DISCRETE-TIME RANDOM PROCESSES 9**

Random variables - ensemble averages a review, random processes - ensemble averages, autocorrelation and autocovariance matrices, ergodic random process, white noise, filtering random processes, spectral factorization, special types of random processes - AR, MA, ARMA

**UNIT II SPECTRUM ESTIMATION 10**

Bias and consistency, Non-parametric methods - Periodogram, modified-Periodogram - performance analysis. Bartlett's method, Welch's method, Blackman-Tukey method. Performance comparison. Parametric methods - autoregressive (AR) spectrum estimation - autocorrelation method, Prony's method, solution using Levinson Durbin recursion.

**UNIT III OPTIMUM FILTERS 9**

Wiener filters - FIR Wiener filter - discrete Wiener Hopf equation, Applications - filtering, linear prediction. IIR Wiener filter - causal and non-causal filters. Recursive estimators - discrete Kalman filter.

**UNIT IV ADAPTIVE FILTERS 9**

Principles and properties of adaptive filters - FIR adaptive filters. Adaptive algorithms - steepest descent algorithm, the LMS algorithm - convergence. Applications of adaptive filtering - noise cancellation, channel equalization.

**UNIT V MULTIREOLUTION ANALYSIS 8**

Short-time Fourier transform - Heisenberg uncertainty principle. Principles of multi-resolution analysis - sub-band coding, the continuous and discrete wavelet transform - properties. Applications of wavelet transform - noise reduction, image compression.

**TOTAL:45 PERIODS****OUTCOMES:****At the end of the course, the student should be able to:**

- Articulate and apply the concepts of special random processes in practical applications
- Choose appropriate spectrum estimation techniques for a given random process
- Apply optimum filters appropriately for a given communication application
- Apply appropriate adaptive algorithm for processing non-stationary signals
- Apply and analyse wavelet transforms for signal and image processing based applications

**TEXT BOOKS**

1. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008. (UNIT I-IV)
2. P. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993 (UNIT V)



## REFERENCES:

1. John G. Proakis & Dimitris G. Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. Sophoncles J. Orfanidis, "Optimum signal processing", McGraw Hill, 2000

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| <b>EC8001</b> | <b>MEMS AND NEMS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                      | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

### OBJECTIVES:

- To introduce the concepts of micro and nano electromechanical devices
- To know the fabrication process of Microsystems
- To know the design concepts of micro sensors and micro actuators
- To introduce the concepts of quantum mechanics and nano systems

### **UNIT I INTRODUCTION TO MEMS AND NEMS 9**

Introduction to Design of MEMS and NEMS, Overview of Nano and Microelectromechanical Systems, Applications of Micro and Nanoelectromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals.

### **UNIT II MEMS FABRICATION TECHNOLOGIES 9**

Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, Sputtering Etching techniques, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA.

### **UNIT III MICRO SENSORS 9**

MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressure sensors, Case study: Piezoelectric energy harvester

### **UNIT IV MICRO ACTUATORS 9**

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces, Case Study: RF Switch.

### **UNIT V NANO DEVICES 9**

Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnO nanorods based NEMS device: Gas sensor.

**TOTAL: 45 PERIODS**

### OUTCOMES:

**On successful completion of this course, the student should be able to:**

- Interpret the basics of micro/nano electromechanical systems including their applications and advantages
- Recognize the use of materials in micro fabrication and describe the fabrication processes including surface micromachining, bulk micromachining and LIGA.
- Analyze the key performance aspects of electromechanical transducers including sensors and actuators
- Comprehend the theoretical foundations of quantum mechanics and Nano systems

## REFERENCES:

1. Marc Madou, "Fundamentals of Microfabrication", CRC press 1997.
2. Stephen D. Senturia, "Micro system Design", Kluwer Academic Publishers, 2001
3. Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata Mcraw Hill, 2002.
4. Chang Liu, "Foundations of MEMS", Pearson education India limited, 2006,
5. Sergey Edward Lyshevski, "MEMS and NEMS: Systems, Devices, and Structures" CRC Press, 2002

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| <b>EC8002</b> | <b>MULTIMEDIA COMPRESSION AND COMMUNICATION</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

## OBJECTIVES:

The student should be made:

- To understand the compression schemes for text, voice, image and video
- To understand the QoS issues in multimedia network
- To know the communication protocols for multimedia networking

### **UNIT I AUDIO COMPRESSION 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 II IMAGE AND VIDEO COMPRESSION 9**

Graphics Interchange format- Tagged image file format-Digitized documents- Digitized pictures- JPEG-Video Encoding-Motion estimation –Overview of H.263 and MPEG-2

### **UNIT III TEXT COMPRESSION 7**

Static and Dynamic Huffman coding – Arithmetic coding –Lempel-Ziv coding – LZW coding

### **UNIT IV GUARANTEED SERVICE MODEL 10**

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 V MULTIMEDIA COMMUNICATION 10**

Stream characteristics for Continuous media – Temporal Relationship – Object Stream Interactions, Media Levity, 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:45 PERIODS**

## OUTCOMES:

At the end of the course, the student should be able to:

- Design audio compression techniques
- Configure Text, image and video compression techniques
- Select suitable service model for specific application
- Configure multimedia communication network

**TEXT BOOK:**

1. Fred Halsall, —Multimedia communication- Applications, Networks, Protocols and Standards, Pearson education, 2007.

**REFERENCES**

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. R. Steimnetz, K. Nahrstedt, —Multimedia Computing, Communications and Applications, Pearson Education, First ed, 1995.
5. Nalin K Sharda, 'Multimedia Information Networking', Prentice Hall of India, 1999
6. Aura Ganz, Zvi Ganz and Kitti Wongthawaravat, 'Multimedia Wireless Networks: Technologies, Standards and QoS', Prentice Hall, 2003.
7. Ellen Kayata Wesel, 'Wireless Multimedia Communications: Networking Video, Voice and Data', Addison Wesley, 1998

**EC8003****CMOS ANALOG IC DESIGN**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To study the fundamentals of analog circuits and MOS device models
- To gain knowledge on various configurations of MOS transistors and feedback concepts
- To study the characteristics of noise and frequency response of the amplifier
- To learn the concepts of Op-Amp frequency compensation, capacitor switches and PLLs

**UNIT I INTRODUCTION TO ANALOG IC DESIGN AND CURRENT MIRRORS 9**

Concepts of Analog Design - General consideration of MOS devices – MOS I/V Characteristics – Second order effects – MOS device models. Basic current mirrors- Cascode current mirrors- Active current mirrors- Large and Small signal analysis- Common mode properties.

**UNIT II AMPLIFIERS AND FEEDBACK 9**

Basic Concepts – Common source stage- Source follower- Common gate stage- Cascode stage. Single ended and differential operation- Basic Differential pair- Common mode response- Differential pair with MOS loads- Gilbert Cell. Feedback- General Consideration of feedback circuits- Feedback topologies- Effect of loading- Effect of feedback on Noise.

**UNIT III FREQUENCY RESPONSE OF AMPLIFIERS AND NOISE 9**

General considerations- Miller Effect and Association of Poles with Nodes, Common source stage- Source followers- Common gate stage- Cascode stage- Differential pair. Noise- Statistical characteristics of noise- Types of noise- Representation of noise in circuits- Noise in single stage amplifiers- Noise in differential pairs- Noise Bandwidth.

**UNIT IV OPERATIONAL AMPLIFIER STABILITY AND FREQUENCY COMPENSATION 9**

General Considerations- One and Two Stage Op Amps- Gain Boosting- Comparison- Common mode feedback- Input range limitations- Slew rate- Power Supply Rejection- Noise in Op Amps- General consideration of stability and frequency compensation- Multipole system- Phase margin- Frequency compensation- Compensation of two stage op Amps- Other compensation techniques.

**UNIT V SWITCHED CAPACITOR CIRCUITS AND PLLS****9**

General Considerations- Sampling switches- Switched Capacitor Amplifiers- Switched Capacitor Integrator- Switched Capacitor Common mode feedback. Phase Locked Loops-Simple PLL- Charge pump PLLs - Non ideal Effects in PLLs- Delay locked loops- its Applications.

**TOTAL:45 PERIODS****OUTCOMES:****Upon completion of the course, student should be able to:**

- Realize the concepts of Analog MOS devices and current mirror circuits.
- Design different configuration of Amplifiers and feedback circuits.
- Analyze the characteristics of frequency response of the amplifier and its noise.
- Analyze the performance of the stability and frequency compensation techniques of Op-Amp Circuits.
- Construct switched capacitor circuits and PLLs

**TEXT BOOK:**

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2001, 33<sup>rd</sup> re-print, 2016.

**REFERENCES:**

1. Phillip Allen and Douglas Holmberg "CMOS Analog Circuit Design" Second Edition, Oxford University Press, 2004.
2. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis, Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, 5th Edition, Wiley, 2009
3. Grebene, "Bipolar and MOS Analog Integrated circuit design", John Wiley & sons, Inc., 2003

**EC8004****WIRELESS NETWORKS**

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| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:****The student should be made:**

- To understand the concept about Wireless networks, protocol stack and standards
- To understand and analyse the network layer solutions for Wireless networks
- To study about fundamentals of 3G Services, its protocols and applications
- To have in depth knowledge on internetworking of WLAN and WWAN
- To learn about evolution of 4G Networks, its architecture and applications

**UNIT I WIRELESS LAN****9**

Introduction-WLAN technologies: - IEEE802.11: System architecture, protocol architecture, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, WPAN – IEEE 802.15.4, Wireless USB, Zigbee, 6LoWPAN, WirelessHART

**UNIT II MOBILE NETWORK LAYER****9**

Introduction - Mobile IP: IP packet delivery, Agent discovery, tunneling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol - mobile ad-hoc network: Routing: Destination Sequence distance vector, IoT: CoAP

**UNIT III 3G OVERVIEW****9**

Overview of UTM S Terrestrial Radio access network-UMTS Core network Architecture: 3GPP Architecture, User equipment, CDMA2000 overview- Radio and Network components, Network structure, Radio Network, TD-CDMA, TD – SCDMA.

**UNIT IV INTERNETWORKING BETWEEN WLANS AND WWANS 9**

Internetworking objectives and requirements, Schemes to connect WLANS and 3G Networks, Session Mobility, Internetworking Architecture for WLAN and GPRS, System Description, Local Multipoint Distribution Service, Multichannel Multipoint Distribution System.

**UNIT V 4G & Beyond 9**

Introduction – 4G vision – 4G features and challenges - Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO.

**TOTAL:45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the student would be able to:**

- Conversant with the latest 3G/4G networks and its architecture
- Design and implement wireless network environment for any application using latest wireless protocols and standards
- Ability to select the suitable network depending on the availability and requirement
- Implement different type of applications for smart phones and mobile devices with latest network strategies

**TEXT BOOKS:**

1. Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education 2012.(Unit I,II,III)
2. Vijay Garg, "Wireless Communications and networking", First Edition, Elsevier 2007.(Unit IV,V)

**REFERENCES:**

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband", Second Edition, Academic Press, 2008.
2. Anurag Kumar, D.Manjunath, Joy kuri, "Wireless Networking", First Edition, Elsevier 2011.
3. Simon Haykin , Michael Moher, David Koilpillai, "Modern Wireless Communications", First Edition, Pearson Education 2013

**GE8075**

**INTELLECTUAL PROPERTY RIGHTS**

**L T P C  
3 0 0 3**

**OBJECTIVE:**

- To give an idea about IPR, registration and its enforcement.

**UNIT I INTRODUCTION 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 II REGISTRATION OF IPRs 10**

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

**UNIT III AGREEMENTS AND LEGISLATIONS 10**

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

**UNIT IV 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 V ENFORCEMENT OF IPRs** **7**  
 Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

**TOTAL : 45 PERIODS**

**OUTCOME:**

- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

**TEXT BOOKS:**

1. V. Scope Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002.

**REFERENCES:**

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

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| <b>EC8092</b> | <b>ADVANCED WIRELESS COMMUNICATION</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To expose the students to the importance of improving capacity of wireless channel using MIMO
- To enable understanding of channel impairment mitigation using space-time block and Trellis codes
- To teach advanced MIMO system like layered space time codes, MU-MIMO System and MIMO-OFDM systems

**UNIT I CAPACITY OF WIRELESS CHANNELS** **9**  
 The crowded spectrum, need for high data rate, MIMO systems – Array Gain, Diversity Gain, Data Pipes, Spatial MUX, MIMO System Model. MIMO System Capacity – channel known at the TX, Channel unknown to the TX – capacity of deterministic channels, Random channels and frequency selective channels.

**UNIT II RADIO WAVE PROPAGATION** **9**  
 Radio wave propagation – Macroscopic fading- free space and out door, small scale fading Fading measurements – Direct pulse measurements, spread spectrum correlation channel sounding frequency domain channel sounding, Antenna Diversity – Diversity combining methods.

**9**

**UNIT III SPACE TIME BLOCK CODES**  
 Delay Diversity scheme, Alamoti space time code – Maximum likelihood decoding maximum ratio combining. Transmit diversity space time block codes for real signal constellation and complex signal constellation - decoding of STBC.

**UNIT IV SPACE TIME TRELLIS CODES 9**

Space time coded systems, space time code word design criteria, design of space time T C on slow fading channels, design of STTC on Fast Fading channels, performance analysis in slow and fast fading channels, effect of imperfect channel estimation and Antenna correlation on performance, comparison of STBC & STTC.

**UNIT V LAYERED SPACE TIME CODES 9**

LST transmitter – Horizontal and Vertical LST receiver – ML Rx, Zero forcing Rx; MMSE Rx, SIC Rx, ZF V-blast Rx- MMSE V-blast Rx, Iterative Rx - capacity of MIMO – OFDM systems – capacity of MIMO multi user systems.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**The student should be able to:**

- Comprehend and appreciate the significance and role of this course in the present contemporary world
- Apply the knowledge about the importance of MIMO in today's communication
- Appreciate the various methods for improving the data rate of wireless communication system

**REFERENCES:**

1. Mohinder Jankiraman, Space-time codes and MIMO systems, Artech House, Boston, London . www.artech house.com, ISBN 1-58053-865-7-2004
2. Paulraj Rohit Nabar, Dhananjay Gore, Introduction of space time wireless communication systems, Cambridge University Press, 2003.
3. David Tse and Pramod Viswanath, —Fundamentals of Wireless CommunicationII, Cambridge University Press, 2005.
4. Sergio Verdu “ Multi User Detection” Cambridge University Press, 1998

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| <b>EC8071</b> | <b>COGNITIVE RADIO</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                        | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

**The student should be made:**

- To understand the evolving software defined radio and cognitive radio techniques and their essential functionalities
- To study the basic architecture and standard for cognitive radio
- To understand the physical, MAC and Network layer design of cognitive radio
- To expose the student to evolving applications and advanced features of cognitive radio

**UNIT I INTRODUCTION TO SOFTWARE-DEFINED RADIO AND COGNITIVE RADIO 9**

Evolution of Software Defined Radio and Cognitive radio: goals, benefits, definitions, architectures, relations with other radios, issues, enabling technologies, radio frequency spectrum and regulations.

**UNIT II COGNITIVE RADIO ARCHITECTURE 9**

Cognition cycle – orient, plan, decide and act phases, Organization, SDR as a platform for Cognitive Radio – Hardware and Software Architectures, Overview of IEEE 802.22 standard for broadband wireless access in TV bands.

**UNIT III SPECTRUM SENSING AND DYNAMIC SPECTRUM ACCESS 9**

Introduction – Primary user detection techniques – energy detection, feature detection, matched filtering, cooperative detection and other approaches, Fundamental Tradeoffs in spectrum sensing, Spectrum Sharing Models of Dynamic Spectrum Access - Unlicensed and Licensed Spectrum Sharing, Fundamental Limits of Cognitive Radio.

**UNIT IV MAC AND NETWORK LAYER DESIGN FOR COGNITIVE RADIO 9**

MAC for cognitive radios – Polling, ALOHA, slotted ALOHA, CSMA, CSMA / CA, Network layer design – routing in cognitive radios, flow control and error control techniques.

**UNIT V ADVANCED TOPICS IN COGNITIVE RADIO 9**

Overview of security issues in cognitive radios, auction based spectrum markets in cognitive radio networks, public safety and cognitive radio, cognitive radio for Internet of Things.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Gain knowledge on the design principles on software defined radio and cognitive radio
- Develop the ability to design and implement algorithms for cognitive radio spectrum sensing and dynamic spectrum access
- Build experiments and projects with real time wireless applications
- Apply the knowledge of advanced features of cognitive radio for real world applications

**TEXT BOOKS:**

1. Alexander M. Wyglinski, Maziar Nekovee, Thomas Hou, “Cognitive Radio Communications and Networks”, Academic Press, Elsevier, 2010. (Unit I to IV)
2. Huseyin Arslan (Ed.), “Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer, 2007. (Unit V)

**REFERENCES:**

1. Bruce Fette, “Cognitive Radio Technology”, Newnes, 2006.
2. Kwang-Cheng Chen, Ramjee Prasad, “ Cognitive Radio Networks”, John Wiley and Sons, 2009.
3. Ezio Biglieri, Professor Andrea J. Goldsmith, Dr Larry J. Greenstein, Narayan B. Mandayam, H. Vincent Poor, “Principles of Cognitive Radio” , Cambridge University Press, 2012.

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| <b>GE8072</b> | <b>FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer





## REFERENCES:

1. Hiriappa B, "Corporate Strategy – Managing the Business", Author House, 2013.
2. Peter F Drucker, "People and Performance", Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise Resource Planning – Concepts", Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

**CS8082**

**MACHINE LEARNING TECHNIQUES**

**L T P C**  
**3 0 0 3**

## OBJECTIVES:

- To understand the need for machine learning for various problem solving
- To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning
- To learn the new approaches in machine learning
- To design appropriate machine learning algorithms for problem solving

## UNIT I INTRODUCTION

**9**

Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

## UNIT II NEURAL NETWORKS AND GENETIC ALGORITHMS

**9**

Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.

## UNIT III BAYESIAN AND COMPUTATIONAL LEARNING

**9**

Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.

## UNIT IV INSTANT BASED LEARNING

**9**

K- Nearest Neighbour Learning – Locally weighted Regression – Radial Bases Functions – Case Based Learning.

## UNIT V ADVANCED LEARNING

**9**

Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning

**TOTAL : 45 PERIODS**

## OUTCOMES:

**At the end of the course, the students will be able to**

- Differentiate between supervised, unsupervised, semi-supervised machine learning approaches
- Apply specific supervised or unsupervised machine learning algorithm for a particular problem
- Analyse and suggest the appropriate machine learning approach for the various types of problem
- Design and make modifications to existing machine learning algorithms to suit an

- individual application
- Provide useful case studies on the advanced machine learning algorithms

**TEXT BOOK:**

1. Tom M. Mitchell, “Machine Learning”, McGraw-Hill Education (India) Private Limited, 2013.

**REFERENCES:**

1. Ethem Alpaydin, “Introduction to Machine Learning (Adaptive Computation and Machine Learning)”, The MIT Press 2004.
2. Stephen Marsland, “Machine Learning: An Algorithmic Perspective”, CRC Press, 2009.

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| <b>EC8005</b> | <b>ELECTRONIC PACKAGING AND TESTING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVE:**

- To introduce and discuss various issues related to the system packaging

**UNIT I OVERVIEW OF ELECTRONIC SYSTEMS PACKAGING 9**

Functions of an Electronic Package, Packaging Hierarchy, IC packaging: MEMS packaging, consumer electronics packaging, medical electronics packaging, Trends, Challenges, Driving Forces on Packaging Technology, Materials for Microelectronic packaging, Packaging Material Properties, Ceramics, Polymers, and Metals in Packaging, Material for high density interconnect substrates

**UNIT II ELECTRICAL ISSUES IN PACKAGING 9**

Electrical Issues of Systems Packaging, Signal Distribution, Power Distribution, Electromagnetic Interference, Transmission Lines, Clock Distribution, Noise Sources, Digital and RF Issues. Design Process Electrical Design: Interconnect Capacitance, Resistance and Inductance fundamentals; Packaging roadmaps - Hybrid circuits - Resistive, Capacitive and Inductive parasitics

**UNIT III CHIP PACKAGES 9**

IC Assembly - Purpose, Requirements, Technologies, Wire bonding, Tape Automated Bonding, Flip Chip, Wafer Level Packaging, reliability, wafer level burn – in and test. Single chip packaging: functions, types, materials processes, properties, characteristics, trends. Multi chip packaging: types, design, comparison, trends. System – in - package (SIP); Passives: discrete, integrated, and embedded

**UNIT IV PCB, SURFACE MOUNT TECHNOLOGY AND THERMAL CONSIDERATIONS 9**

Printed Circuit Board: Anatomy, CAD tools for PCB design, Standard fabrication, Micro via Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges. Thermal Management, Heat transfer fundamentals, Thermal conductivity and resistance, Conduction, convection and radiation – Cooling requirements

**UNIT V TESTING 9**

Reliability, Basic concepts, Environmental interactions. Thermal mismatch and fatigue – failures – thermo mechanically induced – electrically induced – chemically induced. Electrical Testing: System level electrical testing, Interconnection tests, Active Circuit Testing, Design for Testability

**TOTAL:45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Give a comprehensive introduction to the various packaging types used along with the

associated thermal, speed, signal and integrity power issues

- Enable design of packages which can withstand higher temperature, vibrations and shock
- Design of PCBs which minimize the EMI and operate at higher frequency
- Analyze the concepts of Testing and testing methods

**TEXT BOOK:**

1. Tummala, Rao R., Fundamentals of Microsystems Packaging, McGraw Hill, 2001

**REFERENCES:**

1. Blackwell (Ed), The electronic packaging handbook, CRC Press, 2000.
2. Tummala, Rao R, Microelectronics packaging handbook, McGraw Hill, 2008.
3. Bosshart, Printed Circuit Boards Design and Technology, TataMcGraw Hill, 1988.
4. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011
5. R.S.Khandpur, Printed Circuit Board, Tata McGraw Hill, 2005
6. Recent literature in Electronic Packaging
7. Michael L. Bushnell & Vishwani D. Agrawal, "Essentials of Electronic Testing for Digital, memory & Mixed signal VLSI Circuits", Kluwer Academic Publishers.2000.
8. M. Abramovici, M. A. Breuer, and A.D. Friedman, "Digital System Testing and Testable Design", Computer Science Press, 1990

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| <b>EC8006</b> | <b>MIXED SIGNAL IC DESIGN</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                               | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

**The student should be made to:**

- Study the mixed signal of submicron CMOS circuits
- Understand the various integrated based filters and topologies
- Learn the data converters architecture, modeling and signal to noise ratio
- Study the integrated circuit of oscillators and PLLs

**UNIT I SUBMICRON CMOS CIRCUIT DESIGN 9**

Submicron CMOS: Overview and Models, CMOS process flow, Capacitors and Resistors. Digital circuit design: The MOSFET Switch, Delay Elements, An Adder. Analog Circuit Design: Biasing, Op-Amp Design, Circuit Noise.

**UNIT II INTEGRATOR BASED CMOS FILTERS 9**

Integrator Building Blocks- low pass filter, Active RC integrators, MOSFET-C Integrators,  $g_m$ -C integrators, Discrete time integrators. Filtering Topologies: The Bilinear transfer function, The Biquadratic transfer function, Filters using Noise shaping.

**UNIT III DATA CONVERTER ARCHITECTURES 9**

DAC Architectures- Resistor string, R-2R ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, and Pipeline DAC. ADC Architectures- Flash, Two-step flash ADC, Pipeline ADC, Integrating ADC's, Successive Approximation ADC.

**UNIT IV DATA CONVERTER MODELING AND SNR 9**

Sampling and Aliasing: A modeling approach, Impulse sampling, The sample and Hold, Quantization noise. Data converter SNR: An overview, Clock Jitter, Improving SNR using Averaging, Decimating filter for ADCs, Interpolating filter for DACs, Band pass and High pass sinc filters - Using feedback to improve SNR.

**UNIT V OSCILLATORS AND PLL 9**

LC oscillators, Voltage Controlled Oscillators. Simple PLL, Charge pumps PLLs, Non ideal effects in PLLs, Delay Locked Loops.

**OUTCOMES:**

**Upon completion of the course, student should be able to**

- Apply the concepts for mixed signal MOS circuit.
- Analyze the characteristics of IC based CMOS filters.
- Design of various data converter architecture circuits.
- Analyze the signal to noise ratio and modeling of mixed signals.
- Design of oscillators and phase lock loop circuit.

**REFERENCES:**

1. CMOS Mixed Signal Circuit Design by R.Jacob Baker, Wiley India, IEEE Press, reprint 2008.
2. CMOS Circuit Design, Layout and Simulation by R.Jacob Baker, Wiley India, IEEE Press, Second Edition, reprint 2009.
3. Design of Analog CMOS Integrated Circuits by Behzad Razavi, McGraw Hill, 33<sup>rd</sup> Reprint, 2016.

**GE8071****DISASTER MANAGEMENT****LT P C  
3 0 0 3****OBJECTIVES:**

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

**UNIT I INTRODUCTION TO DISASTERS****9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

**UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR)****9**

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

**UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT****9**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

**UNIT IV DISASTER RISK MANAGEMENT IN INDIA****9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes



**UNIT IV EMC DESIGN FOR CIRCUITS AND PCBs 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 V EMI MEASUREMENTS AND STANDARDS 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:45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Identify the various types and mechanisms of Electromagnetic Interference
- Propose a suitable EMI mitigation technique
- Describe the various EMC Standards and methods to measure them

**TEXT BOOKS:**

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)

**REFERENCES:**

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.

|               |                             |          |          |          |          |
|---------------|-----------------------------|----------|----------|----------|----------|
| <b>EC8007</b> | <b>LOW POWER SoC DESIGN</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                             | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

**The student should be made to:**

- Identify sources of power in an IC.
- Understand basic principle of System on Chip design
- Learn optimization of power in combinational and sequential logic machines for SoC Design
- Identify suitable techniques to reduce the power dissipation and design circuits with low power dissipation.

**UNIT I POWER CONSUMPTION IN CMOS 9**

Physics of power dissipation in CMOS FET devices – Hierarchy of limits of power – Sources of power consumption – Static Power Dissipation, Active Power Dissipation - Designing for Low Power, Circuit Techniques for Leakage Power Reduction - Basic principle of low power design, Logic level power optimization – Circuit level low power design.

**UNIT II SYSTEM-ON-CHIP DESIGN 9**

System-on-Chip Concept, Design Principles in SoC Architecture, SoC Design Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus-Based Communication Architectures. High performance algorithms for ASICs/ SoCs as case studies – Canonic Signed Digit Arithmetic, KCM, Distributed Arithmetic, High performance digital filters for sigma-delta ADC

**UNIT III POWER OPTIMIZATION OF COMBINATIONAL AND SEQUENTIAL LOGIC MACHINES FOR SOC 9**

Introduction to Standard Cell-Based Layout – Simulation - Combinational Network Delay - Logic and interconnect Design - Power Optimization - Switch Logic Networks. Introduction - Latches and Flip-Flops - Sequential Systems and Clocking Disciplines - Sequential System Design - Power Optimization - Design Validation - Sequential Testing.

**UNIT IV DESIGN OF LOW POWER CIRCUITS FOR SUB SYSTEM ON A SOC 9**

Subsystem Design Principles - Combinational Shifters – Adders – ALUs – Multipliers – High Density Memory – Field Programmable Gate Arrays - Programmable Logic Arrays - Computer arithmetic techniques for low power system – low voltage low power static Random access and dynamic Random access memories, low power clock, Inter connect and layout design

**UNIT V FLOOR PLANNING 9**

Floor-planning Methods – Block Placement & Channel Definition - Global Routing - switchbox Routing - Power Distribution - Clock Distributions - Floor-planning Tips - Design Validation - Off-Chip Connections – Packages, The I/O Architecture - PAD Design

**TOTAL:45 PERIODS**

**OUTCOME:**

**At the end of the course, the student should be able to:**

- Analyze and design low-power VLSI circuits using different circuit technologies for system on chip design

**TEXT BOOKS:**

- J.Rabaey, “Low Power Design Essentials (Integrated Circuits and Systems)”, Springer, 2009
- Wayne Wolf, “Modern VLSI Design – System – on – Chip Design”, Prentice Hall, 3rd Edition, 2008.

**REFERENCES:**

- J.B.Kuo & J.H.Lou, “Low-voltage CMOS VLSI Circuits”, Wiley, 1999.
- A.Bellaowar & M.I.Elmasry, “Low power Digital VLSI Design, Circuits and Systems”, Kluwer, 1996.
- Wayne Wolf, “Modern VLSI Design – IP based Design”, Prentice Hall, 4th Edition, 2008.
- M.J.S. Smith : Application Specific Integrated Circuits, Pearson, 2003
- Sudeep Pasricha and NikilDutt, On-Chip Communication Architectures System on Chip Interconnect, Elsevier, 2008
- Recent literature in Low Power VLSI Circuits.
- Recent literature in Design of ASICs

**EC8008**

**PHOTONIC NETWORKS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To enable the student to understand the importance of the backbone infrastructure for our present and future communication needs and familiarize them with the architectures and the protocol stack in use
- To enable the student to understand the differences in the design of data plane and the control plane and the routing, switching and the resource allocation methods and the network management and protection methods in vogue
- To expose the student to the advances in networking and switching domains and the future trends



**UNIT I OPTICAL SYSTEM COMPONENTS 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 II OPTICAL NETWORK ARCHITECTURES 9**  
 Introduction to Optical Networks; SONET / SDH, Metropolitan-Area Networks, Layered Architecture; Broadcast and Select Networks – Topologies for Broadcast Networks, Media-Access Control Protocols, Wavelength Routing Architecture.

**UNIT III WAVELENGTH ROUTING NETWORKS 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 IV PACKET SWITCHING AND ACCESS NETWORKS 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 V NETWORK DESIGN AND MANAGEMENT 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:45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student would be able to:**

- Use the backbone infrastructure for our present and future communication needs
- Analyze the architectures and the protocol stack
- Compare the differences in the design of data plane, control plane, routing, switching, resource allocation methods, network management and protection methods in vogue

**REFERENCES:**

1. Rajiv Ramaswami and Kumar N. Sivarajan, “Optical Networks: A Practical Perspective”, Harcourt Asia Pte Ltd., Second Edition 2004.
2. C. Siva Ram Moorthy and Mohan Gurusamy, “WDM Optical Networks: Concept, Design and Algorithms”, Prentice Hall of India, 1st Edition, 2002.
3. P.E. Green, Jr., “Fiber Optic Networks”, Prentice Hall, NJ, 1993.
4. Biswanath Mukherjee, “Optical WDM Networks”, Springer Series, 2006.

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| <b>EC8009</b> | <b>COMPRESSIVE SENSING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                            | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To present the basic theory and ideas showing when it is possible to reconstruct sparse or nearly sparse signals from undersampled data
- To expose students to recent ideas in modern convex optimization allowing rapid signal recovery
- To give students a sense of real time applications that might benefit from compressive sensing ideas

**UNIT I INTRODUCTION TO COMPRESSED SENSING 9**

Introduction; Motivation; Mathematical Background; Traditional Sampling; Traditional Compression; Conventional Data Acquisition System; Drawbacks of Transform coding; Compressed Sensing (CS).

**UNIT II SPARSITY AND SIGNAL RECOVERY 9**

Signal Representation; Basis vectors; Sensing matrices; Restricted Isometric Property; Coherence; Stable recovery; Number of measurements.

**UNIT III RECOVERY ALGORITHMS 9**

Basis Pursuit algorithm: L1 minimization; Matching pursuit: Orthogonal Matching Pursuit(OMP), Stagewise OMP, Regularized OMP, Compressive Sampling Matching Pursuit (CoSaMP); Iterative Thresholding algorithm: Hard thresholding, Soft thresholding; Model based : Model based CoSaMP, Model based HIT.

**UNIT IV COMPRESSIVE SENSING FOR WSN 9**

Basics of WSN; Wireless Sensor without Compressive Sensing; Wireless Sensor with Compressive Sensing; Compressive Wireless Sensing: Spatial compression in WSNs, Projections in WSNs, Compressed Sensing in WSNs.

**UNIT V APPLICATIONS OF COMPRESSIVE SENSING 9**

Compressed Sensing for Real-Time Energy-Efficient Compression on Wireless Body Sensor Nodes; Compressive sensing in video surveillance; An Application of Compressive Sensing for Image Fusion; Single-Pixel Imaging via Compressive Sampling.

**TOTAL:45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Appreciate the motivation and the necessity for compressed sensing technology.
- Design a new algorithm or modify an existing algorithm for different application areas in wireless sensor network.

**TEXT BOOKS:**

1. Radha S, Hemalatha R, Aasha Nandhini S, "Compressive Sensing for Wireless Communication: Challenges and Opportunities", River publication, 2016. (UNIT I-V)
2. Mark A. Davenport, Marco F. Duarte, Yonina C. Eldar and Gitta Kutyniok, "Introduction to Compressed Sensing," in Compressed Sensing: Theory and Applications, Y. Eldar and G. Kutyniok, eds., Cambridge University Press, 2011 (UNIT I)

**REFERENCES:**

1. Duarte, M.F.; Davenport, M.A.; Takhar, D.; Laska, J.N.; Ting Sun; Kelly, K.F.; Baraniuk, R.G.; , "Single-Pixel Imaging via Compressive Sampling," Signal Processing Magazine, IEEE, vol.25, no.2, pp.83-91, March 2008.
2. Tao Wan.; Zengchang Qin.; , "An application of compressive sensing for image fusion", CIVR '10 Proceedings of the ACM International Conference on Image and Video Retrieval, Pages 3-9.
3. H. Mamaghanian , N. Khaled , D. Atienza and P. Vanderghyest "Compressed sensing for real-time energy-efficient ecg compression on wireless body sensor nodes", IEEE Trans. Biomed. Eng., vol. 58, no. 9, pp.2456 -2466 2011.
4. Mohammadreza Balouchestani.; Kaamran Raahemifar.; and Sridhar Krishnan.;; "COMPRESSED SENSING IN WIRELESS SENSOR NETWORKS: SURVEY" , Canadian Journal on Multimedia and Wireless Networks Vol. 2, No. 1, February 2011.

**OBJECTIVES:**

- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods

**UNIT I DIGITAL IMAGE FUNDAMENTALS****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 II IMAGE ENHANCEMENT****9**

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

**UNIT III IMAGE RESTORATION****9**

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

**UNIT IV IMAGE SEGMENTATION****9**

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

**UNIT V IMAGE COMPRESSION AND RECOGNITION****9**

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

**TOTAL :45 PERIODS****OUTCOMES:**

**At the end of the course, the students should be able to:**

- Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
- Operate on images using the techniques of smoothing, sharpening and enhancement.
- Understand the restoration concepts and filtering techniques.
- Learn the basics of segmentation, features extraction, compression and recognition methods for color models.

**TEXT BOOKS:**

1. Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson, Third Edition, 2010.
2. Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson, 2002.

**REFERENCES**

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 RM. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002
5. Milan Sonka et al 'Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.

**GE8076****PROFESSIONAL ETHICS IN ENGINEERING****L T P C  
3 0 0 3****OBJECTIVE:**

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

**UNIT I HUMAN VALUES****10**

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 – Introduction to Yoga and meditation for professional excellence and stress management.

**UNIT II ENGINEERING ETHICS****9**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

**UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION****9**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

**UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS****9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

**UNIT V GLOBAL ISSUES****8**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

**TEXT BOOKS:**

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

**REFERENCES:**

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd., New Delhi, 2013.
6. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011.

**Web sources:**

1. [www.onlineethics.org](http://www.onlineethics.org)
2. [www.nspe.org](http://www.nspe.org)
3. [www.globalethics.org](http://www.globalethics.org)
4. [www.ethics.org](http://www.ethics.org)

**EC8010****VIDEO ANALYTICS**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:****The student should be made:**

- To understand the need for video Analytics
- To understand the basic configuration of video analytics
- To understand the functional blocks of a video analytic system
- To get exposed to the various applications of video analytics

**UNIT I VIDEO ANALYTIC COMPONENTS****9**

Need for Video Analytics-Overview of video Analytics- Foreground extraction- Feature extraction-classifier - Preprocessing- edge detection- smoothing- Feature space-PCA-FLD-SIFT features

**UNIT II FOREGROUND EXTRACTION****9**

Background estimation- Averaging- Gaussian Mixture Model- Optical Flow based- Image Segmentation- Region growing- Region splitting-Morphological operations- erosion-Dilation-Tracking in a multiple camera environment

**UNIT III CLASSIFIERS****9**

Neural networks (back propagation) - Deep learning networks- Fuzzy Classifier- Bayesian classifier-HMM based classifier

**UNIT IV VIDEO ANALYTICS FOR SECURITY** **9**  
 Abandoned object detection- human behavioral analysis -human action recognition- perimeter security- crowd analysis and prediction of crowd congestion

**UNIT V VIDEO ANALYTICS FOR BUSINESS INTELLIGENCE & TRAFFIC MONITORING AND ASSISTANCE** **9**

Customer behavior analysis - people counting- Traffic rule violation detection- traffic congestion identification for route planning- driver assistance- lane change warning

**TOTAL :45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Design video analytic algorithms for security applications
- Design video analytic algorithms for business intelligence
- Design custom made video analytics system for the given target application

**REFERENCES:**

1. Graeme A. Jones (Editor), Nikos Paragios (Editor), Carlo S. Regazzoni (Editor) Video-Based Surveillance Systems: Computer Vision and Distributed Processing , Kluwer academic publisher, 2001
2. Nilanjan Dey (Editor), Amira Ashour (Editor) and Suvojit Acharjee (Editor), Applied Video Processing in Surveillance and Monitoring Systems (IGI global) 2016
3. Zhihao Chen (Author), Ye Yang (Author), Jingyu Xue (Author), Liping Ye (Author), Feng Guo (Author), The Next Generation of Video Surveillance and Video Analytics: The Unified Intelligent Video Analytics Suite, CreateSpace Independent Publishing Platform, 2014
4. Caifeng Shan (Editor), Fatih Porikli (Editor), Tao Xiang (Editor), Shaogang Gong (Editor) Video Analytics for Business Intelligence, Springer, 2012

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|---------------|---|----------|----------|----------|----------|
| <b>EC8011</b> | <b>DSP PROCESSOR ARCHITECTURE AND PROGRAMMING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

**The objective of this course is to provide knowledge on:**

- Basics on Digital Signal Processors
- Programmable DSP's Architecture, On-chip Peripherals and Instruction set
- Programming for signal processing applications
- Advanced Programmable DSP Processors

**UNIT I FUNDAMENTALS OF PROGRAMMABLE DSPs** **9**

Introduction to Programmable DSPs, Architectural Features of PDSPs - Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access – Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals, Applications of Programmable DSPs.

**UNIT II TMS320C5X PROCESSOR** **9**

Architecture of C5X Processor – Addressing modes – Assembly language Instructions - Pipeline structure, On-chip Peripherals – Block Diagram of DSP starter kit (DSK) – Software Tools, DSK on-board peripherals, Application Programs for processing real time signals.

**UNIT III TMS320C6X PROCESSOR 9**

Architecture of the C6x Processor - Instruction Set – Addressing modes, Assembler directives, On-chip peripherals, DSP Development System: DSP Starter Kit - Code Composer Studio - Support Files – Introduction to AIC23 codec and other on-board peripherals, Real-Time Programming Examples for Signals and Noise generation, Frequency analysis, Filter design.

**UNIT IV ADSP PROCESSORS 9**

Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions – Application programs –Filter design, FFT calculation.

**UNIT V ADVANCED PROCESSORS 9**

Study of TI's advanced processors - TMS320C674x and TMS320C55x DSPs, ADSP's Blackfin and SigmaDSP Processors, NXP's DSP56Fxx Family of DSP Processors, Comparison of the features of TI, ADSP and NXP DSP family processors.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Analyze the concepts of Digital Signal Processors
- Demonstrate their ability to program the DSP processor for signal processing applications
- Discuss, compare and select the suitable Advanced DSP Processors for real-time signal processing applications

**REFERENCES:**

1. B. Venkataramani and M. Bhaskar, "Digital Signal Processors – Architecture, Programming and Applications" – Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.
2. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, Cengage Learning India Private Limited, Delhi 2012.
3. Rulph Chassaing and Donald Reay, Digital Signal Processing and Applications with the C6713 and C6416 DSK, John Wiley & Sons, Inc., Publication, 2012 (Reprint).
4. User guides Texas Instruments, Analog Devices and NXP.

**EC8094**

**SATELLITE COMMUNICATION**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
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**OBJECTIVES:**

**The student should be made to:**

- Understand the basics of satellite orbits
- Understand the satellite segment and earth segment
- Analyze the various methods of satellite access
- Understand the applications of satellites
- Understand the basics of satellite Networks

**UNIT I SATELLITE ORBITS 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.

|   |  |                         |
|---|--|-------------------------|
| <b>UNIT II</b>  | <b>SPACE SEGMENT</b>                       | <b>9</b>                |
| Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders-The Antenna Subsystem. |  |                         |
| <b>UNIT III</b>   | <b>SATELLITE LINK DESIGN</b>               | <b>9</b>                |
| Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.   |  |                         |
| <b>UNIT IV</b>  | <b>SATELLITE ACCESS AND CODING METHODS</b> | <b>9</b>                |
| Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, DAMA Assignment Methods, compression – encryption, Coding Schemes.             |  |                         |
| <b>UNIT V</b>   | <b>SATELLITE APPLICATIONS</b>              | <b>9</b>                |
| INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles, Differential GPS, Direct Broadcast satellites (DBS/DTH).                  |  |                         |
|   |  | <b>TOTAL:45 PERIODS</b> |

**OUTCOMES:**

**At the end of the course, the student would be able to:**

- Analyze the satellite orbits
- Analyze the earth segment and space segment
- Analyze the satellite Link design
- Design various satellite applications

**TEXT BOOKS:**

1. Dennis Roddy, "Satellite Communication", 4th Edition, Mc Graw Hill International, 2006.
2. Timothy,Pratt,Charles,W.Bostain,JeremyE.Allnutt,"SatelliteCommunication",2<sup>nd</sup> Edition, Wiley Publications,2002

**REFERENCES:**

1. Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall/Pearson, 2007.
2. N.Agarwal, "Design of Geosynchronous Space Craft", Prentice Hall, 1986.
3. Bruce R. Elbert, "The Satellite Communication Applications", Hand Book, Artech House Boston London, 1997.
4. Tri T. Ha, "Digital Satellite Communication", II nd edition, 1990.
5. Emanuel Fthenakis, "Manual of Satellite Communications", Mc Graw Hill Book Co., 1984.
6. Robert G. Winch, "Telecommunication Trans Mission Systems", Mc Graw-Hill Book Co., 1983.
7. Brian Ackroyd, "World Satellite Communication and earth station Design", BSP professional Books, 1990.
8. G.B.Bleazard, "Introducing Satellite communications", NCC Publication, 1985.
9. M.Richharia, "Satellite Communication Systems-Design Principles", Macmillan 2003.



**OBJECTIVES:**

- To learn the basic concepts of Soft Computing
- To become familiar with various techniques like neural networks, genetic algorithms and fuzzy systems.
- To apply soft computing techniques to solve problems.

**UNIT I INTRODUCTION TO SOFT COMPUTING 9**

Introduction-Artificial Intelligence-Artificial Neural Networks-Fuzzy Systems-Genetic Algorithm and Evolutionary Programming-Swarm Intelligent Systems-Classification of ANNs-McCulloch and Pitts Neuron Model-Learning Rules: Hebbian and Delta- Perceptron Network-Adaline Network-Madaline Network.

**UNIT II ARTIFICIAL NEURAL NETWORKS 9**

Back propagation Neural Networks - Kohonen Neural Network -Learning Vector Quantization -Hamming Neural Network - Hopfield Neural Network- Bi-directional Associative Memory -Adaptive Resonance Theory Neural Networks- Support Vector Machines - Spike Neuron Models.

**UNIT III FUZZY SYSTEMS 9**

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations -Membership Functions -Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making.

**UNIT IV GENETIC ALGORITHMS 9**

Basic Concepts- Working Principles -Encoding- Fitness Function - Reproduction - Inheritance Operators - Cross Over - Inversion and Deletion -Mutation Operator - Bit-wise Operators -Convergence of Genetic Algorithm.

**UNIT V HYBRID SYSTEMS 9**

Hybrid Systems -Neural Networks, Fuzzy Logic and Genetic -GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon completion of this course, the students should be able to**

- Apply suitable soft computing techniques for various applications.
- Integrate various soft computing techniques for complex problems.

**TEXT BOOKS:**

1. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
2. S.N.Sivanandam, S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt.Ltd., 2nd Edition, 2011.
3. S.Rajasekaran, G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm, Synthesis and Applications", PHI Learning Pvt.Ltd., 2017.

**REFERENCES:**

1. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro-Fuzzy and Soft Computing", Prentice-Hall of India, 2002.



2. Ben Gold and Nelson Morgan "Speech and Audio signal processing- processing and perception of speech and music", John Wiley and sons 2006

## REFERENCES

1. Lawrence Rabiner, Biiing and– Hwang Juang and B.Yegnanarayana "Fundamentals of Speech Recognition", Pearson Education, 2009
2. Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons, 1999
3. Donglos O shanhnessy "Speech Communication: Human and Machine ", 2nd Ed. University press 2001.

**GE8073**

**FUNDAMENTALS OF NANOSCIENCE**

**L T P C  
3 0 0 3**

### OBJECTIVE:

To learn about basis of nanomaterial science, preparation method, types and application

### UNIT I INTRODUCTION

**8**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires- ultra-thin films-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

### UNIT II GENERAL METHODS OF PREPARATION

**9**

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

### UNIT III NANOMATERIALS

**12**

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO<sub>2</sub>, MgO, ZrO<sub>2</sub>, NiO, Nano alumina, CaO, AgTiO<sub>2</sub>, Ferrites, Nano clays- functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

### UNIT IV CHARACTERIZATION TECHNIQUES

**9**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

### UNIT V APPLICATIONS

**7**

Nano InfoTech: Information storage- Nano computer, molecular switch, super chip, nanocrystal, Nano biotechnology: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targeted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nano sensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sun barrier products - In Photostat, printing, solar cell, battery.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

**TEXT BOOKS:**

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Characterization of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

**REFERENCES:**

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.



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**ANNA UNIVERSITY, CHENNAI**  
**AFFILIATED INSTITUTIONS**  
**B.E. MECHANICAL ENGINEERING**  
**REGULATIONS – 2017**  
**CHOICE BASED CREDIT SYSTEM**

**PROGRAMME EDUCATIONAL OBJECTIVES:**

Bachelor of Mechanical Engineering curriculum is designed to impart Knowledge, Skill and Attitude on the graduates to

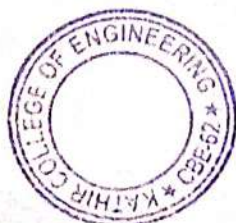
1. Have a successful career in Mechanical Engineering and allied industries.
2. Have expertise in the areas of Design, Thermal, Materials and Manufacturing.
3. Contribute towards technological development through academic research and industrial practices.
4. Practice their profession with good communication, leadership, ethics and social responsibility.
5. Graduates will adapt to evolving technologies through life-long learning.

**PROGRAMME OUTCOMES**

1. An ability to apply knowledge of mathematics and engineering sciences to develop mathematical models for industrial problems.
2. An ability to identify, formulate, and solve complex engineering problems. with high degree of competence.
3. An ability to design and conduct experiments, as well as to analyze and interpret data obtained through those experiments.
4. An ability to design mechanical systems, component, or a process to meet desired needs within the realistic constraints such as environmental, social, political and economic sustainability.
5. An ability to use modern tools, software and equipment to analyze multidisciplinary problems.
6. An ability to demonstrate on professional and ethical responsibilities.
7. An ability to communicate, write reports and express research findings in a scientific community.
8. An ability to adapt quickly to the global changes and contemporary practices.
9. An ability to engage in life-long learning.

**PEO / PO Mapping**

| Programme Educational Objectives | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|----------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| I                                | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   |
| II                               | ✓   | ✓   | ✓   |     | ✓   |     |     | ✓   |     |
| III                              |     | ✓   |     | ✓   | ✓   | ✓   |     | ✓   |     |
| IV                               |     |     |     |     | ✓   | ✓   | ✓   |     | ✓   |
| V                                |     | ✓   | ✓   | ✓   | ✓   |     |     |     | ✓   |



|   |              | <b>COURSE TITLE</b>   | <b>PO1</b>          | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PO6</b> | <b>PO7</b> | <b>PO8</b> | <b>PO9</b> |            |
|---|--------------|---|---------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| <b>YEAR 1</b>   | <b>SEM 1</b> | Communicative English   |                     |            |            |            |            |            | ✓          |            |            |            |
|   |              | Engineering Mathematics I                                     | ✓                   | ✓          | ✓          |            |            |            |            |            | ✓          |            |
|   |              | Engineering Physics   | ✓                   | ✓          | ✓          |            |            |            |            |            |            | ✓          |
|   |              | Engineering Chemistry   |                     |            |            | ✓          |            |            |            |            |            |            |
|   |              | Problem Solving and Python Programming                        |                     |            |            |            |            | ✓          |            |            |            |            |
|   |              | Engineering Graphics  |                     | ✓          | ✓          |            |            |            |            | ✓          |            |            |
|   |              | Problem Solving and Python Programming Laboratory             |                     |            | ✓          |            |            | ✓          |            |            |            |            |
|   |              | Physics and Chemistry Laboratory                              |                     |            | ✓          |            |            |            |            |            |            |            |
|   |              |   | <b>COURSE TITLE</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PO6</b> | <b>PO7</b> | <b>PO8</b> | <b>PO9</b> |
|   | <b>SEM 2</b> | Technical English   |                     |            |            |            |            |            |            | ✓          |            |            |
|   |              | Engineering Mathematics II                                    | ✓                   | ✓          | ✓          |            |            |            |            | ✓          |            | ✓          |
|   |              | Materials Science   |                     |            |            | ✓          |            |            |            |            | ✓          |            |
|   |              | Basic Electrical, Electronics and Instrumentation Engineering |                     |            |            | ✓          |            |            |            |            | ✓          |            |
|   |              | Environmental Science and Engineering                         |                     |            |            | ✓          |            |            |            |            |            |            |
|   |              | Engineering Mechanics   | ✓                   | ✓          |            |            |            |            |            | ✓          | ✓          | ✓          |
| Engineering Practices Laboratory                              |              |   |                     | ✓          |            |            |            |            |            |            |            |            |
| Basic Electrical, Electronics and Instrumentation Engineering |              |   |                     | ✓          |            |            |            |            |            |            |            |            |
|   |              | <b>COURSE TITLE</b>   | <b>PO1</b>          | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PO6</b> | <b>PO7</b> | <b>PO8</b> | <b>PO9</b> |            |
| <b>YEAR 2</b>   | <b>SEM 3</b> | Transforms and Partial Differential Equations                 | ✓                   | ✓          | ✓          |            |            |            |            | ✓          | ✓          |            |
|   |              | Engineering Thermodynamics                                    | ✓                   | ✓          | ✓          |            |            |            | ✓          | ✓          |            |            |
|   |              | Fluid Mechanics and Machinery                                 | ✓                   | ✓          | ✓          |            |            |            |            |            |            |            |
|   |              | Manufacturing Technology - I                                  |                     |            | ✓          | ✓          | ✓          | ✓          |            |            | ✓          | ✓          |
|   |              | Electrical Drives and Controls                                |                     |            |            |            |            |            |            |            |            |            |
|   |              | Manufacturing Technology Laboratory - I                       |                     |            | ✓          | ✓          | ✓          | ✓          |            |            | ✓          | ✓          |
|   |              | Computer Aided Machine Drawing                                |                     |            | ✓          | ✓          | ✓          | ✓          |            |            | ✓          | ✓          |
|   |              | Electrical Engineering Laboratory                             |                     |            | ✓          |            |            |            |            |            |            |            |
|   |              | Interpersonal Skills / Listening & Speaking                   |                     |            | ✓          |            |            |            |            |            |            |            |
|   |              |   | <b>COURSE TITLE</b> | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PO6</b> | <b>PO7</b> | <b>PO8</b> | <b>PO9</b> |
|   | <b>SEM 4</b> | Statistics and Numerical Methods                              | ✓                   | ✓          |            |            |            |            |            |            |            |            |
|   |              | Kinematics of Machinery                                       | ✓                   | ✓          | ✓          |            | ✓          |            |            |            |            |            |
|   |              | Manufacturing Technology- II                                  | ✓                   |            | ✓          | ✓          | ✓          |            |            |            | ✓          | ✓          |
|   |              | Engineering Metallurgy  |                     |            |            |            |            |            |            | ✓          |            |            |

|        |                                |  |   |            |            |            |            |            |            |            |            |            |
|--------|--------------------------------|--|---|------------|------------|------------|------------|------------|------------|------------|------------|------------|
|        |                                | Strength of Materials for Mechanical Engineers                 | ✓                                       | ✓          | ✓          | ✓          |            |            |            |            |            |            |
|        |                                | Thermal Engineering- I   | ✓                                       | ✓          |            |            | ✓          |            |            |            |            |            |
|        |                                | Manufacturing Technology Laboratory-II                         |   |            | ✓          |            |            |            |            |            |            |            |
|        |                                | Strength of Materials and Fluid Mechanics Machinery Laboratory |   |            | ✓          |            |            |            |            |            |            |            |
|        |                                | Advanced Reading and Writing                                   |   |            |            |            |            | ✓          |            |            | ✓          |            |
|        |                                | <b>COURSE TITLE</b>  | <b>PO1</b>                              | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PO6</b> | <b>PO7</b> | <b>PO8</b> | <b>PO9</b> |            |
| YEAR 3 | SEM 5                          | Thermal Engineering- II  | ✓                                       | ✓          |            |            | ✓          |            |            | ✓          |            |            |
|        |                                | Design of Machine Elements                                     |   | ✓          |            | ✓          |            |            | ✓          | ✓          | ✓          |            |
|        |                                | Metrology and Measurements                                     | ✓                                       |            | ✓          | ✓          |            |            |            | ✓          | ✓          |            |
|        |                                | Dynamics of Machines   | ✓                                       | ✓          | ✓          |            | ✓          |            |            | ✓          |            |            |
|        |                                | Kinematics and Dynamics Laboratory                             | ✓                                       | ✓          | ✓          | ✓          |            |            |            |            |            |            |
|        |                                | Thermal Engineering Laboratory                                 | ✓                                       | ✓          | ✓          |            |            |            |            |            |            |            |
|        |                                | Metrology and Measurements Laboratory                          | ✓                                       | ✓          | ✓          | ✓          |            |            |            | ✓          |            |            |
|        |                                |  | <b>COURSE TITLE</b>                     | <b>PO1</b> | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PO6</b> | <b>PO7</b> | <b>PO8</b> | <b>PO9</b> |
|        |                                | SEM 6  | Design of Transmission Systems          |            | ✓          |            | ✓          |            |            | ✓          |            | ✓          |
|        |                                |  | Computer Aided Design and Manufacturing |            | ✓          | ✓          |            | ✓          |            |            |            |            |
|        |                                |  | Heat and Mass Transfer                  | ✓          | ✓          | ✓          | ✓          |            |            |            | ✓          | ✓          |
|        |                                |  | Finite Element Analysis                 | ✓          | ✓          |            | ✓          |            |            |            |            | ✓          |
|        |                                |  | Hydraulics and Pneumatics               | ✓          | ✓          |            | ✓          |            |            |            |            | ✓          |
|        |                                |  | C.A.D. / C.A.M. Laboratory              |            | ✓          | ✓          |            |            |            | ✓          |            |            |
|        | Design and Fabrication Project |  |   |            |            |            |            |            | ✓          | ✓          |            | ✓          |
|        |                                | Professional Communication                                     |   |            |            | ✓          | ✓          | ✓          | ✓          |            | ✓          |            |
|        |                                | <b>COURSE TITLE</b>  | <b>PO1</b>                              | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PO6</b> | <b>PO7</b> | <b>PO8</b> | <b>PO9</b> |            |
| YEAR 4 | SEM 7                          | Power Plant Engineering  | ✓                                       | ✓          | ✓          | ✓          |            |            |            | ✓          |            |            |
|        |                                | Mechatronics   | ✓                                       | ✓          | ✓          |            | ✓          |            |            | ✓          | ✓          |            |
|        |                                | Process Planning and Cost Estimation                           |   | ✓          |            | ✓          |            |            |            |            |            |            |
|        |                                | Simulation and Analysis Laboratory                             | ✓                                       |            |            |            | ✓          |            |            | ✓          |            |            |
|        |                                | Mechatronics Laboratory  | ✓                                       | ✓          | ✓          |            | ✓          |            |            |            | ✓          | ✓          |
|        |                                | Technical Seminar  |   |            |            |            |            |            |            | ✓          |            |            |
|        |                                | SEM 8  | Project Work                            | ✓          | ✓          | ✓          |            |            |            | ✓          | ✓          |            |
|        |                                |  | Principles of Management                |            |            |            |            |            |            | ✓          |            | ✓          |

**ANNA UNIVERSITY, CHENNAI**  
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**B.E. MECHANICAL ENGINEERING**  
**REGULATIONS - 2017**  
**CHOICE BASED CREDIT SYSTEM**  
**I TO VIII SEMESTERS CURRICULA AND SYLLABI**

**SEMESTER I**

| SL. NO            | COURSE CODE | COURSE TITLE                                      | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |           |           |
| 1.                | HS8151      | Communicative English                             | HS       | 4               | 4         | 0        | 0         | 4         |
| 2.                | MA8151      | Engineering Mathematics - I                       | BS       | 4               | 4         | 0        | 0         | 4         |
| 3.                | PH8151      | Engineering Physics                               | BS       | 3               | 3         | 0        | 0         | 3         |
| 4.                | CY8151      | Engineering Chemistry                             | BS       | 3               | 3         | 0        | 0         | 3         |
| 5.                | GE8151      | Problem Solving and Python Programming            | ES       | 3               | 3         | 0        | 0         | 3         |
| 6.                | GE8152      | Engineering Graphics                              | ES       | 6               | 2         | 0        | 4         | 4         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |           |           |
| 7.                | GE8161      | Problem Solving and Python Programming Laboratory | ES       | 4               | 0         | 0        | 4         | 2         |
| 8.                | BS8161      | Physics and Chemistry Laboratory                  | BS       | 4               | 0         | 0        | 4         | 2         |
| <b>TOTAL</b>      |             |   |          | <b>31</b>       | <b>19</b> | <b>0</b> | <b>12</b> | <b>25</b> |

**SEMESTER II**

| SL. NO            | COURSE CODE | COURSE TITLE   | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|--|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |  |          |                 |           |          |          |           |
| 1.                | HS8251      | Technical English  | HS       | 4               | 4         | 0        | 0        | 4         |
| 2.                | MA8251      | Engineering Mathematics - II   | BS       | 4               | 4         | 0        | 0        | 4         |
| 3.                | PH8251      | Materials Science  | BS       | 3               | 3         | 0        | 0        | 3         |
| 4.                | BE8253      | Basic Electrical, Electronics and Instrumentation Engineering            | ES       | 3               | 3         | 0        | 0        | 3         |
| 5.                | GE8291      | Environmental Science and Engineering                                    | HS       | 3               | 3         | 0        | 0        | 3         |
| 6.                | GE8292      | Engineering Mechanics  | ES       | 5               | 3         | 2        | 0        | 4         |
| <b>PRACTICALS</b> |             |  |          |                 |           |          |          |           |
| 7.                | GE8261      | Engineering Practices Laboratory   | ES       | 4               | 0         | 0        | 4        | 2         |
| 8.                | BE8261      | Basic Electrical, Electronics and Instrumentation Engineering Laboratory | ES       | 4               | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>      |             |  |          | <b>30</b>       | <b>20</b> | <b>2</b> | <b>8</b> | <b>25</b> |



### SEMESTER III

| SL. NO.          | COURSE CODE | COURSE TITLE                                  | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|------------------|-------------|---|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>    |             |   |          |                 |           |          |           |           |
| 1.               | MA8353      | Transforms and Partial Differential Equations | BS       | 4               | 4         | 0        | 0         | 4         |
| 2.               | ME8391      | Engineering Thermodynamics                    | PC       | 5               | 3         | 2        | 0         | 4         |
| 3.               | CE8394      | Fluid Mechanics and Machinery                 | ES       | 4               | 4         | 0        | 0         | 4         |
| 4.               | ME8351      | Manufacturing Technology - I                  | PC       | 3               | 3         | 0        | 0         | 3         |
| 5.               | EE8353      | Electrical Drives and Controls                | ES       | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICAL</b> |             |   |          |                 |           |          |           |           |
| 6.               | ME8361      | Manufacturing Technology Laboratory - I       | PC       | 4               | 0         | 0        | 4         | 2         |
| 7.               | ME8381      | Computer Aided Machine Drawing                | PC       | 4               | 0         | 0        | 4         | 2         |
| 8.               | EE8361      | Electrical Engineering Laboratory             | ES       | 4               | 0         | 0        | 4         | 2         |
| 9.               | HS8381      | Interpersonal Skills / Listening & Speaking   | EEC      | 2               | 0         | 0        | 2         | 1         |
| <b>TOTAL</b>     |             |   |          | <b>33</b>       | <b>17</b> | <b>2</b> | <b>14</b> | <b>25</b> |

### SEMESTER IV

| SL. NO.          | COURSE CODE | COURSE TITLE   | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|------------------|-------------|--|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>    |             |  |          |                 |           |          |           |           |
| 1.               | MA8452      | Statistics and Numerical Methods                                   | BS       | 4               | 4         | 0        | 0         | 4         |
| 2.               | ME8492      | Kinematics of Machinery  | PC       | 3               | 3         | 0        | 0         | 3         |
| 3.               | ME8451      | Manufacturing Technology - II                                      | PC       | 3               | 3         | 0        | 0         | 3         |
| 4.               | ME8491      | Engineering Metallurgy   | PC       | 3               | 3         | 0        | 0         | 3         |
| 5.               | CE8395      | Strength of Materials for Mechanical Engineers                     | ES       | 3               | 3         | 0        | 0         | 3         |
| 6.               | ME8493      | Thermal Engineering- I   | PC       | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICAL</b> |             |  |          |                 |           |          |           |           |
| 7.               | ME8462      | Manufacturing Technology Laboratory - II                           | PC       | 4               | 0         | 0        | 4         | 2         |
| 8.               | CE8381      | Strength of Materials and Fluid Mechanics and Machinery Laboratory | ES       | 4               | 0         | 0        | 4         | 2         |
| 9.               | HS8461      | Advanced Reading and Writing                                       | EEC      | 2               | 0         | 0        | 2         | 1         |
| <b>TOTAL</b>     |             |  |          | <b>29</b>       | <b>19</b> | <b>0</b> | <b>10</b> | <b>24</b> |

### SEMESTER V

| SL. NO.          | COURSE CODE | COURSE TITLE                          | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|------------------|-------------|---------------------------------------|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>    |             |                                       |          |                 |           |          |           |           |
| 1.               | ME8595      | Thermal Engineering- II               | PC       | 3               | 3         | 0        | 0         | 3         |
| 2.               | ME8593      | Design of Machine Elements            | PC       | 3               | 3         | 0        | 0         | 3         |
| 3.               | ME8501      | Metrology and Measurements            | PC       | 3               | 3         | 0        | 0         | 3         |
| 4.               | ME8594      | Dynamics of Machines                  | PC       | 4               | 4         | 0        | 0         | 4         |
| 5.               |             | Open Elective I                       | OE       | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICAL</b> |             |                                       |          |                 |           |          |           |           |
| 6.               | ME8511      | Kinematics and Dynamics Laboratory    | PC       | 4               | 0         | 0        | 4         | 2         |
| 7.               | ME8512      | Thermal Engineering Laboratory        | PC       | 4               | 0         | 0        | 4         | 2         |
| 8.               | ME8513      | Metrology and Measurements Laboratory | PC       | 4               | 0         | 0        | 4         | 2         |
| <b>TOTAL</b>     |             |                                       |          | <b>28</b>       | <b>16</b> | <b>0</b> | <b>12</b> | <b>22</b> |

### SEMESTER VI

| SL. NO.          | COURSE CODE | COURSE TITLE                            | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|------------------|-------------|---|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>    |             |   |          |                 |           |          |           |           |
| 1.               | ME8651      | Design of Transmission Systems          | PC       | 3               | 3         | 0        | 0         | 3         |
| 2.               | ME8691      | Computer Aided Design and Manufacturing | PC       | 3               | 3         | 0        | 0         | 3         |
| 3.               | ME8693      | Heat and Mass Transfer                  | PC       | 5               | 3         | 2        | 0         | 4         |
| 4.               | ME8692      | Finite Element Analysis                 | PC       | 3               | 3         | 0        | 0         | 3         |
| 5.               | ME8694      | Hydraulics and Pneumatics               | PC       | 3               | 3         | 0        | 0         | 3         |
| 6.               |             | Professional Elective - I               | PE       | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICAL</b> |             |   |          |                 |           |          |           |           |
| 7.               | ME8681      | CAD / CAM Laboratory                    | PC       | 4               | 0         | 0        | 4         | 2         |
| 8.               | ME8682      | Design and Fabrication Project          | EEC      | 4               | 0         | 0        | 4         | 2         |
| 9.               | HS8581      | Professional Communication              | EEC      | 2               | 0         | 0        | 2         | 1         |
| <b>TOTAL</b>     |             |   |          | <b>30</b>       | <b>18</b> | <b>2</b> | <b>10</b> | <b>24</b> |

**SEMESTER VII**

| SL. NO.          | COURSE CODE | COURSE TITLE                         | CATEGORY | CONTACT PERIODS | L         | T        | P         | C         |
|------------------|-------------|--------------------------------------|----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>    |             |                                      |          |                 |           |          |           |           |
| 1.               | ME8792      | Power Plant Engineering              | PC       | 3               | 3         | 0        | 0         | 3         |
| 2.               | ME8793      | Process Planning and Cost Estimation | PC       | 3               | 3         | 0        | 0         | 3         |
| 3.               | ME8791      | Mechatronics                         | PC       | 3               | 3         | 0        | 0         | 3         |
| 4.               |             | Open Elective - II                   | OE       | 3               | 3         | 0        | 0         | 3         |
| 5.               |             | Professional Elective - II           | PE       | 3               | 3         | 0        | 0         | 3         |
| 6.               |             | Professional Elective - III          | PE       | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICAL</b> |             |                                      |          |                 |           |          |           |           |
| 7.               | ME8711      | Simulation and Analysis Laboratory   | PC       | 4               | 0         | 0        | 4         | 2         |
| 8.               | ME8781      | Mechatronics Laboratory              | PC       | 4               | 0         | 0        | 4         | 2         |
| 9.               | ME8712      | Technical Seminar                    | EEC      | 2               | 0         | 0        | 2         | 1         |
| <b>TOTAL</b>     |             |                                      |          | <b>28</b>       | <b>18</b> | <b>0</b> | <b>10</b> | <b>23</b> |

**SEMESTER VIII**

| SL. NO.          | COURSE CODE | COURSE TITLE              | CATEGORY | CONTACT PERIODS | L        | T        | P         | C         |
|------------------|-------------|---------------------------|----------|-----------------|----------|----------|-----------|-----------|
| <b>THEORY</b>    |             |                           |          |                 |          |          |           |           |
| 1.               | MG8591      | Principles of Management  | HS       | 3               | 3        | 0        | 0         | 3         |
| 2.               |             | Professional Elective- IV | PE       | 3               | 3        | 0        | 0         | 3         |
| <b>PRACTICAL</b> |             |                           |          |                 |          |          |           |           |
| 3.               | ME8811      | Project Work              | EEC      | 20              | 0        | 0        | 20        | 10        |
| <b>TOTAL</b>     |             |                           |          | <b>29</b>       | <b>9</b> | <b>0</b> | <b>20</b> | <b>16</b> |

**TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 184**

### HUMANITIES AND SOCIAL SCIENCES (HS)

| SL. NO. | COURSE CODE | COURSE TITLE                          | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|---------------------------------------|----------|-----------------|---|---|---|---|
| 1.      | HS8151      | Communicative English                 | HS       | 4               | 4 | 0 | 0 | 4 |
| 2.      | HS8251      | Technical English                     | HS       | 4               | 4 | 0 | 0 | 4 |
| 3.      | GE8291      | Environmental Science and Engineering | HS       | 3               | 3 | 0 | 0 | 3 |
| 4.      | MG8591      | Principles of Management              | HS       | 3               | 3 | 0 | 0 | 3 |

### BASIC SCIENCE (BS)

| SL. NO. | COURSE CODE | COURSE TITLE                                  | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|---|----------|-----------------|---|---|---|---|
| 1.      | MA8151      | Engineering Mathematics - I                   | BS       | 5               | 3 | 2 | 0 | 4 |
| 2.      | PH8151      | Engineering Physics                           | BS       | 3               | 3 | 0 | 0 | 3 |
| 3.      | CY8151      | Engineering Chemistry                         | BS       | 3               | 3 | 0 | 0 | 3 |
| 4.      | BS8161      | Physics and Chemistry Laboratory              | BS       | 4               | 0 | 0 | 4 | 2 |
| 5.      | MA8251      | Engineering Mathematics II                    | BS       | 4               | 4 | 0 | 0 | 4 |
| 6.      | PH8251      | Materials Science                             | BS       | 3               | 3 | 0 | 0 | 3 |
| 7.      | MA8353      | Transforms and Partial Differential Equations | BS       | 4               | 4 | 0 | 0 | 4 |
| 8.      | MA8452      | Statistics and Numerical Methods              | BS       | 4               | 4 | 0 | 0 | 4 |

### ENGINEERING SCIENCES (ES)

| SL. NO. | COURSE CODE | COURSE TITLE   | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|--|----------|-----------------|---|---|---|---|
| 1.      | GE8151      | Problem Solving and Python Programming                                   | ES       | 3               | 3 | 0 | 0 | 3 |
| 2.      | GE8152      | Engineering Graphics   | ES       | 6               | 2 | 0 | 4 | 4 |
| 3.      | GE8161      | Problem Solving and Python Programming Laboratory                        | ES       | 4               | 0 | 0 | 4 | 2 |
| 4.      | BE8253      | Basic Electrical, Electronics and Instrumentation Engineering            | ES       | 3               | 3 | 0 | 0 | 3 |
| 5.      | GE8292      | Engineering Mechanics  | ES       | 5               | 3 | 2 | 0 | 4 |
| 6.      | GE8261      | Engineering Practices Laboratory   | ES       | 4               | 0 | 0 | 4 | 2 |
| 7.      | BE8261      | Basic Electrical, Electronics and Instrumentation Engineering Laboratory | ES       | 4               | 0 | 0 | 4 | 2 |
| 8.      | CE8394      | Fluid Mechanics and Machinery  | ES       | 5               | 3 | 2 | 0 | 4 |
| 9.      | EE8353      | Electrical Drives and Controls   | ES       | 3               | 3 | 0 | 0 | 3 |
| 10.     | EE8361      | Electrical Engineering Laboratory  | ES       | 4               | 0 | 0 | 4 | 2 |
| 11.     | CE8395      | Strength of Materials for Mechanical Engineers                           | ES       | 3               | 3 | 0 | 0 | 3 |
| 12.     | CE8381      | Strength of Materials and Fluid Mechanics and Machinery Laboratory       | ES       | 4               | 0 | 0 | 4 | 2 |

**PROFESSIONAL CORE (PC)**

| SL. NO. | COURSE CODE | COURSE TITLE                            | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|---|----------|-----------------|---|---|---|---|
| 1.      | ME8391      | Engineering Thermodynamics              | PC       | 5               | 3 | 2 | 0 | 4 |
| 2.      | ME8351      | Manufacturing Technology - I            | PC       | 3               | 3 | 0 | 0 | 3 |
| 3.      | ME8361      | Manufacturing Technology Laboratory - I | PC       | 4               | 0 | 0 | 4 | 2 |
| 4.      | ME8381      | Computer Aided Machine Drawing          | PC       | 4               | 0 | 0 | 4 | 2 |
| 5.      | ME8492      | Kinematics of Machinery                 | PC       | 3               | 3 | 0 | 0 | 3 |
| 6.      | ME8451      | Manufacturing Technology- II            | PC       | 3               | 3 | 0 | 0 | 3 |
| 7.      | ME8491      | Engineering Metallurgy                  | PC       | 3               | 3 | 0 | 0 | 3 |
| 8.      | ME8493      | Thermal Engineering- I                  | PC       | 3               | 3 | 0 | 0 | 3 |
| 9.      | ME8462      | Manufacturing Technology Laboratory-II  | PC       | 4               | 0 | 0 | 4 | 2 |
| 10.     | ME8595      | Thermal Engineering- II                 | PC       | 3               | 3 | 0 | 0 | 3 |
| 11.     | ME8593      | Design of Machine Elements              | PC       | 3               | 3 | 0 | 0 | 3 |
| 12.     | ME8501      | Metrology and Measurements              | PC       | 3               | 3 | 0 | 0 | 3 |
| 13.     | ME8594      | Dynamics of Machines                    | PC       | 4               | 4 | 0 | 0 | 4 |
| 14.     | ME8511      | Kinematics and Dynamics Laboratory      | PC       | 4               | 0 | 0 | 4 | 2 |
| 15.     | ME8512      | Thermal Engineering Laboratory          | PC       | 4               | 0 | 0 | 4 | 2 |
| 16.     | ME8513      | Metrology and Measurements Laboratory   | PC       | 4               | 0 | 0 | 4 | 2 |
| 17.     | ME8651      | Design of Transmission Systems          | PC       | 3               | 3 | 0 | 0 | 3 |
| 18.     | ME8691      | Computer Aided Design and Manufacturing | PC       | 3               | 3 | 0 | 0 | 3 |
| 19.     | ME8693      | Heat and Mass Transfer                  | PC       | 5               | 3 | 2 | 0 | 4 |
| 20.     | ME8692      | Finite Element Analysis                 | PC       | 3               | 3 | 0 | 0 | 3 |
| 21.     | ME8694      | Hydraulics and Pneumatics               | PC       | 3               | 3 | 0 | 0 | 3 |
| 22.     | ME8681      | C.A.D. / C.A.M. Laboratory              | PC       | 4               | 0 | 0 | 4 | 2 |
| 23.     | ME8682      | Design and Fabrication Project          | PC       | 4               | 0 | 0 | 4 | 2 |
| 24.     | ME8792      | Power Plant Engineering                 | PC       | 3               | 3 | 0 | 0 | 3 |
| 25.     | ME8791      | Mechatronics                            | PC       | 3               | 3 | 0 | 0 | 3 |
| 26.     | ME8793      | Process Planning and Cost Estimation    | PC       | 3               | 3 | 0 | 0 | 3 |
| 27.     | ME8711      | Simulation and Analysis Laboratory      | PC       | 4               | 0 | 0 | 4 | 2 |
| 28.     | ME8781      | Mechatronics Laboratory                 | PC       | 4               | 0 | 0 | 4 | 2 |

**PROFESSIONAL ELECTIVES FOR B.E. MECHANICAL ENGINEERING**

**SEMESTER VI, ELECTIVE I**

| SL. NO. | COURSE CODE | COURSE TITLE                    | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|---------------------------------|----------|-----------------|---|---|---|---|
| 1.      | ME8091      | Automobile Engineering          | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.      | PR8592      | Welding Technology              | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.      | ME8096      | Gas Dynamics and Jet Propulsion | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.      | GE8075      | Intellectual Property Rights    | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.      | GE8073      | Fundamentals of Nanoscience     | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VII, ELECTIVE II**

| SL. NO. | COURSE CODE | COURSE TITLE                                | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|---|----------|-----------------|---|---|---|---|
| 1.      | ME8071      | Refrigeration and Air conditioning          | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.      | ME8072      | Renewable Sources of Energy                 | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.      | ME8098      | Quality Control and Reliability Engineering | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.      | ME8073      | Unconventional Machining Processes          | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.      | MG8491      | Operations Research                         | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.      | MF8071      | Additive Manufacturing                      | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.      | GE8077      | Total Quality Management                    | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VII, ELECTIVE III**

| SL. NO. | COURSE CODE | COURSE TITLE  | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|---|----------|-----------------|---|---|---|---|
| 1.      | ME8099      | Robotics  | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.      | ME8095      | Design of Jigs, Fixtures and Press Tools            | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.      | ME8093      | Computational Fluid Dynamics                        | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.      | ME8097      | Non Destructive Testing and Evaluation              | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.      | ME8092      | Composite Materials and Mechanics                   | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.      | GE8072      | Foundation Skills in Integrated Product Development | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.      | GE8074      | Human Rights  | PE       | 3               | 3 | 0 | 0 | 3 |
| 8.      | GE8071      | Disaster Management                                 | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VIII, ELECTIVE IV**

| SL. NO. | COURSE CODE | COURSE TITLE                              | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|---|----------|-----------------|---|---|---|---|
| 1.      | IE8693      | Production Planning and Control           | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.      | MG8091      | Entrepreneurship Development              | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.      | ME8094      | Computer Integrated Manufacturing Systems | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.      | ME8074      | Vibration and Noise Control               | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.      | EE8091      | Micro Electro Mechanical Systems          | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.      | GE8076      | Professional Ethics in Engineering        | PE       | 3               | 3 | 0 | 0 | 3 |

**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

| SL. NO. | COURSE CODE | COURSE TITLE                     | CATEGORY | CONTACT PERIODS | L | T | P  | C  |
|---------|-------------|----------------------------------|----------|-----------------|---|---|----|----|
| 1.      | HS8381      | Interpersonal Skills/Listening & | EEC      | 4               | 0 | 0 | 4  | 2  |
| 2.      | ME8712      | Technical Seminar                | EEC      | 2               | 0 | 0 | 2  | 1  |
| 3.      | ME8811      | Project Work                     | EEC      | 20              | 0 | 0 | 20 | 12 |
| 4.      | HS8461      | Advanced Reading and Writing     | EEC      | 2               | 0 | 0 | 2  | 1  |
| 5.      | ME8682      | Design and Fabrication Project   | EEC      | 4               | 0 | 0 | 4  | 2  |
| 6.      | HS8581      | Professional Communication       | EEC      | 2               | 0 | 0 | 2  | 1  |

**SUMMARY**

| SL. NO. | SUBJECT AREA           | CREDITS PER SEMESTER |           |           |           |           |           |           |           | CREDITS TOTAL | Percentage % |
|---------|------------------------|----------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|---------------|--------------|
|         |                        | I                    | II        | III       | IV        | V         | VI        | VII       | VIII      |               |              |
| 1.      | HS                     | 4                    | 7         | -         | -         | -         |           | -         | 3         | 14            | 7.61%        |
| 2.      | BS                     | 12                   | 7         | 4         | 4         | -         | -         | -         | -         | 27            | 14.67%       |
| 3.      | ES                     | 9                    | 11        | 9         | 5         | -         | -         | -         | -         | 33            | 17.80%       |
| 4.      | PC                     | -                    | -         | 11        | 14        | 19        | 18        | 13        | -         | 74            | 40.22%       |
| 5.      | PE                     | -                    | -         | -         | -         | -         | 3         | 6         | 3         | 15            | 8.15%        |
| 6.      | OE                     | -                    | -         | -         | -         | 3         | -         | 3         |           | 6             | 3.26%        |
| 7.      | EEC                    | -                    | -         | 1         | 1         | -         | 3         | 1         | 10        | 16            | 7.6%         |
|         | <b>Total</b>           | <b>25</b>            | <b>25</b> | <b>25</b> | <b>24</b> | <b>22</b> | <b>24</b> | <b>23</b> | <b>16</b> | <b>184</b>    |              |
| 8.      | Non Credit / Mandatory |                      |           |           |           |           |           |           |           |               |              |



HS8151

COMMUNICATIVE ENGLISH

|   |   |   |   |
|---|---|---|---|
| L | T | P | C |
| 4 | 0 | 0 | 4 |

**OBJECTIVES:**

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

**UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY & FRIENDS 12**

Reading- short comprehension passages, practice in skimming-scanning and predicting- Writing- completing sentences- - developing hints. Listening- short texts- short formal and informal conversations. Speaking- introducing oneself - exchanging personal information- Language development- Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development-- prefixes- suffixes- articles.- count/ uncount nouns.

**UNIT II GENERAL READING AND FREE WRITING 12**

Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register- Writing - paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures -Listening- telephonic conversations. Speaking - sharing information of a personal kind—greeting - taking leave- Language development - prepositions, conjunctions Vocabulary development- guessing meanings of words in context.

**UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 12**

Reading- short texts and longer passages (close reading) Writing- understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences Listening – listening to longer texts and filling up the table- product description- narratives from different sources. Speaking- asking about routine actions and expressing opinions. Language development- degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs.

**UNIT IV READING AND LANGUAGE DEVELOPMENT 12**

Reading- comprehension-reading longer texts- reading different types of texts- magazines Writing- letter writing, informal or personal letters-e-mails-conventions of personal email- Listening- listening to dialogues or conversations and completing exercises based on them. Speaking- speaking about oneself- speaking about one's friend- Language development- Tenses- simple present-simple past-present continuous and past continuous- Vocabulary development- synonyms-antonyms- phrasal verbs

**UNIT V EXTENDED WRITING 12**

Reading- longer texts- close reading -Writing- brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing-Listening – listening to talks-conversations- Speaking – participating in conversations- short group conversations-Language development-modal verbs- present/ past perfect tense - Vocabulary development-collocations- fixed and semi-fixed expressions

**TOTAL: 60 PERIODS**

## OUTCOMES:

At the end of the course, learners will be able to:

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English
- Write short essays of a general kind and personal letters and emails in English.

## TEXT BOOKS:

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

## REFERENCES

- 1 Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
- 2 Means,L. Thomas and Elaine Langlois. English & Communication For Colleges. CengageLearning ,USA: 2007
- 3 Redston, Chris & Gillies Cunningham Face2Face (Pre-intermediate Student's Book & Workbook) Cambridge University Press, New Delhi: 2005
- 4 Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
- 5 Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013

**MA8151**

**ENGINEERING MATHEMATICS – I**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

## OBJECTIVES :

The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modeling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

### UNIT I DIFFERENTIAL CALCULUS

12

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

### UNIT II 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 - Lagrange's method of undetermined multipliers.

### UNIT III 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 IV          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.

**UNIT V          DIFFERENTIAL EQUATIONS****12**

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type - System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

**TOTAL : 60 PERIODS****OUTCOMES :**

After completing this course, students should demonstrate competency in the following skills:

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Apply various techniques in solving differential equations.

**TEXT BOOKS :**

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7<sup>th</sup> Edition, New Delhi, 2015. [For Units I & III - 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].

**REFERENCES :**

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10<sup>th</sup> Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3<sup>rd</sup> Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, "Thomas Calculus", 12<sup>th</sup> Edition, Pearson India, 2016.

**OBJECTIVES:**

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

**UNIT I                      PROPERTIES OF MATTER                      9**

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

**UNIT II                      WAVES AND FIBER OPTICS                      9**

Oscillatory motion - forced and damped oscillations: differential equation and its solution - plane progressive waves - wave equation. Lasers : population of energy levels, Einstein's A and B coefficients derivation - resonant cavity, optical amplification (qualitative) - Semiconductor lasers: homojunction and heterojunction - Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) - losses associated with optical fibers - fibre optic sensors: pressure and displacement.

**UNIT III                      THERMAL PHYSICS                      9**

Transfer of heat energy - thermal expansion of solids and liquids - expansion joints - bimetallic strips - thermal conduction, convection and radiation - heat conduction in solids - thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) - thermal insulation - applications: heat exchangers, refrigerators, ovens and solar water heaters.

**UNIT IV                      QUANTUM PHYSICS                      9**

Black body radiation - Planck's theory (derivation) - Compton effect: theory and experimental verification - wave particle duality - electron diffraction - concept of wave function and its physical significance - Schrödinger's wave equation - time independent and time dependent equations - particle in a one-dimensional rigid box - tunnelling (qualitative) - scanning tunnelling microscope.

**UNIT V                      CRYSTAL PHYSICS                      9**

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices - inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

**TOTAL :    45                      PERIODS**

**OUTCOMES:**

Upon completion of this course,

- the students will gain knowledge on the basics of properties of matter and its applications,
- the students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- the students will get knowledge on advanced physics concepts of quantum theory and its

- applications in tunneling microscopes, and
- the students will understand the basics of crystals, their structures and different crystal growth techniques.

#### TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

#### REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics". W.H. Freeman, 2007.

CY8151

ENGINEERING CHEMISTRY

L T P C  
3 0 0 3

#### OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

#### UNIT I WATER AND ITS TREATMENT

9

Hardness of water - types - expression of hardness - units - estimation of hardness of water by EDTA - numerical problems - boiler troubles (scale and sludge) - treatment of boiler feed water - Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment - Ion exchange process, zeolite process - desalination of brackish water - Reverse Osmosis.

#### UNIT II SURFACE CHEMISTRY AND CATALYSIS

9

Adsorption: Types of adsorption - adsorption of gases on solids - adsorption of solute from solutions - adsorption isotherms - Freundlich's adsorption isotherm - Langmuir's adsorption isotherm - contact theory - kinetics of surface reactions, unimolecular reactions, Langmuir - applications of adsorption on pollution abatement.

Catalysis: Catalyst - types of catalysis - criteria - autocatalysis - catalytic poisoning and catalytic promoters - acid base catalysis - applications (catalytic convertor) - enzyme catalysis- Michaelis - Menten equation.

#### UNIT III ALLOYS AND PHASE RULE

9

Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) - heat treatment of steel. Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.

**UNIT IV FUELS AND COMBUSTION****9**

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel. Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

**UNIT V ENERGY SOURCES AND STORAGE DEVICES****9**

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H<sub>2</sub>-O<sub>2</sub> fuel cell.

**TOTAL: 45 PERIODS****OUTCOMES:**

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

**TEXT BOOKS:**

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

**REFERENCES:**

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

**GE8151****PROBLEM SOLVING AND PYTHON PROGRAMMING****L T P C  
3 0 0 3****OBJECTIVES:**

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures – lists, tuples, dictionaries.
- To do input/output with files in Python.

**UNIT I ALGORITHMIC PROBLEM SOLVING****9**

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

**UNIT II DATA, EXPRESSIONS, STATEMENTS 9**

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

**UNIT III CONTROL FLOW, FUNCTIONS 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. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

**UNIT IV 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; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

**UNIT V FILES, MODULES, PACKAGES 9**

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

**OUTCOMES:**

**Upon completion of the course, students will be able to**

- Develop algorithmic solutions to simple computational problems
- Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python Programs.

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**

1. Allen B. Downey, ‘ ‘ Think Python: How to Think Like a Computer Scientist”, 2<sup>nd</sup> edition, Updated for Python 3, Shroff/O’Reilly Publishers, 2016\_(<http://greenteapress.com/wp/think-python/>)
2. Guido van Rossum and Fred L. Drake Jr, “An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

**REFERENCES:**

1. John V Guttag, “Introduction to Computation and Programming Using Python”, Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, “Exploring Python”, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, CENGAGE Learning, 2012.
5. Charles Dierbach, “Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, “Practical Programming: An Introduction to Computer Science using Python 3”, Second edition, Pragmatic Programmers, LLC, 2013.

**OBJECTIVES:**

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.

**CONCEPTS AND CONVENTIONS (Not for Examination)**

1

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

**UNIT I PLANE CURVES AND FREEHAND SKETCHING**

7+12

Basic Geometrical constructions, Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloid - construction of involutes of square and circle - Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles -Representation of Three Dimensional objects - Layout of views- Freehand sketching of multiple views from pictorial views of objects

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE**

6+12

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

**UNIT III PROJECTION OF SOLIDS**

5+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

**UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**

5+12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other - obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids - Prisms, pyramids cylinders and cones.

**UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS**

6+12

Principles of isometric projection – isometric scale -Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

**TOTAL: 90 PERIODS****OUTCOMES:**

On successful completion of this course, the student will be able to

- familiarize with the fundamentals and standards of Engineering graphics
- perform freehand sketching of basic geometrical constructions and multiple views of objects.
- project orthographic projections of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- visualize and to project isometric and perspective sections of simple solids.



**TEXT BOOK:**

1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2008.

**REFERENCES:**

1. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50<sup>th</sup> Edition, 2010.
2. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff, John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2<sup>nd</sup> Edition, 2009.

**Publication of Bureau of Indian Standards:**

1. IS 10711 - 2001: Technical products Documentation - Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) - 2001: Technical products Documentation - Lettering.
3. IS 10714 (Part 20) - 2001 & SP 46 - 2003: Lines for technical drawings.
4. IS 11669 - 1986 & SP 46 - 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) - 2001: Technical drawings - Projection Methods.

**Special points applicable to University Examinations on Engineering Graphics:**

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

**GE8161****PROBLEM SOLVING AND PYTHON PROGRAMMING  
LABORATORY****L T P C  
0 0 4 2****OBJECTIVES:**

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

**LIST OF PROGRAMS**

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort

7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

**PLATFORM NEEDED**

Python 3 interpreter for Windows/Linux

**OUTCOMES:**

**Upon completion of the course, students will be able to**

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

**TOTAL :60 PERIODS**

**BS8161**

**PHYSICS AND CHEMISTRY LABORATORY**  
**(Common to all branches of B.E. / B.Tech Programmes)**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>0</b> | <b>0</b> | <b>4</b> | <b>2</b> |

**OBJECTIVES:**

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

**LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)**

1. Determination of rigidity modulus - Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser  
 (b) Determination of acceptance angle in an optical fiber.
4. Determination of thermal conductivity of a bad conductor - Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid - Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum - spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire - Air wedge method

**TOTAL: 30 PERIODS**

**OUTCOMES:**

Upon completion of the course, the students will be able to

- apply principles of elasticity, optics and thermal properties for engineering applications.

## CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

### OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
  - To acquaint the students with the determination of molecular weight of a polymer by viscometry.
1. Estimation of HCl using  $\text{Na}_2\text{CO}_3$  as primary standard and Determination of alkalinity in water sample.
  2. Determination of total, temporary & permanent hardness of water by EDTA method.
  3. Determination of DO content of water sample by Winkler's method.
  4. Determination of chloride content of water sample by argentometric method.
  5. Estimation of copper content of the given solution by Iodometry.
  6. Determination of strength of given hydrochloric acid using pH meter.
  7. Determination of strength of acids in a mixture of acids using conductivity meter.
  8. Estimation of iron content of the given solution using potentiometer.
  9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
  10. Estimation of sodium and potassium present in water using flame photometer.
  11. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
  12. Pseudo first order kinetics-ester hydrolysis.
  13. Corrosion experiment-weight loss method.
  14. Determination of CMC.
  15. Phase change in a solid.
  16. Conductometric titration of strong acid vs strong base.

### OUTCOMES:

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

**TOTAL: 30 PERIODS**

### TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8<sup>TH</sup> edition, 2014)

**HS8251**

**TECHNICAL ENGLISH**

| L | T | P | C |
|---|---|---|---|
| 4 | 0 | 0 | 4 |

### OBJECTIVES:

The Course prepares second semester engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialisation.

### UNIT I INTRODUCTION TECHNICAL ENGLISH

**12**

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking -Asking for and giving directions- Reading - reading short technical texts from journals- newspapers- Writing- purpose statements - extended definitions - issue- writing instructions - checklists-recommendations-Vocabulary Development- technical vocabulary Language Development -subject verb agreement - compound words.

**UNIT II READING AND STUDY SKILLS 12**  
 Listening- Listening to longer technical talks and completing exercises based on them-Speaking – describing a process-Reading - reading longer technical texts- identifying the various transitions in a text- paragraphing- Writing- interpreting charts, graphs- Vocabulary Development-vocabulary used in formal letters/emails and reports Language Development- impersonal passive voice, numerical adjectives.

**UNIT III TECHNICAL WRITING AND GRAMMAR 12**  
 Listening- Listening to classroom lectures/ talks on engineering/technology -Speaking - introduction to technical presentations- Reading – longer texts both general and technical, practice in speed reading; Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words. Language Development- embedded sentences

**UNIT IV REPORT WRITING 12**  
 Listening- Listening to documentaries and making notes. Speaking - mechanics of presentations- Reading - reading for detailed comprehension- Writing- email etiquette- job application - cover letter -Résumé preparation( via email and hard copy)- analytical essays and issue based essays-- Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- if conditionals.

**UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 12**  
 Listening- TED/Ink talks; Speaking -participating in a group discussion -Reading- reading and understanding technical articles Writing- Writing reports- minutes of a meeting- accident and survey- Vocabulary Development- verbal analogies Language Development- reported speech

**TOTAL : 60 PERIODS**

**OUTCOMES:**

At the end of the course learners will be able to:

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

**TEXT BOOKS:**

1. Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Black swan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

**REFERENCES**

1. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice.Oxford University Press: New Delhi,2014.
2. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
3. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
5. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning, USA: 2007

**Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading.**

**OBJECTIVES :**

This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

**UNIT I            MATRICES****12**

Eigen values and Eigenvectors of a real matrix - Characteristic equation - Properties of Eigen values and Eigenvectors - Cayley-Hamilton theorem - Diagonalization of matrices - Reduction of a quadratic form to canonical form by orthogonal transformation - Nature of quadratic forms.

**UNIT II            VECTOR CALCULUS****12**

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

**UNIT III           ANALYTIC FUNCTIONS****12**

Analytic functions - Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties - Harmonic conjugates - Construction of analytic function - Conformal mapping - Mapping by functions  $w = z + c, cz, \frac{1}{z}, z^2$  - Bilinear transformation.

**UNIT IV            COMPLEX INTEGRATION****12**

Line integral - Cauchy's integral theorem - Cauchy's integral formula - Taylor's and Laurent's series - Singularities - Residues - Residue theorem - Application of residue theorem for evaluation of real integrals - Use of circular contour and semicircular contour.

**UNIT V            LAPLACE TRANSFORMS****12**

Existence conditions - Transforms of elementary functions - Transform of unit step function and unit impulse function - Basic properties - Shifting theorems - Transforms of derivatives and integrals - Initial and final value theorems - Inverse transforms - Convolution theorem - Transform of periodic functions - Application to solution of linear second order ordinary differential equations with constant coefficients.

**TOTAL: 60 PERIODS****OUTCOMES :**

After successfully completing the course, the student will have a good understanding of the following topics and their applications:

- Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
- Gradient, divergence and curl of a vector point function and related identities.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Analytic functions, conformal mapping and complex integration.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

**TEXT BOOKS :**

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10<sup>th</sup> Edition, New Delhi, 2016.

**REFERENCES :**

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.), New Delhi, 7<sup>th</sup> Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3<sup>rd</sup> Edition, 2007.
3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4<sup>th</sup> Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6<sup>th</sup> Edition, New Delhi, 2012.

|               | <b>MATERIALS SCIENCE</b>   | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|---------------|--|----------|----------|----------|----------|
| <b>PH8251</b> | (Common to courses offered in Faculty of Mechanical Engineering<br>Except B.E. Materials Science and Engineering ) | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To introduce the essential principles of materials science for mechanical and related engineering applications.

**UNIT I PHASE DIAGRAMS 9**

Solid solutions - Hume Rothery's rules - the phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions – free energy composition curves for binary systems - microstructural change during cooling.

**UNIT II FERROUS ALLOYS 9**

The iron-carbon equilibrium diagram - phases, invariant reactions - microstructure of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels - effect of alloying elements on the Fe-C system - diffusion in solids - Fick's laws - phase transformations - T-T-T-diagram for eutectoid steel - pearlitic, bainitic and martensitic transformations - tempering of martensite - steels - stainless steels - cast irons.

**UNIT III MECHANICAL PROPERTIES 9**

Tensile test - plastic deformation mechanisms - slip and twinning - role of dislocations in slip - strengthening methods - strain hardening - refinement of the grain size - solid solution strengthening - precipitation hardening - creep resistance - creep curves - mechanisms of creep - creep-resistant materials - fracture - the Griffith criterion - critical stress intensity factor and its determination - fatigue failure - fatigue tests - methods of increasing fatigue life - hardness - Rockwell and Brinell hardness - Knoop and Vickers microhardness.



**UNIT II AC CIRCUITS 9**  
Introduction to AC circuits - waveforms and RMS value - power and power factor, single phase and three-phase balanced circuits - Three phase loads - housing wiring, industrial wiring, materials of wiring

**UNIT III ELECTRICAL MACHINES 9**  
Principles of operation and characteristics of ; DC machines, Transformers (single and three phase ) ,Synchronous machines , three phase and single phase induction motors.

**UNIT IV ELECTRONIC DEVICES & CIRCUITS 9**  
Types of Materials - Silicon & Germanium- N type and P type materials - PN Junction -Forward and Reverse Bias -Semiconductor Diodes -Bipolar Junction Transistor - Characteristics --Field Effect Transistors - Transistor Biasing -Introduction to operational Amplifier -Inverting Amplifier -Non Inverting Amplifier -DAC – ADC .

**UNIT V MEASUREMENTS & INSTRUMENTATION 9**  
Introduction to transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect and Mechanical - ,Classification of instruments - Types of indicating Instruments - multimeters -Oscilloscopes- - three-phase power measurements – instrument transformers (CT and PT )

**TOTAL : 45 PERIODS**

**OUTCOMES:**

Ability to

- Understand electric circuits and working principles of electrical machines
- Understand the concepts of various electronic devices
- Choose appropriate instruments for electrical measurement for a specific application

**TEXT BOOKS**

1. Leonard S Bobrow, "Foundations of Electrical Engineering", Oxford University Press, 2013
2. D P Kothari and I.J Nagarath, "Electrical Machines "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint ,2016
3. Thereja .B.L., "Fundamentals of Electrical Engineering and Electronics", S. Chand & Co. Ltd., 2008

**REFERENCES**

1. Del Toro, "Electrical Engineering Fundamentals", Pearson Education, New Delhi, 2007
2. John Bird, "Electrical Circuit Theory and Technology", Elsevier, First Indian Edition, 2006
3. Allan S Moris, "Measurement and Instrumentation Principles", Elseveir, First Indian Edition, 2006
4. Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice Hall of India, 2006
5. A.E.Fitzgerald, David E Higginbotham and Arvin Gabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009
6. N K De, Dipu Sarkar, "Basic Electrical Engineering", Universities Press (India)Private Limited 2016



**OBJECTIVES:**

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

**UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14**

Definition, scope and importance of environment - need for public awareness - concept of an ecosystem - structure and function of an ecosystem - producers, consumers and decomposers - energy flow in the ecosystem - ecological succession - food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) - Introduction to biodiversity definition: genetic, species and ecosystem diversity - biogeographical classification of India - value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels - India as a mega-diversity nation - hot-spots of biodiversity - threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - endangered and endemic species of India - conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems - pond, river, hill slopes, etc.

**UNIT II ENVIRONMENTAL POLLUTION 8**

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards - solid waste management: causes, effects and control measures of municipal solid wastes - role of an individual in prevention of pollution – pollution case studies - disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site - Urban / Rural / Industrial / Agricultural.

**UNIT III NATURAL RESOURCES 10**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies - Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies - Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

#### **UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT**

**7**

From unsustainable to sustainable development - urban problems related to energy - water conservation, rain water harvesting, watershed management - resettlement and rehabilitation of people; its problems and concerns, case studies - role of non-governmental organization- environmental ethics: Issues and possible solutions - climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. - wasteland reclamation - consumerism and waste products - environment production act - Air (Prevention and Control of Pollution) act - Water (Prevention and control of Pollution) act - Wildlife protection act - Forest conservation act - enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

#### **UNIT V HUMAN POPULATION AND THE ENVIRONMENT**

**6**

Population growth, variation among nations - population explosion - family welfare programme - environment and human health - human rights - value education - HIV / AIDS - women and child welfare - role of information technology in environment and human health - Case studies.

**TOTAL: 45 PERIODS**

#### **OUTCOMES:**

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

#### **TEXTBOOKS:**

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2<sup>nd</sup> edition, Pearson Education, 2004.

#### **REFERENCES :**

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hyderabad, 2015.
3. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
4. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.

**GE8292**

**ENGINEERING MECHANICS**

**L T P C**

**3 2 0 4**

#### **OBJECTIVES:**

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

#### **UNIT I STATICS OF PARTICLES**

**9+6**

Introduction - Units and Dimensions - Laws of Mechanics - Lami's theorem, Parallelogram and triangular Law of forces - Vectorial representation of forces - Vector operations of forces -additions, subtraction, dot product, cross product - Coplanar Forces - rectangular components - Equilibrium of a particle - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility .

**UNIT II EQUILIBRIUM OF RIGID BODIES****9+6**

Free body diagram - Types of supports -Action and reaction forces - stable equilibrium - Moments and Couples - Moment of a force about a point and about an axis - Vectorial representation of moments and couples - Scalar components of a moment - Varignon's theorem - Single equivalent force -Equilibrium of Rigid bodies in two dimensions - Equilibrium of Rigid bodies in three dimensions

**UNIT III PROPERTIES OF SURFACES AND SOLIDS****9+6**

Centroids and centre of mass - Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula – Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration - T section, I section, Angle section, Hollow section by using standard formula - Parallel axis theorem and perpendicular axis theorem - Principal moments of inertia of plane areas - Principal axes of inertia-Mass moment of inertia -mass moment of inertia for prismatic, cylindrical and spherical solids from first principle - Relation to area moments of inertia.

**UNIT IV DYNAMICS OF PARTICLES****9+6**

Displacements, Velocity and acceleration, their relationship - Relative motion - Curvilinear motion - Newton's laws of motion - Work Energy Equation- Impulse and Momentum - Impact of elastic bodies.

**UNIT V FRICTION AND RIGID BODY DYNAMICS****9+6**

Friction force - Laws of sliding friction - equilibrium analysis of simple systems with sliding friction - wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies - Velocity and acceleration - General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

**TOTAL : 45+30=75 PERIODS****OUTCOMES:**

On successful completion of this course, the student will be able to

- illustrate the vectorial and scalar representation of forces and moments
- analyse the rigid body in equilibrium
- evaluate the properties of surfaces and solids
- calculate dynamic forces exerted in rigid body
- determine the friction and the effects by the laws of friction

**TEXT BOOKS:**

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8<sup>th</sup> Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

**REFERENCES:**

1. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
2. Hibbeler, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11<sup>th</sup> Edition, Pearson Education 2010.
3. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4<sup>th</sup> Edition, Pearson Education 2006.
4. Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
5. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3<sup>rd</sup> Edition, Vikas Publishing House Pvt. Ltd., 2005.

**OBJECTIVES:**

To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

**GROUP A (CIVIL & MECHANICAL)****I CIVIL ENGINEERING PRACTICE****13****Buildings:**

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

**Plumbing Works:**

- (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
- (b) Study of pipe connections requirements for pumps and turbines.
- (c) Preparation of plumbing line sketches for water supply and sewage works.
- (d) Hands-on-exercise:  
Basic pipe connections - Mixed pipe material connection - Pipe connections with different joining components.
- (e) Demonstration of plumbing requirements of high-rise buildings.

**Carpentry using Power Tools only:**

- (a) Study of the joints in roofs, doors, windows and furniture.
- (b) Hands-on-exercise:  
Wood work, joints by sawing, planing and cutting.

**II MECHANICAL ENGINEERING PRACTICE****18****Welding:**

- (a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
- (b) Gas welding practice

**Basic Machining:**

- (a) Simple Turning and Taper turning
- (b) Drilling Practice

**Sheet Metal Work:**

- (a) Forming & Bending:
- (b) Model making - Trays and funnels.
- (c) Different type of joints.

**Machine assembly practice:**

- (a) Study of centrifugal pump
- (b) Study of air conditioner

**Demonstration on:**

- (a) Smithy operations, upsetting, swaging, setting down and bending. Example - Exercise - Production of hexagonal headed bolt.
- (b) Foundry operations like mould preparation for gear and step cone pulley.
- (c) Fitting - Exercises - Preparation of square fitting and V - fitting models.

## GROUP B (ELECTRICAL & ELECTRONICS)

- III ELECTRICAL ENGINEERING PRACTICE** **13**
1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
  2. Fluorescent lamp wiring.
  3. Stair case wiring
  4. Measurement of electrical quantities - voltage, current, power & power factor in RLC circuit.
  5. Measurement of energy using single phase energy meter.
  6. Measurement of resistance to earth of an electrical equipment.
- IV ELECTRONICS ENGINEERING PRACTICE** **16**
1. Study of Electronic components and equipments - Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
  2. Study of logic gates AND, OR, EX-OR and NOT.
  3. Generation of Clock Signal.
  4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
  5. Measurement of ripple factor of HWR and FWR.

**TOTAL: 60 PERIODS**

### **OUTCOMES:**

On successful completion of this course, the student will be able to

- fabricate carpentry components and pipe connections including plumbing works.
- use welding equipments to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundary and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

### **LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:**

- 1. CIVIL**
- |   |          |
|---|----------|
| 1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. | 15 Sets. |
| 2. Carpentry vice (fitted to work bench)  | 15 Nos.  |
| 3. Standard woodworking tools   | 15 Sets. |
| 4. Models of industrial trusses, door joints, furniture joints  | 5 each   |
| 5. Power Tools: (a) Rotary Hammer   | 2 Nos    |
| (b) Demolition Hammer   | 2 Nos    |
| (c) Circular Saw  | 2 Nos    |
| (d) Planer  | 2 Nos    |
| (e) Hand Drilling Machine   | 2 Nos    |
| (f) Jigsaw  | 2 Nos    |
- MECHANICAL**
- |   |         |
|---|---------|
| 1. Arc welding transformer with cables and holders                            | 5 Nos.  |
| 2. Welding booth with exhaust facility  | 5 Nos.  |
| 3. Welding accessories like welding shield, chipping hammer, wire brush, etc. | 5 Sets. |
| 4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.    | 2 Nos.  |



**OUTCOMES:**

- Ability to determine the speed characteristic of different electrical machines
- Ability to design simple circuits involving diodes and transistors
- Ability to use operational amplifiers

**1. LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

| S.No. | NAME OF THE EQUIPMENT         | Qty. |
|-------|-------------------------------|------|
| 1     | D. C. Motor Generator Set     | 2    |
| 2     | D.C. Shunt Motor              | 2    |
| 3     | Single Phase Transformer      | 2    |
| 4     | Single Phase Induction Motor  | 2    |
| 5     | Ammeter A.C and D.C           | 20   |
| 6     | Voltmeters A.C and D.C        | 20   |
| 7.    | Watt meters LPF and UPF       | 4    |
| 8.    | Resistors & Breadboards       | -    |
| 9.    | Cathode Ray Oscilloscopes     | 4    |
| 10.   | Dual Regulated power supplies | 6    |
| 11.   | A.C. Signal Generators        | 4    |
| 12.   | Transistors (BJT, JFET)       | -    |

**MA8353****TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |

**OBJECTIVES:**

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

**UNIT I 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 II 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 III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS****12**

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation - One dimensional equation of heat conduction - Steady state solution of two dimensional equation of heat conduction.

**UNIT IV      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 V      Z - TRANSFORMS AND DIFFERENCE EQUATIONS****12**

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations - Solution of difference equations using Z - transform.

**TOTAL : 60 PERIODS****OUTCOMES :**

Upon successful completion of the course, students should be able to:

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

**TEXT BOOKS :**

1. Grewal B.S., "Higher Engineering Mathematics", 43<sup>rd</sup> Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

**REFERENCES :**

1. B.V Ramana..., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
2. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10<sup>th</sup> Edition, John Wiley, India, 2016.
3. G. James, "Advanced Modern Engineering Mathematics", 3<sup>rd</sup> Edition, Pearson Education, 2007.
4. L.C Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
5. N.P. Bali. and Manish Goyal, "A Textbook of Engineering Mathematics", 9<sup>th</sup> Edition, Laxmi Publications Pvt. Ltd, 2014.
6. R.C. Wylie, and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

**ME8391****ENGINEERING THERMODYNAMICS****L T P C****3 2 0 4****OBJECTIVE:**

- To familiarize the students to understand the fundamentals of thermodynamics and to perform thermal analysis on their behavior and performance.

(Use of Standard and approved Steam Table, Mollier Chart, Compressibility Chart and Psychrometric Chart permitted)



**UNIT I BASIC CONCEPTS AND FIRST LAW 9+6**

Basic concepts - concept of continuum, comparison of microscopic and macroscopic approach. Path and point functions. Intensive and extensive, total and specific quantities. System and their types. Thermodynamic Equilibrium State, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer, definition and comparison, sign convention. Displacement work and other modes of work .P-V diagram. Zeroth law of thermodynamics – concept of temperature and thermal equilibrium- relationship between temperature scales -new temperature scales. First law of thermodynamics -application to closed and open systems – steady and unsteady flow processes.

**UNIT II SECOND LAW AND AVAILABILITY ANALYSIS 9+6**

Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries. Carnot cycle Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T-s diagram, Tds Equations, entropy change for - pure substance, ideal gases - different processes, principle of increase in entropy. Applications of II Law. High and low grade energy. Available and non-available energy of a source and finite body. Energy and irreversibility. Expressions for the energy of a closed system and open systems. Energy balance and entropy generation. Irreversibility. I and II law Efficiency.

**UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 9+6**

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles, Economiser, preheater, Binary and Combined cycles.

**UNIT IV IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS 9+6**

Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases- Reduced properties. Compressibility factor-.Principle of Corresponding states. -Generalised Compressibility Chart and its use-. Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes. Simple Calculations.

**UNIT V GAS MIXTURES AND PSYCHROMETRY 9+6**

Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture – Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function. Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process – adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications

**TOTAL : 75 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Apply the first law of thermodynamics for simple open and closed systems under steady and unsteady conditions.
- CO2 Apply second law of thermodynamics to open and closed systems and calculate entropy and availability.
- CO3 Apply Rankine cycle to steam power plant and compare few cycle improvement methods
- CO4 Derive simple thermodynamic relations of ideal and real gases
- CO5 Calculate the properties of gas mixtures and moist air and its use in psychrometric processes

**TEXT BOOKS :**

1. R.K.Rajput, "A Text Book Of Engineering Thermodynamics ",Fifth Edition,2017.
2. Yunus a. Cengel & michael a. Boles, "Thermodynamics", 8th edition 2015.

**REFERENCES:**

1. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
2. Borgnakke & Sonntag, "Fundamental of Thermodynamics", 8th Edition , 2016.
3. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2016.
4. Michael J. Moran, Howard N. Shapiro, "Fundamentals of Engineering Thermodynamics", 8th Edition.
5. Nag.P.K., "Engineering Thermodynamics", 5<sup>th</sup> Edition, Tata McGraw-Hill, New Delhi, 2013.

**CE8394****FLUID MECHANICS AND MACHINERY****L T P C  
4 0 0 4****OBJECTIVES**

- The properties of fluids and concept of control volume are studied
- The applications of the conservation laws to flow through pipes are studied.
- To understand the importance of dimensional analysis
- To understand the importance of various types of flow in pumps.
- To understand the importance of various types of flow in turbines.

**UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 12**

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation.

**UNIT II FLOW THROUGH CIRCULAR CONDUITS 12**

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli- Boundary layer concepts - types of boundary layer thickness - Darcy Weisbach equation -friction factor- Moody diagram- commercial pipes- minor losses - Flow through pipes in series and parallel.

**UNIT III DIMENSIONAL ANALYSIS 12**

Need for dimensional analysis - methods of dimensional analysis - Similitude -types of similitude - Dimensionless parameters- application of dimensionless parameters - Model analysis.

**UNIT IV PUMPS 12**

Impact of jets - Euler's equation - Theory of roto-dynamic machines - various efficiencies- velocity components at entry and exit of the rotor- velocity triangles - Centrifugal pumps- working principle - work done by the impeller - performance curves - Reciprocating pump- working principle - Rotary pumps -classification.

**UNIT V TURBINES 12**

Classification of turbines - heads and efficiencies - velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner - draft tube. Specific speed - unit quantities - performance curves for turbines – governing of turbines.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

Upon completion of this course, the students will be able to

- Apply mathematical knowledge to predict the properties and characteristics of a fluid.
- Can analyse and calculate major and minor losses associated with pipe flow in piping networks.
- Can mathematically predict the nature of physical quantities
- Can critically analyse the performance of pumps
- Can critically analyse the performance of turbines.

**TEXT BOOK:**

1. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi 2013.

**REFERENCES:**

1. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
2. Kumar K. L., "Engineering Fluid Mechanics", Eurasia Publishing House(p) Ltd., New Delhi 2016
3. Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery", 2011.
4. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010

**ME8351****MANUFACTURING TECHNOLOGY – I****L T P C  
3 0 0 3****OBJECTIVE:**

- To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components.

**UNIT I METAL CASTING PROCESSES****9**

Sand Casting : Sand Mould - Type of patterns - Pattern Materials - Pattern allowances -Moulding sand Properties and testing - Cores -Types and applications - Moulding machines- Types and applications; Melting furnaces : Blast and Cupola Furnaces; Principle of special casting processes : Shell - investment - Ceramic mould - Pressure die casting - Centrifugal Casting - CO2 process - Stir casting; Defects in Sand casting

**UNIT II JOINING PROCESSES****9**

Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas welding - Types - Flame characteristics; Manual metal arc welding - Gas Tungsten arc welding - Gas metal arc welding - Submerged arc welding - Electro slag welding; Operating principle and applications of: Resistance welding - Plasma arc welding - Thermit welding - Electron beam welding - Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects: types, causes and cure.

**UNIT III METAL FORMING PROCESSES****9**

Hot working and cold working of metals - Forging processes - Open, impression and closed die forging - forging operations. Rolling of metals- Types of Rolling - Flat strip rolling - shape rolling operations - Defects in rolled parts. Principle of rod and wire drawing - Tube drawing - Principles of Extrusion - Types - Hot and Cold extrusion.

**UNIT IV SHEET METAL PROCESSES****9**

Sheet metal characteristics - shearing, bending and drawing operations - Stretch forming operations - Formability of sheet metal - Test methods -special forming processes-Working principle and applications - Hydro forming - Rubber pad forming - Metal spinning- Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming - Micro forming

**UNIT V MANUFACTURE OF PLASTIC COMPONENTS****9**

Types and characteristics of plastics - Moulding of thermoplastics - working principles and typical applications - injection moulding - Plunger and screw machines - Compression moulding, Transfer Moulding - Typical industrial applications - introduction to blow moulding -Rotational moulding - Film blowing - Extrusion - Thermoforming - Bonding of Thermoplastics.

**TOTAL: 45 PERIODS****OUTCOMES:**

- CO1 Explain different metal casting processes, associated defects, merits and demerits
- CO2 Compare different metal joining processes.
- CO3 Summarize various hot working and cold working methods of metals.
- CO4 Explain various sheet metal making processes.
- CO5 Distinguish various methods of manufacturing plastic components.

**TEXT BOOKS:**

1. Hajra Choudhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", volume I and II, Media promoters and Publishers Private Limited, Mumbai, 2008
2. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 2013

**REFERENCES:**

1. Gowri P. Hariharan, A.Suresh Babu, "Manufacturing Technology I", Pearson Education, 2008
2. Paul Degarma E, Black J.T and Ronald A. Kosher, "Materials and Processes, in Manufacturing" Eight Edition, Prentice - Hall of India, 1997.
3. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 4<sup>th</sup> Edition, TMH-2013
4. Roy. A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2006
5. Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2014.

**EE8353****ELECTRICAL DRIVES AND CONTROLS****L T P C  
3 0 0 3****OBJECTIVES:**

- To understand the basic concepts of different types of electrical machines and their performance.
- To study the different methods of starting D.C motors and induction motors.
- To study the conventional and solid-state drives

**UNIT I INTRODUCTION****8**

Basic Elements - Types of Electric Drives - factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

**UNIT II DRIVE MOTOR CHARACTERISTICS 9**  
Mechanical characteristics - Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors.

**UNIT III STARTING METHODS 8**  
Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.

**UNIT IV CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES 10**  
Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers -applications.

**UNIT V CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES 10**  
Speed control of three phase induction motor - Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- Upon Completion of this subject, the students can able to explain different types of electrical machines and their performance

**TEXT BOOKS:**

1. Nagrath .I.J. & Kothari .D.P, “Electrical Machines”, Tata McGraw-Hill, 2006
2. Vedam Subrahmaniam, “Electric Drives (Concepts and Applications)”, Tata McGraw-Hill, 2010

**REFERENCES:**

1. Partab. H., “Art and Science and Utilisation of Electrical Energy”, Dhanpat Rai and Sons, 2017
2. Pillai.S.K “A First Course on Electric Drives”, Wiley Eastern Limited, 2012
3. Singh. M.D., K.B.Khanchandani, “Power Electronics”, Tata McGraw-Hill, 2006.

**ME8361 MANUFACTURING TECHNOLOGY LABORATORY – I L T P C**  
**0 0 4 2**

**OBJECTIVE:**

- To Study and practice the various operations that can be performed in lathe, shaper, drilling, milling machines etc. and to equip with the practical knowledge required in the core industries.

**LIST OF EXPERIMENTS**

Machining and Machining time estimations for:

1. Taper Turning
2. External Thread cutting
3. Internal Thread Cutting
4. Eccentric Turning
5. Knurling
6. Square Head Shaping
7. Hexagonal Head Shaping
8. Fabrication of simple structural shapes using Gas Metal Arc Welding
9. Joining of plates and pipes using Gas Metal Arc Welding/ Arc Welding /Submerged arc welding
10. Preparation of green sand moulds
- 11 Manufacturing of simple sheet metal components using shearing and bending operations.
12. Manufacturing of sheet metal components using metal spinning on a lathe

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Demonstrate the safety precautions exercised in the mechanical workshop.
- CO2 Make the workpiece as per given shape and size using Lathe.
- CO3 Join two metals using arc welding.
- CO4 Use sheet metal fabrication tools and make simple tray and funnel.
- CO5 Use different moulding tools, patterns and prepare sand moulds.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

| <b>S. NO.</b> | <b>NAME OF THE EQUIPMENT</b>   | <b>Qty.</b> |
|---------------|--|-------------|
| 1             | Centre Lathes  | 7 Nos.      |
| 2             | Horizontal Milling Machine   | 1 No        |
| 3             | Vertical Milling Machine   | 1 No        |
| 4             | Shaper   | 1 No.       |
| 5             | Arc welding transformer with cables and holders                        | 2 Nos       |
| 6             | Oxygen and acetylene gas cylinders, blow pipe and other welding outfit | 1 No        |
| 7             | Moulding table, Moulding equipments                                    | 2 Nos       |
| 8             | Sheet metal forming tools and equipments                               | 2 Nos.      |

**OBJECTIVES:**

- To make the students understand and interpret drawings of machine components
- To prepare assembly drawings both manually and using standard CAD packages
- To familiarize the students with Indian Standards on drawing practices and standard components
- To gain practical experience in handling 2D drafting and 3D modeling software systems.

**UNIT I DRAWING STANDARDS & FITS AND TOLERANCES 12**

Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc. - Limits, Fits - Tolerancing of individual dimensions - Specification of Fits - Preparation of production drawings and reading of part and assembly drawings, basic principles of geometric dimensioning & tolerancing.

**UNIT II INTRODUCTION TO 2D DRAFTING 16**

- Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed drawing.
- Bearings - Bush bearing, Plummer block
- Valves - Safety and non-return valves.

**UNIT III 3D GEOMETRIC MODELING AND ASSEMBLY 32**

Sketcher - Datum planes - Protrusion - Holes - Part modeling - Extrusion - Revolve - Sweep - Loft - Blend - Fillet - Pattern - Chamfer - Round - Mirror - Section - Assembly

- Couplings - Flange, Universal, Oldham's, Muff, Gear couplings
- Joints - Knuckle, Gib & cotter, strap, sleeve & cotter joints
- Engine parts – Piston, connecting rod, cross-head (vertical and horizontal), stuffing box, multi-plate clutch
- Miscellaneous machine components – Screw jack, machine vice, tail stock, chuck, vane and gear pump

**TOTAL:60 PERIODS**

**Note:** 25% of assembly drawings must be done manually and remaining 75% of assembly drawings must be done by using any CAD software. The above tasks can be performed manually and using standard commercial 2D / 3D CAD software

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

CO1 Follow the drawing standards, Fits and Tolerances

CO2 Re-create part drawings, sectional views and assembly drawings as per standards

**TEXT BOOK:**

1. Gopalakrishna K.R., "Machine Drawing", 22nd Edition, Subhas Stores Books Corner, Bangalore, 2013

**REFERENCES:**

1. N. D. Bhatt and V.M. Panchal, "Machine Drawing", 48th Edition, Charotar Publishers, 2013
2. Junnarkar, N.D., "Machine Drawing", 1st Edition, Pearson Education, 2004
3. N. Siddeshwar, P. Kanniah, V.V.S. Sastri, "Machine Drawing", published by Tata Mc GrawHill, 2006
4. S. Trymbaka Murthy, "A Text Book of Computer Aided Machine Drawing", CBS Publishers, New Delhi, 2007

EE8361

**ELECTRICAL ENGINEERING LABORATORY**

**L T P C**  
**0 0 4 2**

**OBJECTIVE:**

- To validate the principles studied in theory by performing experiments in the laboratory

**LIST OF EXPERIMENTS**

1. Load test on DC Shunt & DC Series motor
2. O.C.C & Load characteristics of DC Shunt and DC Series generator
3. Speed control of DC shunt motor (Armature, Field control)
4. Load test on single phase transformer
5. O.C & S.C Test on a single phase transformer
6. Regulation of an alternator by EMF & MMF methods.
7. V curves and inverted V curves of synchronous Motor
8. Load test on three phase squirrel cage Induction motor
9. Speed control of three phase slip ring Induction Motor
10. Study of DC & AC Starters

**TOTAL: 60 PERIODS**

**OUTCOME:**

- Ability to perform speed characteristic of different electrical machine

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

| S.No. | NAME OF THE EQUIPMENT                     | Qty. |
|-------|---|------|
| 1     | DC Shunt motor                            | 2    |
| 2     | DC Series motor                           | 1    |
| 3     | DC shunt motor-DC Shunt Generator set     | 1    |
| 4     | DC Shunt motor-DC Series Generator set    | 1    |
| 5     | Single phase transformer                  | 2    |
| 6     | Three phase alternator                    | 2    |
| 7     | Three phase synchronous motor             | 1    |
| 8     | Three phase Squirrel cage Induction motor | 1    |
| 9     | Three phase Slip ring Induction motor     | 1    |

HS8381

**INTERPERSONAL SKILLS/LISTENING & SPEAKING**

**L T P C**  
**0 0 2 1**

**OBJECTIVES: The Course will enable learners to:**

- Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities.
- improve general and academic listening skills
- Make effective presentations.



## UNIT I

Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.

## UNIT II

Listen to a process information- give information, as part of a simple explanation - conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.

## UNIT III

Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist- listen for detail

## UNIT IV

Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures conversational speech listening to and participating in conversations - persuade.

## UNIT V

Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.

**TOTAL : 30 PERIODS**

### **OUTCOMES: At the end of the course Learners will be able to:**

- Listen and respond appropriately.
- Participate in group discussions
- Make effective presentations
- Participate confidently and appropriately in conversations both formal and informal

### **TEXT BOOKS:**

1. Brooks, Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.
2. Richards, C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010

### **REFERENCES**

1. Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
3. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014
4. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
5. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.

**OBJECTIVES:**

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

**UNIT I TESTING OF HYPOTHESIS****12**

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means - Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

**UNIT II DESIGN OF EXPERIMENTS****12**

One way and two way classifications - Completely randomized design - Randomized block design - Latin square design -  $2^2$  factorial design.

**UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS****12**

Solution of algebraic and transcendental equations - Fixed point iteration method - Newton Raphson method - Solution of linear system of equations - Gauss elimination method - Pivoting - Gauss Jordan method - Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

**UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION****12**

Lagrange's and Newton's divided difference interpolations - Newton's forward and backward difference interpolation - Approximation of derivatives using interpolation polynomials - Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

**UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS****12**

Single step methods : Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order equations - Multi step methods : Milne's and Adams - Bash forth predictor corrector methods for solving first order equations.

**TOTAL : 60 PERIODS****OUTCOMES :**

Upon successful completion of the course, students will be able to:

- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture.
- Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications

**TEXT BOOKS :**

1. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", 10<sup>th</sup> Edition, Khanna Publishers, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8<sup>th</sup> Edition, 2015.

**REFERENCES :**

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9<sup>th</sup> Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8<sup>th</sup> Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2006.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 2004.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 8<sup>th</sup> Edition, Pearson Education, Asia, 2007.

**ME8492****KINEMATICS OF MACHINERY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To understand the basic components and layout of linkages in the assembly of a system machine.
- To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
- To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

**UNIT I           BASICS OF MECHANISMS****9**

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility - Kutzbach criterion, Gruebler's criterion - Grashof's Law - Kinematic inversions of four-bar chain and slider crank chains - Limit positions - Mechanical advantage - Transmission Angle - Description of some common mechanisms - Quick return mechanisms, Straight line generators, Universal Joint - rocker mechanisms.

**UNIT II           KINEMATICS OF LINKAGE MECHANISMS****9**

Displacement, velocity and acceleration analysis of simple mechanisms - Graphical method- Velocity and acceleration polygons - Velocity analysis using instantaneous centres - kinematic analysis of simple mechanisms - Coincident points - Coriolis component of Acceleration - Introduction to linkage synthesis problem.

**UNIT III           KINEMATICS OF CAM MECHANISMS****9**

Classification of cams and followers - Terminology and definitions - Displacement diagrams - Uniform velocity, parabolic, simple harmonic and cycloidal motions - Derivatives of follower motions - Layout of plate cam profiles - Specified contour cams - Circular arc and tangent cams - Pressure angle and undercutting - sizing of cams.

**UNIT IV GEARS AND GEAR TRAINS****9**

Law of toothed gearing - Involute and cycloidal tooth profiles -Spur Gear terminology and definitions -Gear tooth action - contact ratio - Interference and undercutting. Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. Gear trains - Speed ratio, train value - Parallel axis gear trains – Epicyclic Gear Trains.

**UNIT V FRICTION IN MACHINE ELEMENTS****9**

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication - Friction clutches - Belt and rope drives - Friction in brakes- Band and Block brakes.

**TOTAL: 45 PERIODS****OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Discuss the basics of mechanism
- CO2 Calculate velocity and acceleration in simple mechanisms
- CO3 Develop CAM profiles
- CO4 Solve problems on gears and gear trains
- CO5 Examine friction in machine elements

**TEXT BOOKS:**

1. F.B. Sayyad, “Kinematics of Machinery”, MacMillan Publishers Pvt Ltd., Tech-max Educational resources, 2011.
2. Rattan, S.S, “Theory of Machines”, 4<sup>th</sup> Edition, Tata McGraw-Hill, 2014.
3. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, 4<sup>th</sup> Edition, Oxford University Press, 2014.

**REFERENCES:**

1. Allen S. Hall Jr., “Kinematics and Linkage Design”, Prentice Hall, 1961
2. Cleghorn. W. L, “Mechanisms of Machines”, Oxford University Press, 2014
3. Ghosh. A and Mallick, A.K., “Theory of Mechanisms and Machines”, 3<sup>rd</sup> Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006.
4. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low-Prices Student Edition, 1999.
5. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.

**ME8451****MANUFACTURING TECHNOLOGY – II**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching.
- To understand the basic concepts of Computer Numerical Control (CNC) of machine tools and CNC Programming

**UNIT I THEORY OF METAL CUTTING****9**

Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools- nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

- UNIT II TURNING MACHINES 9**  
Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout – automatic lathes: semi automatic – single spindle : Swiss type, automatic screw type – multi spindle:
- UNIT III SHAPER, MILLING AND GEAR CUTTING MACHINES 9**  
Shaper - Types of operations. Drilling ,reaming, boring, Tapping. Milling operations-types of milling cutter. Gear cutting – forming and generation principle and construction of gear milling ,hobbing and gear shaping processes -finishing of gears.
- UNIT IV ABRASIVE PROCESS AND BROACHING 9**  
Abrasive processes: grinding wheel – specifications and selection, types of grinding process- cylindrical grinding, surface grinding, centreless grinding and internal grinding- Typical applications – concepts of surface integrity, broaching machines: broach construction - push, pull, surface and continuous broaching machines
- UNIT V CNC MACHINING 9**  
Numerical Control (NC) machine tools - CNC types, constructional details, special features, machining centre, part programming fundamentals CNC – manual part programming – micromachining – wafer machining.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Explain the mechanism of material removal processes.
- CO2 Describe the constructional and operational features of centre lathe and other special purpose lathes.
- CO3 Describe the constructional and operational features of shaper, planner, milling, drilling, sawing and broaching machines.
- CO4 Explain the types of grinding and other super finishing processes apart from gear manufacturing processes.
- CO5 Summarize numerical control of machine tools and write a part program.

**TEXT BOOKS:**

1. Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters 2014
2. Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", 3<sup>rd</sup> Edition, Tata McGraw-Hill, New Delhi, 2013.

**REFERENCES:**

1. Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J.White "Machine Tool Practices", Prentice Hall of India, 1998
2. Geoffrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", Mc Graw Hill, 1984
3. HMT, "Production Technology", Tata McGraw Hill, 1998.
4. Roy. A.Lindberg, "Process and Materials of Manufacture," Fourth Edition, PHI/Pearson Education 2006.

**OBJECTIVE:**

- To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

**UNIT I ALLOYS AND PHASE DIAGRAMS 9**

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, eutectoid, peritectic, and peritectoid reactions, Iron – carbon equilibrium diagram. Classification of steel and cast Iron microstructure, properties and application.

**UNIT II HEAT TREATMENT 9**

Definition - Full annealing, stress relief, recrystallisation and spheroidising - normalising, hardening and Tempering of steel. Isothermal transformation diagrams - cooling curves superimposed on I.T. diagram CCR - Hardenability, Jominy end quench test - Austempering, martempering - case hardening, carburizing, Nitriding, cyaniding, carbonitriding - Flame and Induction hardening - Vacuum and Plasma hardening. .

**UNIT III FERROUS AND NON-FERROUS METALS 9**

Effect of alloying additions on steel-  $\alpha$  and  $\beta$  stabilisers- stainless and tool steels - HSLA, Maraging steels - Cast Iron - Grey, white, malleable, spheroidal - alloy cast irons, Copper and copper alloys – Brass, Bronze and Cupronickel - Aluminium and Al-Cu - precipitation strengthening treatment - Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys.

**UNIT IV NON-METALLIC MATERIALS 9**

Polymers - types of polymer, commodity and engineering polymers - Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes)- Engineering Ceramics – Properties and applications of Al<sub>2</sub>O<sub>3</sub>, SiC, Si<sub>3</sub>N<sub>4</sub>, PSZ and SIALON -Composites- Classifications- Metal Matrix and FRP - Applications of Composites.

**UNIT V MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS 9**

Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), hardness tests, Impact test Izod and Charpy, fatigue and creep failure mechanisms.

**TOTAL: 45 PERIODS****OUTCOMES**

**Upon the completion of this course the students will be able to**

- CO1 Explain alloys and phase diagram, Iron-Iron carbon diagram and steel classification.
- CO2 Explain isothermal transformation, continuous cooling diagrams and different heat treatment processes.
- CO3 Clarify the effect of alloying elements on ferrous and non-ferrous metals
- CO4 Summarize the properties and applications of non metallic materials.
- CO5 Explain the testing of mechanical properties. .

**TEXT BOOKS:**

1. Avner, S.H., "Introduction to Physical Metallurgy", McGraw Hill Book Company, 1997.
2. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian Edition 2014

**REFERENCES:**

1. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 2010.
2. Raghavan.V, "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd., 2015.
3. U.C. Jindal : Material Science and Metallurgy, "Engineering Materials and Metallurgy", First Edition, Dorling Kindersley, 2012
4. Upadhyay. G.S. and Anish Upadhyay, "Materials Science and Engineering", Viva Books Pvt. Ltd., New Delhi, 2006.

|               |   |          |          |          |          |
|---------------|---|----------|----------|----------|----------|
| <b>CE8395</b> | <b>STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the stresses and deformations induced in thin and thick shells.

**UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9**

Rigid bodies and deformable solids - Tension, Compression and Shear Stresses - Deformation of simple and compound bars - Thermal stresses - Elastic constants - Volumetric strains - Stresses on inclined planes - principal stresses and principal planes - Mohr's circle of stress.

**UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9**

Beams - types transverse loading on beams - Shear force and bending moment in beams - Cantilevers - Simply supported beams and over - hanging beams. Theory of simple bending- bending stress distribution - Load carrying capacity - Proportioning of sections - Flitched beams - Shear stress distribution.

**UNIT III TORSION 9**

Torsion formulation stresses and deformation in circular and hollow shafts - Stepped shafts- Deflection in shafts fixed at the both ends - Stresses in helical springs - Deflection of helical springs, carriage springs.

**UNIT IV DEFLECTION OF BEAMS 9**

Double Integration method - Macaulay's method - Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy - Maxwell's reciprocal theorems.

**UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9**

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders - spherical shells subjected to internal pressure - Deformation in spherical shells - Lamé's theorem.

**TOTAL: 45 PERIODS**





**UNIT IV INTERNAL COMBUSTION ENGINE PERFORMANCE AND SYSTEMS 9**

Performance parameters and calculations. Morse and Heat Balance tests. Multipoint Fuel Injection system and Common Rail Direct Injection systems. Ignition systems – Magneto, Battery and Electronic. Lubrication and Cooling systems. Concepts of Supercharging and Turbocharging – Emission Norms.

**UNIT V GAS TURBINES 9**

Gas turbine cycle analysis – open and closed cycle. Performance and its improvement - Regenerative, Intercooled, Reheated cycles and their combinations. Materials for Turbines.

**TOTAL:45 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Apply thermodynamic concepts to different air standard cycles and solve problems.
- CO2 Solve problems in single stage and multistage air compressors
- CO3 Explain the functioning and features of IC engines, components and auxiliaries.
- CO4 Calculate performance parameters of IC Engines.
- CO5 Explain the flow in Gas turbines and solve problems.

**TEXT BOOKS:**

1. Kothandaraman.C.P., Domkundwar. S,Domkundwar. A.V., "A course in thermal Engineering", Fifth Edition, "Dhanpat Rai & sons , 2016
2. Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2017

**REFERENCES:**

1. Arora.C.P, "Refrigeration and Air Conditioning ," Tata McGraw-Hill Publishers 2008
2. Ganesan V.." Internal Combustion Engines" , Third Edition, Tata McGraw-Hill 2012
3. Ramalingam. K.K., "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2009.
4. Rudramoorthy, R, "Thermal Engineering ",Tata McGraw-Hill, New Delhi,2003
5. Sarkar, B.K,"Thermal Engineering" Tata McGraw-Hill Publishers, 2007

|               |   |          |          |          |          |
|---------------|---|----------|----------|----------|----------|
| <b>ME8462</b> | <b>MANUFACTURING TECHNOLOGY LABORATORY – II</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>0</b> | <b>0</b> | <b>4</b> | <b>2</b> |

**OBJECTIVE:**

- To Study and acquire knowledge on various basic machining operations in special purpose machines and its applications in real life manufacture of components in the industry

**LIST OF EXPERIMENTS:**

1. Contour milling using vertical milling machine
2. Spur gear cutting in milling machine
3. Helical Gear Cutting in milling machine
4. Gear generation in hobbing machine
5. Gear generation in gear shaping machine
6. Plain Surface grinding
7. Cylindrical grinding
8. Tool angle grinding with tool and Cutter Grinder
9. Measurement of cutting forces in Milling / Turning Process
10. CNC Part Programming

**OUTCOMES:**

Upon the completion of this course the students will be able to

- CO1 use different machine tools to manufacturing gears
- CO2 Ability to use different machine tools to manufacturing gears.
- CO3 Ability to use different machine tools for finishing operations
- CO4 Ability to manufacture tools using cutter grinder
- CO5 Develop CNC part programming

**TOTAL: 60 PERIODS**

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

| S.No. | NAME OF THE EQUIPMENT        | Qty.      |
|-------|------------------------------|-----------|
| 1     | Turret and Capstan Lathes    | 1 No each |
| 2     | Horizontal Milling Machine   | 2 No      |
| 3     | Vertical Milling Machine     | 1 No      |
| 4     | Surface Grinding Machine     | 1 No.     |
| 5     | Cylindrical Grinding Machine | 1 No.     |
| 6     | Radial Drilling Machine      | 1 No.     |
| 7     | lathe Tool Dynamometer       | 1 No      |
| 8     | Milling Tool Dynamometer     | 1 No      |
| 9     | Gear Hobbing Machine         | 1 No      |
| 10    | Tool Makers Microscope       | 1 No      |
| 11    | CNC Lathe                    | 1 No      |
| 12    | CNC Milling machine          | 1 No      |
| 13    | Gear Shaping machine         | 1 No      |
| 14    | Centerless grinding machine  | 1 No      |
| 15    | Tool and cutter grinder      | 1 No      |

|               |   |          |          |          |          |
|---------------|---|----------|----------|----------|----------|
| <b>CE8381</b> | <b>STRENGTH OF MATERIALS AND FLUID MECHANICS<br/>AND MACHINERY LABORATORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>0</b> | <b>0</b> | <b>4</b> | <b>2</b> |

**OBJECTIVES:**

- To study the mechanical properties of materials when subjected to different types of loading.
- To verify the principles studied in Fluid Mechanics theory by performing experiments in lab.

**STRENGTH OF MATERIALS****30****LIST OF EXPERIMENTS**

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinnell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical properties Comparison

- (i) Unhardened specimen
  - (ii) Quenched Specimen and
  - (iii) Quenched and tempered specimen.
11. Microscopic Examination of
- (i) Hardened samples and
  - (ii) Hardened and tempered samples.

**OUTCOME:**

- Ability to perform Tension, Torsion, Hardness, Compression, and Deformation test on Solid materials.

**LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS**

| S.No. | NAME OF THE EQUIPMENT  | Qty. |
|-------|--|------|
| 1     | Universal Tensile Testing machine with double 1 shear attachment - 40 Ton Capacity | 1    |
| 2     | Torsion Testing Machine (60 NM Capacity)   | 1    |
| 3     | Impact Testing Machine (300 J Capacity)  | 1    |
| 4     | Brinell Hardness Testing Machine   | 1    |
| 5     | Rockwell Hardness Testing Machine  | 1    |
| 6     | Spring Testing Machine for tensile and compressive loads (2500 N)                  | 1    |
| 7     | Metallurgical Microscopes  | 3    |
| 8     | Muffle Furnace (800 C)   | 1    |

**FLUID MECHANICS AND MACHINES LABORATORY**

**30**

**LIST OF EXPERIMENTS**

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump/ submergible pump
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

Upon completion of this course, the students will be able to:

- Perform Tension, Torsion, Hardness, Compression, and Deformation test on Solid materials.
- Use the measurement equipments for flow measurement.
- Perform test on different fluid machinery.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

| S. NO. | NAME OF THE EQUIPMENT                   | Qty. |
|--------|---|------|
| 1      | Orifice meter setup                     | 1    |
| 2      | Venturi meter setup                     | 1    |
| 3      | Rotameter setup                         | 1    |
| 4      | Pipe Flow analysis setup                | 1    |
| 5      | Centrifugal pump/submergible pump setup | 1    |
| 6      | Reciprocating pump setup                | 1    |

|    |                       |   |
|----|-----------------------|---|
| 7  | Gear pump setup       | 1 |
| 8  | Pelton wheel setup    | 1 |
| 9  | Francis turbine setup | 1 |
| 10 | Kaplan turbine setup  | 1 |

**HS8461**

**ADVANCED READING AND WRITING**

**L T P C**  
**0 0 2 1**

**OBJECTIVES:**

- Strengthen the reading skills of students of engineering.
- Enhance their writing skills with specific reference to technical writing.
- Develop students' critical thinking skills.
- Provide more opportunities to develop their project and proposal writing skills.

**UNIT I**

Reading - Strategies for effective reading-Use glosses and footnotes to aid reading comprehension-Read and recognize different text types-Predicting content using photos and title Writing-Plan before writing- Develop a paragraph: topic sentence, supporting sentences, concluding sentence -Write a descriptive paragraph

**UNIT II**

Reading-Read for details-Use of graphic organizers to review and aid comprehension Writing-State reasons and examples to support ideas in writing- Write a paragraph with reasons and examples-Write an opinion paragraph

**UNIT III**

Reading- Understanding pronoun reference and use of connectors in a passage- speed reading techniques-Writing- Elements of a good essay-Types of essays- descriptive-narrative- issue-based-argumentative-analytical.

**UNIT IV**

Reading- Genre and Organization of Ideas- Writing- Email writing- resumes - Job application- project writing-writing convincing proposals.

**UNIT V**

Reading- Critical reading and thinking- understanding how the text positions the reader- identify Writing- Statement of Purpose- letter of recommendation- Vision statement

**TOTAL: 30 PERIODS**

**OUTCOMES: At the end of the course Learners will be able to:**

- Write different types of essays.
- Write winning job applications.
- Read and evaluate texts critically.
- Display critical thinking in various professional contexts.

**TEXT BOOKS:**

1. Debra Daise, CharlNorloff, and Paul Carne Reading and Writing (Level 4) Oxford University Press: Oxford, 2011
2. Gramer F. Margot and Colin S. Ward Reading and Writing (Level 3) Oxford University Press: Oxford, 2011

## REFERENCES

1. Davis, Jason and Rhonda Liss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006
2. E. Suresh Kumar and et al. Enriching Speaking and Writing Skills. Second Edition. Orient Black swan: Hyderabad, 2012
3. Withrow, Jeans and et al. Inspired to Write. Readings and Tasks to develop writing skills. Cambridge University Press: Cambridge, 2004
4. Goatly, Andrew. Critical Reading and Writing. Routledge: United States of America, 2000
5. Petelin, Roslyn and Marsh Durham. The Professional Writing Guide: Knowing Well and Knowing Why. Business & Professional Publishing: Australia, 2004

ME8595

THERMAL ENGINEERING – II

|   |   |   |   |
|---|---|---|---|
| L | T | P | C |
| 3 | 0 | 0 | 3 |

### OBJECTIVES:

- To apply the thermodynamic concepts for Nozzles, Boilers, Turbines, and Refrigeration & Air Conditioning Systems.
- To understand the concept of utilising residual heat in thermal systems.

### UNIT I STEAM NOZZLE 9

Types and Shapes of nozzles, Flow of steam through nozzles, Critical pressure ratio, Variation of mass flow rate with pressure ratio. Effect of friction. Metastable flow.

### UNIT II BOILERS 9

Types and comparison. Mountings and Accessories. Fuels - Solid, Liquid and Gas. Performance calculations, Boiler trial.

### UNIT III STEAM TURBINES 9

Types, Impulse and reaction principles, Velocity diagrams, Work done and efficiency – optimal operating conditions. Multi-staging, compounding and governing.

### UNIT IV COGENERATION AND RESIDUAL HEAT RECOVERY 9

Cogeneration Principles, Cycle Analysis, Applications, Source and utilisation of residual heat. Heat pipes, Heat pumps, Recuperative and Regenerative heat exchangers. Economic Aspects.

### UNIT V REFRIGERATION AND AIR – CONDITIONING 9

Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Performance calculations, Working principle of air cycle, vapour absorption system, and Thermoelectric refrigeration. Air conditioning systems, concept of RSHF, GSHF and ESHF, Cooling load calculations. Cooling towers – concept and types.

**TOTAL:45 PERIODS**

### OUTCOMES:

**Upon the completion of this course the students will be able to**

- CO1 Solve problems in Steam Nozzle
- CO2 Explain the functioning and features of different types of Boilers and auxiliaries and calculate performance parameters.
- CO3 Explain the flow in steam turbines, draw velocity diagrams for steam turbines and solve problems.
- CO4 Summarize the concept of Cogeneration, Working features of Heat pumps and Heat exchangers
- CO5 Solve problems using refrigerant table / charts and psychrometric charts

**TEXT BOOKS:**

1. Kothandaraman, C.P., Domkundwar .S and Domkundwar A.V., "A course in Thermal Engineering", Dhanpat Rai & Sons, 2016.
2. Mahesh. M. Rathore, "Thermal Engineering", 1<sup>st</sup> Edition, Tata Mc Graw Hill Publications, 2010.

**REFERENCES:**

1. Arora .C.P., "Refrigeration and Air Conditioning", Tata Mc Graw Hill, 2008
2. Ballaney. P.L ." Thermal Engineering", Khanna publishers, 24th Edition 2012
3. Charles H Butler : Cogeneration" McGraw Hill, 1984.
4. Donald Q. Kern, " Process Heat Transfer", Tata Mc Graw Hill, 2001.
5. Sydney Reiter "Industrial and Commercial Heat Recovery Systems" Van Nostrand Reinholds, 1985.

**ME8593****DESIGN OF MACHINE ELEMENTS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To learn to use catalogues and standard machine components
- (Use of P S G Design Data Book is permitted)

**UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9**

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers, fits and tolerances - Direct, Bending and torsional stress equations - Impact and shock loading - calculation of principle stresses for various load combinations, eccentric loading - curved beams - crane hook and 'C' frame- Factor of safety - theories of failure - Design based on strength and stiffness - stress concentration - Design for variable loading.

**UNIT II SHAFTS AND COUPLINGS 9**

Design of solid and hollow shafts based on strength, rigidity and critical speed - Keys, keyways and splines - Rigid and flexible couplings.

**UNIT III TEMPORARY AND PERMANENT JOINTS 9**

Threaded fastners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints - Welded joints, riveted joints for structures - theory of bonded joints.

**UNIT IV ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 9**

Various types of springs, optimization of helical springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines- Connecting Rods and crank shafts.

**UNIT V BEARINGS 9**

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi and Boyd graphs, -- Selection of Rolling Contact bearings.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Explain the influence of steady and variable stresses in machine component design.
- CO2 Apply the concepts of design to shafts, keys and couplings.
- CO3 Apply the concepts of design to temporary and permanent joints.
- CO4 Apply the concepts of design to energy absorbing members, connecting rod and crank shaft.
- CO5 Apply the concepts of design to bearings.

**TEXT BOOKS:**

1. Bhandari V, "Design of Machine Elements", 4<sup>th</sup> Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 9th Edition, Tata McGraw-Hill, 2011.

**REFERENCES:**

1. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", Tata McGraw-Hill BookCo.(Schaum's Outline), 2010
2. Ansel Ugural, "Mechanical Design - An Integral Approach", 1<sup>st</sup> Edition, Tata McGraw-Hill Book Co, 2003.
3. P.C. Gope, "Machine Design - Fundamental and Application", PHI learning private ltd, New Delhi, 2012.
4. R.B. Patel, "Design of Machine Elements", MacMillan Publishers India P Ltd., Tech-Max Educational resources, 2011.
5. Robert C. Juvinall and Kurt M Marshek, "Fundamentals of Machine Design", 4<sup>th</sup> Edition, Wiley, 2005
6. Sundararajamoorthy T. V. Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2015.

**ME8501****METROLOGY AND MEASUREMENTS**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To provide knowledge on various Metrological equipments available to measure the dimension of the components.
- To provide knowledge on the correct procedure to be adopted to measure the dimension of the components.

**UNIT I BASICS OF METROLOGY****9**

Introduction to Metrology - Need - Elements - Work piece, Instruments - Persons - Environment - their effect on Precision and Accuracy - Errors - Errors in Measurements - Types - Control - Types of standards.

**UNIT II LINEAR AND ANGULAR MEASUREMENTS****9**

Linear Measuring Instruments - Evolution - Types - Classification - Limit gauges - gauge design - terminology - procedure - concepts of interchange ability and selective assembly - Angular measuring instruments - Types - Bevel protractor clinometers angle gauges, spirit levels sine bar - Angle alignment telescope - Autocollimator - Applications.

**UNIT III      ADVANCES IN METROLOGY      9**  
 Basic concept of lasers Advantages of lasers - laser Interferometers - types - DC and AC Lasers interferometer - Applications - Straightness - Alignment. Basic concept of CMM - Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System - Element - Applications.

**UNIT IV      FORM MEASUREMENT      9**  
 Principles and Methods of straightness - Flatness measurement - Thread measurement, gear measurement, surface finish measurement, Roundness measurement - Applications.

**UNIT V      MEASUREMENT OF POWER, FLOW AND TEMPERATURE      9**  
 Force, torque, power - mechanical , Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube - Temperature: bimetallic strip, thermocouples, electrical resistance thermometer - Reliability and Calibration - Readability and Reliability.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Describe the concepts of measurements to apply in various metrological instruments
- CO2 Outline the principles of linear and angular measurement tools used for industrial applications
- CO3 Explain the procedure for conducting computer aided inspection
- CO4 Demonstrate the techniques of form measurement used for industrial components
- CO5 Discuss various measuring techniques of mechanical properties in industrial applications

**TEXT BOOKS:**

1. Gupta. I.C., “Engineering Metrology”, Dhanpatrai Publications, 2005.
2. Jain R.K. “Engineering Metrology”, Khanna Publishers, 2009.

**REFERENCES:**

1. Alan S. Morris, “The essence of Measurement”, Prentice Hall of India 1996.
2. Beckwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education , 2014.
3. Charles Reginald Shotbolt, “Metrology for Engineers”, 5<sup>th</sup> edition, Cengage Learning EMEA, 1990.
4. Donald Peckman, “Industrial Instrumentation”, Wiley Eastern, 2004.
5. Raghavendra ,Krishnamurthy “Engineering Metrology & Measurements”, Oxford Univ. Press, 2013.

|               |                             |          |          |          |          |
|---------------|-----------------------------|----------|----------|----------|----------|
| <b>ME8594</b> | <b>DYNAMICS OF MACHINES</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                             | <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |

**OBJECTIVES:**

- To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- To understand the effect of Dynamics of undesirable vibrations.
- To understand the principles in mechanisms used for speed control and stability control.



|  |                              |           |
|--|------------------------------|-----------|
| <b>UNIT I</b>  | <b>FORCE ANALYSIS</b>        | <b>12</b> |
| Dynamic force analysis - Inertia force and Inertia torque- D'Alembert's principle -Dynamic Analysis in reciprocating engines - Gas forces - Inertia effect of connecting rod- Bearing loads - Crank shaft torque - Turning moment diagrams -Fly Wheels - Flywheels of punching presses- Dynamics of Cam- follower mechanism. |                              |           |
| <b>UNIT II</b>   | <b>BALANCING</b>             | <b>12</b> |
| Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder engine - Balancing of Multi-cylinder inline, V-engines - Partial balancing in engines - Balancing of linkages - Balancing machines-Field balancing of discs and rotors.  |                              |           |
| <b>UNIT III</b>  | <b>FREE VIBRATION</b>        | <b>12</b> |
| Basic features of vibratory systems - Degrees of freedom - single degree of freedom - Free vibration- Equations of motion - Natural frequency - Types of Damping - Damped vibration- Torsional vibration of shaft - Critical speeds of shafts - Torsional vibration - Two and three rotor torsional systems.                 |                              |           |
| <b>UNIT IV</b>   | <b>FORCED VIBRATION</b>      | <b>12</b> |
| Response of one degree freedom systems to periodic forcing - Harmonic disturbances - Disturbance caused by unbalance - Support motion -transmissibility - Vibration isolation vibration measurement.   |                              |           |
| <b>UNIT V</b>  | <b>MECHANISM FOR CONTROL</b> | <b>12</b> |
| Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors - Characteristics - Effect of friction - Controlling force curves. Gyroscopes -Gyroscopic forces and torques - Gyroscopic stabilization - Gyroscopic effects in Automobiles, ships and airplanes.                 |                              |           |

**TOTAL : 60 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Calculate static and dynamic forces of mechanisms.
- CO2 Calculate the balancing masses and their locations of reciprocating and rotating masses.
- CO3 Compute the frequency of free vibration.
- CO4 Compute the frequency of forced vibration and damping coefficient.
- CO5 Calculate the speed and lift of the governor and estimate the gyroscopic effect on automobiles, ships and airplanes.

**TEXT BOOKS:**

1. F. B. Sayyad, "Dynamics of Machinery", McMillan Publishers India Ltd., Tech-Max Educational resources, 2011.
2. Rattan, S.S, "Theory of Machines", 4<sup>th</sup> Edition, Tata McGraw-Hill, 2014.
3. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4<sup>th</sup> Edition, Oxford University Press, 2014.

**REFERENCES:**

1. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2014
2. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", 3<sup>rd</sup> Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006.
3. Khurmi, R.S., "Theory of Machines", 14<sup>th</sup> Edition, S Chand Publications, 2005.
4. Rao.J.S. and Dukkupati.R.V. "Mechanisms and Machine Theory", Wiley-Eastern Ltd., New Delhi, 1992.
5. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
6. V.Ramamurthi, "Mechanics of Machines", Narosa Publishing House, 2002.

**OBJECTIVES:**

- To supplement the principles learnt in kinematics and Dynamics of Machinery.
- To understand how certain measuring devices are used for dynamic testing.

**LIST OF EXPERIMENTS**

- a) Study of gear parameters.  
b) Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
- a) Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.  
b) Kinematics of single and double universal joints.
- a) Determination of Mass moment of inertia of Fly wheel and Axle system.  
b) Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus. c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
- Motorized gyroscope - Study of gyroscopic effect and couple.
- Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
- Cams - Cam profile drawing, Motion curves and study of jump phenomenon
- a) Single degree of freedom Spring Mass System - Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination. b) Multi degree freedom suspension system – Determination of influence coefficient.
- a) Determination of torsional natural frequency of single and Double Rotor systems.- Undamped and Damped Natural frequencies.  
b) Vibration Absorber - Tuned vibration absorber.
- Vibration of Equivalent Spring mass system - undamped and damped vibration.
- Whirling of shafts - Determination of critical speeds of shafts with concentrated loads.
- a) Balancing of rotating masses. (b) Balancing of reciprocating masses.
- a) Transverse vibration of Free-Free beam – with and without concentrated masses. b) Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.  
c) Determination of transmissibility ratio using vibrating table.

**TOTAL : 60 PERIODS****OUTCOMES****Upon the completion of this course the students will be able to**

- CO1 Explain gear parameters, kinematics of mechanisms, gyroscopic effect and working of lab equipments.
- CO2 Determine mass moment of inertia of mechanical element, governor effort and range sensitivity, natural frequency and damping coefficient, torsional frequency, critical speeds of shafts, balancing mass of rotating and reciprocating masses, and transmissibility ratio.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

| S.No. | NAME OF THE EQUIPMENT   | Qty.  |
|-------|---|-------|
| 1     | Cam follower setup.   | 1 No. |
| 2     | Motorised gyroscope.  | 1 No. |
| 3     | Governor apparatus - Watt, Porter, Proell and Hartnell governors. | 1 No. |
| 4     | Whirling of shaft apparatus.                                      | 1 No. |
| 5     | Dynamic balancing machine.  | 1 No. |
| 6     | Two rotor vibration setup.  | 1 No. |
| 7     | Spring mass vibration system.                                     | 1 No. |

|    |   |       |
|----|---|-------|
| 8  | Torsional Vibration of single rotor system setup. | 1 No. |
| 9  | Gear Models                                       | 1 No. |
| 10 | Kinematic Models to study various mechanisms.     | 1 No. |
| 11 | Turn table apparatus.                             | 1 No. |
| 12 | Transverse vibration setup of<br>a) cantilever    | 1 No. |

**ME8512**

**THERMAL ENGINEERING LABORATORY**

**L T P C**  
**0 0 4 2**

**OBJECTIVES:**

- To study the value timing-V diagram and performance of IC Engines
- To Study the characteristics of fuels/Lubricates used in IC Engines
- To study the Performance of steam generator/ turbine
- To study the heat transfer phenomena predict the relevant coefficient using implementation
- To study the performance of refrigeration cycle / components

**LIST OF EXPERIMENTS**

**I.C. ENGINE LAB**

1. Valve Timing and Port Timing diagrams.
2. Actual p-v diagrams of IC engines.
3. Performance Test on 4 - stroke Diesel Engine.
4. Heat Balance Test on 4 - stroke Diesel Engine.
5. Morse Test on Multi-cylinder Petrol Engine.
6. Retardation Test on a Diesel Engine.
7. Determination of Flash Point and Fire Point of various fuels / lubricants.

**STEAM LAB**

1. Study on Steam Generators and Turbines.
2. Performance and Energy Balance Test on a Steam Generator.
3. Performance and Energy Balance Test on Steam Turbine.

**HEAT TRANSFER LAB:**

1. Thermal conductivity measurement using guarded plate apparatus.
2. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
3. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
4. Determination of heat transfer coefficient under forced convection from a tube.
5. Determination of Thermal conductivity of composite wall.
6. Determination of Thermal conductivity of insulating powder.
7. Heat transfer from pin-fin apparatus (natural & forced convection modes)
8. Determination of Stefan - Boltzmann constant.
9. Determination of emissivity of a grey surface.
10. Effectiveness of Parallel / counter flow heat exchanger.

**REFRIGERATION AND AIR CONDITIONING LAB**

1. Determination of COP of a refrigeration system
2. Experiments on Psychrometric processes
3. Performance test on a reciprocating air compressor
4. Performance test in a HC Refrigeration System
5. Performance test in a fluidized Bed Cooling Tower

**TOTAL: 60 PERIODS**

**OUTCOMES:****Upon the completion of this course the students will be able to**

- CO1 conduct tests on heat conduction apparatus and evaluate thermal conductivity of materials.
- CO2 conduct tests on natural and forced convective heat transfer apparatus and evaluate heat transfer coefficient.
- CO3 conduct tests on radiative heat transfer apparatus and evaluate Stefan Boltzmann constant and emissivity.
- CO4 conduct tests to evaluate the performance of parallel/counter flow heat exchanger apparatus and reciprocating air compressor.
- CO5 conduct tests to evaluate the performance of refrigeration and airconditioning test rigs.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

|   | <b>NAME OF THE EQUIPMENT</b>                              | <b>Qty.</b> |
|---|---|-------------|
| 1 | I.C Engine - 2 stroke and 4 stroke model                  | 1 set       |
| 2 | Apparatus for Flash and Fire Point                        | 1 No.       |
| 3 | 4-stroke Diesel Engine with mechanical loading.           | 1 No        |
| 4 | 4-stroke Diesel Engine with hydraulic loading.            | 1 No.       |
| 5 | 4-stroke Diesel Engine with electrical loading.           | 1 No.       |
| 6 | Multi-cylinder Petrol Engine                              | 1 No.       |
| 7 | Single cylinder Petrol Engine                             | 1 No.       |
| 8 | Data Acquisition system with any one of the above engines | 1 No.       |
| 9 | Steam Boiler with turbine setup                           | 1 No.       |

| <b>S.No.</b> | <b>NAME OF THE EQUIPMENT</b>                        | <b>Qty.</b> |
|--------------|---|-------------|
| 1            | Guarded plate apparatus                             | 1 No.       |
| 2            | Lagged pipe apparatus                               | 1 No.       |
| 3            | Natural convection-vertical cylinder apparatus      | 1 No.       |
| 4            | Forced convection inside tube apparatus             | 1 No.       |
| 5            | Composite wall apparatus                            | 1 No.       |
| 6            | Thermal conductivity of insulating powder apparatus | 1 No.       |
| 7            | Pin-fin apparatus                                   | 1 No.       |
| 8            | Stefan-Boltzmann apparatus                          | 1 No.       |
| 9            | Emissivity measurement apparatus                    | 1 No.       |
| 10           | Parallel/counter flow heat exchanger apparatus      | 1 No.       |
| 11           | Single/two stage reciprocating air compressor       | 1 No.       |
| 12           | Refrigeration test rig                              | 1 No.       |
| 13           | Air-conditioning test rig                           | 1 No.       |

**OBJECTIVE:**

- To familiar with different measurement equipments and use of this industry for quality inspection.

**LIST OF EXPERIMENTS**

- Calibration and use of measuring instruments - Vernier caliper, micrometer, Vernier height gauge - using gauge blocks
- Calibration and use of measuring instruments - depth micrometer, bore gauge, telescopic gauge
- Measurement of linear dimensions using Comparators
- Measurement of angles using bevel protractor and sine bar
- Measurement of screw thread parameters - Screw thread Micrometers and Three wire method (floating carriage micrometer)
- Measurement of gear parameters - disc micrometers, gear tooth vernier caliper
- Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM)
- Programming of CNC Coordinate Measuring Machines for repeated measurements of identical components
- Non-contact (Optical) measurement using Toolmaker's microscope / Profile projector and Video measurement system
- Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments.
- Machine tool metrology - Level tests using precision level; Testing of straightness of a machine tool guide way using Autocollimator, spindle tests.
- Measurement of force, torque and temperature

**TOTAL: 60 PERIODS****OUTCOMES****Upon the completion of this course the students will be able to**

- CO1 Measure the gear tooth dimensions, angle using sine bar, straightness and flatness, thread parameters, temperature using thermocouple, force, displacement, torque and vibration.
- CO2 Calibrate the vernier, micrometer and slip gauges and setting up the comparator for the inspection.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

| S.No. | NAME OF THE EQUIPMENT                            | Qty. |
|-------|--|------|
| 1     | Micrometer                                       | 5    |
| 2     | Vernier Caliper                                  | 5    |
| 3     | Vernier Height Gauge                             | 2    |
| 4     | Vernier depth Gauge                              | 2    |
| 5     | Slip Gauge Set                                   | 1    |
| 6     | Gear Tooth Vernier                               | 1    |
| 7     | Sine Bar   | 1    |
| 8     | Floating Carriage Micrometer                     | 1    |
| 9     | Profile Projector / Tool Makers Microscope       | 1    |
| 10    | Parallel / counter flow heat exchanger apparatus | 1    |
| 11    | Mechanical / Electrical / Pneumatic Comparator   | 1    |
| 12    | Autocollimator                                   | 1    |
| 13    | Temperature Measuring Setup                      | 1    |
| 14    | Force Measuring Setup                            | 1    |
| 15    | Torque Measuring Setup                           | 1    |



**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 apply the concepts of design to belts, chains and rope drives.
- CO2 apply the concepts of design to spur, helical gears.
- CO3 apply the concepts of design to worm and bevel gears.
- CO4 apply the concepts of design to gear boxes .
- CO5 apply the concepts of design to cams, brakes and clutches

**TEXT BOOKS:**

1. Bhandari V, "Design of Machine Elements", 4<sup>th</sup> Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8<sup>th</sup> Edition, Tata McGraw-Hill, 2008.

**REFERENCES:**

1. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 8<sup>th</sup> Edition, Printice Hall, 2003.
2. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
3. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
4. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4<sup>th</sup> Edition, Wiley, 2005
5. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

**ME8691****COMPUTER AIDED DESIGN AND MANUFACTURING****L T P C  
3 0 0 3****OBJECTIVES:**

- To provide an overview of how computers are being used in mechanical component design
- To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

**UNIT I INTRODUCTION****9**

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations- homogeneous coordinates - Line drawing -Clipping- viewing transformation-Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM -CAD/CAM concepts –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance

**UNIT II GEOMETRIC MODELING****9**

Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling - surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep

**UNIT III CAD STANDARDS****9**

Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - communication standards.

**UNIT IV FUNDAMENTAL OF CNC AND PART PROGRAMING 9**

Introduction to NC systems and CNC - Machine axis and Co-ordinate system- CNC machine tools- Principle of operation CNC- Construction features including structure- Drives and CNC controllers- 2D and 3D machining on CNC- Introduction of Part Programming, types - Detailed Manual part programming on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros- Introduction of CAM package.

**UNIT V CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEM (FMS) 9**

Group Technology(GT),Part Families-Parts Classification and coding-Simple Problems in Opitz Part Coding system-Production flow Analysis-Cellular Manufacturing-Composite part concept-Types of Flexibility - FMS - FMS Components - FMS Application & Benefits - FMS Planning and Control-Quantitative analysis in FMS

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Explain the 2D and 3D transformations, clipping algorithm, Manufacturing models and Metrics
- CO2 Explain the fundamentals of parametric curves, surfaces and Solids
- CO3 Summarize the different types of Standard systems used in CAD
- CO4 Apply NC & CNC programming concepts to develop part programme for Lathe & Milling Machines
- CO5 Summarize the different types of techniques used in Cellular Manufacturing and FMS

**TEXT BOOKS:**

1. Ibrahim Zeid "Mastering CAD CAM" Tata McGraw-Hill PublishingCo.2007
2. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
3. Radhakrishnan P, SubramanyanS.andRaju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi,2000.

**REFERENCES:**

1. Chris McMahon and Jimmie Browne "CAD/CAM Principles", "Practice and Manufacturing management " Second Edition, Pearson Education, 1999.
2. Donald Hearn and M. Pauline Baker "Computer Graphics". Prentice Hall, Inc,1992.
3. Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson Education -2003
4. William M Neumann and Robert F.Sproul "Principles of Computer Graphics", McGraw Hill Book Co. Singapore, 1989.

**ME8693**

**HEAT AND MASS TRANSFER**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>2</b> | <b>0</b> | <b>4</b> |

**OBJECTIVES:**

- To understand the mechanisms of heat transfer under steady and transient conditions.
- To understand the concepts of heat transfer through extended surfaces.
- To learn the thermal analysis and sizing of heat exchangers and to understand the basic concepts of mass transfer.  
(Use of standard HMT data book permitted)



**UNIT I CONDUCTION 9+6**  
General Differential equation of Heat Conduction- Cartesian and Polar Coordinates - One Dimensional Steady State Heat Conduction – plane and Composite Systems - Conduction with Internal Heat Generation - Extended Surfaces - Unsteady Heat Conduction - Lumped Analysis - Semi Infinite and Infinite Solids -Use of Heisler’s charts.

**UNIT II CONVECTION 9+6**  
Free and Forced Convection - Hydrodynamic and Thermal Boundary Layer. Free and Forced Convection during external flow over Plates and Cylinders and Internal flow through tubes .

**UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9+6**  
Nusselt’s theory of condensation - Regimes of Pool boiling and Flow boiling. Correlations in boiling and condensation. Heat Exchanger Types - Overall Heat Transfer Coefficient – Fouling Factors - Analysis – LMTD method - NTU method.

**UNIT IV RADIATION 9+6**  
Black Body Radiation - Grey body radiation - Shape Factor - Electrical Analogy - Radiation Shields. Radiation through gases.

**UNIT V MASS TRANSFER 9+6**  
Basic Concepts - Diffusion Mass Transfer - Fick’s Law of Diffusion - Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

**TOTAL : 75 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems
- CO2 Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems
- CO3 Explain the phenomena of boiling and condensation, apply LMTD and NTU methods of thermal analysis to different types of heat exchanger configurations and solve problems
- CO4 Explain basic laws for Radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems
- CO5 Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications

**TEXT BOOKS:**

1. Holman, J.P., "Heat and Mass Transfer", Tata McGraw Hill, 2000
2. Yunus A. Cengel, "Heat Transfer A Practical Approach", Tata McGraw Hill, 5th Edition 2015

**REFERENCES:**

1. Frank P. Incropera and David P. Dewitt, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons, 1998.
2. Kothandaraman, C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, 1998.
3. Nag, P.K., "Heat Transfer", Tata McGraw Hill, New Delhi, 2002
4. Ozisik, M.N., "Heat Transfer", McGraw Hill Book Co., 1994.
5. R.C. Sachdeva, "Fundamentals of Engineering Heat & Mass transfer", New Age International Publishers, 2009

**OBJECTIVES:**

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To appreciate the use of FEM to a range of Engineering Problems.

**UNIT I INTRODUCTION****9**

Historical Background - Mathematical Modeling of field problems in Engineering - Governing Equations - Discrete and continuous models - Boundary, Initial and Eigen Value problems- Weighted Residual Methods - Variational Formulation of Boundary Value Problems - Ritz Technique - Basic concepts of the Finite Element Method.

**UNIT II ONE-DIMENSIONAL PROBLEMS****9**

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements - Derivation of Shape functions and Stiffness matrices and force vectors- Assembly of Matrices - Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation -Transverse deflections and Natural frequencies of beams.

**UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS****9**

Second Order 2D Equations involving Scalar Variable Functions - Variational formulation -Finite Element formulation - Triangular elements - Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems - Torsion of Non circular shafts -Quadrilateral elements – Higher Order Elements.

**UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS****9**

Equations of elasticity - Plane stress, plane strain and axisymmetric problems - Body forces and temperature effects - Stress calculations - Plate and shell elements.

**UNIT V ISOPARAMETRIC FORMULATION****9**

Natural co-ordinate systems - Isoparametric elements - Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques - Solutions Techniques to Dynamic problems - Introduction to Analysis Software.

**TOTAL : 45 PERIODS****OUTCOMES**

- CO1 Summarize the basics of finite element formulation.
- CO2 Apply finite element formulations to solve one dimensional Problems.
- CO3 Apply finite element formulations to solve two dimensional scalar Problems.
- CO4 Apply finite element method to solve two dimensional Vector problems.
- CO5 Apply finite element method to solve problems on iso parametric element and dynamic Problems.

**TEXT BOOKS:**

1. Reddy. J.N., “An Introduction to the Finite Element Method”, 3rd Edition, Tata McGraw-Hill, 2005
2. Seshu, P, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

## REFERENCES:

1. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications", John Wiley & Sons, 2005 (Indian Reprint 2013)\*
2. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice Hall College Div, 1990
3. Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002
4. Rao, S.S., "The Finite Element Method in Engineering", 3rd Edition, Butterworth Heinemann, 2004
5. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley Student Edition, 2002.

**ME8694**

**HYDRAULICS AND PNEUMATICS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

## OBJECTIVES:

- To provide student with knowledge on the application of fluid power in process, construction and manufacturing Industries.
- To provide students with an understanding of the fluids and components utilized in modern industrial fluid power system.
- To develop a measurable degree of competence in the design, construction and operation of fluid power circuits.

## **UNIT I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS 9**

Introduction to Fluid power - Advantages and Applications - Fluid power systems - Types of fluids - Properties of fluids and selection - Basics of Hydraulics - Pascal's Law - Principles of flow - Friction loss - Work, Power and Torque Problems, Sources of Hydraulic power : Pumping Theory - Pump Classification - Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary - Fixed and Variable displacement pumps - Problems.

## **UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS 9**

Hydraulic Actuators: Cylinders - Types and construction, Application, Hydraulic cushioning - Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves - Types, Construction and Operation - Servo and Proportional valves - Applications - Accessories : Reservoirs, Pressure Switches - Applications - Fluid Power ANSI Symbols - Problems.

## **UNIT III HYDRAULIC CIRCUITS AND SYSTEMS 9**

Accumulators, Intensifiers, Industrial hydraulic circuits - Regenerative, Pump Unloading, Double-Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

## **UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS 9**

Properties of air - Perfect Gas Laws - Compressor - Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit - Cascade method - Electro Pneumatic System - Elements - Ladder diagram - Problems, Introduction to fluidics and pneumatic logic circuits.

## UNIT V TROUBLE SHOOTING AND APPLICATIONS

9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools - Low cost Automation - Hydraulic and Pneumatic power packs.

**TOTAL:45 PERIODS**

### OUTCOMES:

**Upon the completion of this course the students will be able to**

- CO1 Explain the Fluid power and operation of different types of pumps.
- CO2 Summarize the features and functions of Hydraulic motors, actuators and Flow control valves
- CO3 Explain the different types of Hydraulic circuits and systems
- CO4 Explain the working of different pneumatic circuits and systems
- CO5 Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems.

### TEXT BOOKS:

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2005.
2. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw-Hill, 2001.

### REFERENCES:

1. Anthony Lal, "Oil hydraulics in the service of industry", Allied publishers, 1982.
2. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.
3. Majumdar S.R., "Pneumatic systems - Principles and maintenance", Tata McGraw Hill, 1995
4. Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 1989.
5. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006.

ME8681

CAD / CAM LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

### OBJECTIVES:

- To gain practical experience in handling 2D drafting and 3D modelling software systems.
- To study the features of CNC Machine Tool.
- To expose students to modern control systems (Fanuc, Siemens etc.,)
- To know the application of various CNC machines like CNC lathe, CNC Vertical Machining centre, CNC EDM and CNC wire-cut and studying of Rapid prototyping.

### LIST OF EXPERIMENTS

#### 1. 3D GEOMETRIC MODELLING

**30 PERIODS**

##### List of Experiments

1. Introduction of 3D Modelling software

##### Creation of 3D assembly model of following machine elements using 3D Modelling software

2. Flange Coupling
3. Plummer Block
4. Screw Jack
5. Lathe Tailstock
6. Universal Joint
7. Machine Vice
8. Stuffing box
9. Crosshead

10. Safety Valves
11. Non-return valves
12. Connecting rod
13. Piston
14. Crankshaft

\* Students may also be trained in manual drawing of some of the above components

## 2. Manual Part Programming.

**30 PERIODS**

- (i) Part Programming - CNC Machining Centre
  - a) Linear Cutting.
  - b) Circular cutting.
  - c) Cutter Radius Compensation.
  - d) Canned Cycle Operations.
- (ii) Part Programming - CNC Turning Centre
  - a) Straight, Taper and Radius Turning.
  - b) Thread Cutting.
  - c) Rough and Finish Turning Cycle.
  - d) Drilling and Tapping Cycle.

## 3. Computer Aided Part Programming

- e) CL Data and Post process generation using CAM packages.
- f) Application of CAPP in Machining and Turning Centre.

**TOTAL: 60 PERIODS**

## OUTCOMES

- CO1 Draw 3D and Assembly drawing using CAD software  
 CO2 Demonstrate manual part programming with G and M codes using CAM

### LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

| S.No.           | Description of Equipment  | Qty         |
|-----------------|---|-------------|
| <b>HARDWARE</b> |   |             |
| 1.              | Computer Server   | 1           |
| 2.              | Computer nodes or systems (High end CPU with atleast 1 GB main memory) networked to the server  | 30          |
| 3.              | A3 size plotter   | 1           |
| 4.              | Laser Printer   | 1           |
| 5.              | CNC Lathe   | 1           |
| 6.              | CNC milling machine   | 1           |
| <b>SOFTWARE</b> |   |             |
| 7.              | Any High end integrated modeling and manufacturing CAD / CAM software   | 15 licenses |
| 8.              | CAM Software for machining centre and turning centre (CNC Programming and tool path simulation for FANUC / Sinumeric and Heidenhain controller) | 15 licenses |
| 9.              | Licensed operating system   | Adequate    |
| 10.             | Support for CAPP  | Adequate    |

ME8682

**DESIGN AND FABRICATION PROJECT**

**L T P C**  
**0 0 4 2**

**OBJECTIVE:**

- The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

**GUIDELINE FOR REVIEW AND EVALUATION**

The students may be grouped into 2 to 4 and work under a project supervisor. The device/system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry. A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL : 60 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

CO1 design and Fabricate the machine element or the mechanical product.

CO2 demonstrate the working model of the machine element or the mechanical product.

HS8581

**PROFESSIONAL COMMUNICATION**

**L T P C**  
**0 0 2 1**

**OBJECTIVES: The course aims to:**

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

**UNIT I**

Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills--Grooming as a professional with values--Time Management--General awareness of Current Affairs

**UNIT II**

Self-Introduction-organizing the material - Introducing oneself to the audience - introducing the topic - answering questions - individual presentation practice-- presenting the visuals effectively - 5 minute presentations

**UNIT III**

Introduction to Group Discussion-- Participating in group discussions - understanding group dynamics - brainstorming the topic -- questioning and clarifying -GD strategies- activities to improve GD skills

**UNIT IV**

Interview etiquette - dress code - body language - attending job interviews- telephone/skype interview -one to one interview &panel interview - FAQs related to job interviews

## UNIT V

Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes

**TOTAL : 30 PERIODS**

**OUTCOMES: At the end of the course Learners will be able to:**

- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

### Recommended Software

1. Open Source Software
2. Win English

### REFERENCES:

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
3. Interact English Lab Manual for Undergraduate Students,. OrientBalckSwan: Hyderabad, 2016.
4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
5. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010.

**ME8792**

**POWER PLANT ENGINEERING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

### OBJECTIVE:

- Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

### **UNIT I COAL BASED THERMAL POWER PLANTS 9**

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

### **UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 9**

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

### **UNIT III NUCLEAR POWER PLANTS 9**

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : *Boiling Water Reactor (BWR)*, *Pressurized Water Reactor (PWR)*, CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

**UNIT IV POWER FROM RENEWABLE ENERGY 9**  
 Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

**UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 9**  
 Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Explain the layout, construction and working of the components inside a thermal power plant.
- CO2 Explain the layout, construction and working of the components inside a Diesel, Gas and Combined cycle power plants.
- CO3 Explain the layout, construction and working of the components inside nuclear power plants.
- CO4 Explain the layout, construction and working of the components inside Renewable energy power plants.
- CO5 Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

**TEXT BOOK:**

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.

**REFERENCES:**

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.

|               |   |          |          |          |          |
|---------------|---|----------|----------|----------|----------|
| <b>ME8793</b> | <b>PROCESS PLANNING AND COST ESTIMATION</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVE:**

- To introduce the process planning concepts to make cost estimation for various products after process planning

**UNIT I INTRODUCTION TO PROCESS PLANNING 9**  
 Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection

**UNIT II PROCESS PLANNING ACTIVITIES 9**  
 Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies



**UNIT III INTRODUCTION TO COST ESTIMATION 9**  
 Importance of costing and estimation -methods of costing-elements of cost estimation -Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost

**UNIT IV PRODUCTION COST ESTIMATION 9**  
 Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

**UNIT V MACHINING TIME CALCULATION 9**  
 Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 select the process, equipment and tools for various industrial products.
- CO2 prepare process planning activity chart.
- CO3 explain the concept of cost estimation.
- CO4 compute the job order cost for different type of shop floor.
- CO5 calculate the machining time for various machining operations.

**TEXT BOOKS:**

1. Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002.
2. Sinha B.P, “Mechanical Estimating and Costing”, Tata-McGraw Hill publishing co, 1995.

**REFERENCES:**

1. Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002.
2. Ostwalal P.F. and Munez J., “Manufacturing Processes and systems”, 9<sup>th</sup> Edition, John Wiley, 1998.
3. Russell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI, 2003.
4. Mikell P. Groover, “Automation, Production, Systems and Computer Integrated Manufacturing”, Pearson Education 2001.
5. K.C. Jain & L.N. Aggarwal, “Production Planning Control and Industrial Management”, Khanna Publishers 1990.

**ME8791**

**MECHATRONICS**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVE:**

- To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.

**UNIT I INTRODUCTION 9**  
 Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics - Emerging areas of Mechatronics - Classification of Mechatronics. Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers - LVDT - Capacitance sensors - Strain gauges - Eddy current sensor - Hall effect sensor - Temperature sensors - Light sensors

|  |  |          |
|--|--|----------|
| <b>UNIT II</b>   | <b>MICROPROCESSOR AND MICROCONTROLLER</b>      | <b>9</b> |
| Introduction - Architecture of 8085 - Pin Configuration - Addressing Modes -Instruction set, Timing diagram of 8085 - Concepts of 8051 microcontroller - Block diagram,.   |  |          |
| <b>UNIT III</b>  | <b>PROGRAMMABLE PERIPHERAL INTERFACE</b>       | <b>9</b> |
| Introduction - Architecture of 8255, Keyboard interfacing, LED display -interfacing, ADC and DAC interface, Temperature Control - Stepper Motor Control - Traffic Control interface.   |  |          |
| <b>UNIT IV</b>   | <b>PROGRAMMABLE LOGIC CONTROLLER</b>           | <b>9</b> |
| Introduction - Basic structure - Input and output processing - Programming - Mnemonics - Timers, counters and internal relays - Data handling - Selection of PLC.  |  |          |
| <b>UNIT V</b>  | <b>ACTUATORS AND MECHATRONIC SYSTEM DESIGN</b> | <b>9</b> |
| Types of Stepper and Servo motors - Construction - Working Principle - Advantages and Disadvantages. Design process-stages of design process - Traditional and Mechatronics design concepts - Case studies of Mechatronics systems - Pick and place Robot - Engine Management system - Automatic car park barrier. |  |          |

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Discuss the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology.
- CO2 Discuss the architecture of Microprocessor and Microcontroller, Pin Diagram, Addressing Modes of Microprocessor and Microcontroller.
- CO3 Discuss Programmable Peripheral Interface, Architecture of 8255 PPI, and various device interfacing
- CO4 Explain the architecture, programming and application of programmable logic controllers to problems and challenges in the areas of Mechatronic engineering.
- CO5 Discuss various Actuators and Mechatronics system using the knowledge and skills acquired through the course and also from the given case studies

**TEXT BOOKS:**

1. Bolton, "Mechatronics", Prentice Hall, 2008
2. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 5th Edition, Prentice Hall, 2008.

**REFERENCES:**

1. Bradley D.A, Dawson D, Buru N.C and Loader A.J, "Mechatronics", Chapman and Hall, 1993.
2. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013
3. Devadas Shetty and Richard A. Kolk, "Mechatronics Systems Design", PWS publishing company, 2007.
4. Krishna Kant, "Microprocessors & Microcontrollers", Prentice Hall of India, 2007.
5. Michael B.Histand and Davis G.Alciatore, "Introduction to Mechatronics and Measurement systems", McGraw Hill International edition, 2007.

**OBJECTIVES:**

- To give exposure to software tools needed to analyze engineering problems.
- To expose the students to different applications of simulation and analysis tools.

**LIST OF EXPERIMENTS A. SIMULATION**

1. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables
2. Use of Matlab to solve simple problems in vibration
3. Mechanism Simulation using Multibody Dynamic software

**B. ANALYSIS**

1. Force and Stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi - symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.

**TOTAL: 60 PERIODS****OUTCOMES:****Upon the completion of this course the students will be able to**

- CO1 simulate the working principle of air conditioning system, hydraulic and pneumatic cylinder and cam follower mechanisms using MATLAB.
- CO2 analyze the stresses and strains induced in plates, brackets and beams and heat transfer problems.
- CO3 calculate the natural frequency and mode shape analysis of 2D components and beams.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

| S. NO. | NAME OF THE EQUIPMENT   | Qty.        |
|--------|---|-------------|
| 1      | Computer Work Station   | 15          |
| 2      | Color Desk Jet Printer  | 01          |
| 3      | Multibody Dynamic Software Suitable for Mechanism simulation and analysis | 15 licenses |
| 4      | C / MATLAB  | 5 licenses  |

**ME8781**

**MECHATRONICS LABORATORY**

**L T P C**  
**0 0 4 2**

**OBJECTIVE:**

- To know the method of programming the microprocessor and also the design, modeling & analysis of basic electrical, hydraulic & pneumatic Systems which enable the students to understand the concept of mechatronics.

**LIST OF EXPERIMENTS:**

1. Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division – Sorting – Code Conversion.
2. Stepper motor interface.
3. Traffic light interface.
4. Speed control of DC motor.
5. Study of various types of transducers.
6. Study of hydraulic, pneumatic and electro-pneumatic circuits.
7. Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using Software.
8. Study of PLC and its applications.
9. Study of image processing technique.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Demonstrate the functioning of mechatronics system with various pneumatic, hydraulic and electrical systems.
- CO2 Demonstrate the functioning of control systems with the help of PLC and microcontrollers.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

| <b>Sl. No.</b> | <b>NAME OF THE EQUIPMENT</b>  | <b>Qty.</b> |
|----------------|---|-------------|
| 1              | Basic Pneumatic Trainer Kit with manual and electrical controls/ PLC Control each | 1 No.       |
| 2              | Basic Hydraulic Trainer Kit   | 1 No        |
| 3              | Hydraulics and Pneumatics Systems Simulation Software                             | 10 No       |
| 4              | 8051 - Microcontroller kit with stepper motor and drive circuit sets              | 2 No        |
| 5              | Image processing system with hardware & software                                  | 1 No.       |

**ME8712**

**TECHNICAL SEMINAR**

**L T P C**  
**0 0 2 1**

To enrich the communication skills of the student and presentations of technical topics of interest, this course is introduced. In this course, a student has to present three Technical papers or recent advances in engineering/technology that will be evaluated by a Committee constituted by the Head of the Department.

**TOTAL: 30 PERIODS**

**OBJECTIVE:**

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization

**UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9**

Definition of Management - Science or Art - Manager Vs Entrepreneur - types of managers - managerial roles and skills - Evolution of Management - Scientific, human relations, system and contingency approaches - Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment - Current trends and issues in Management.

**UNIT II PLANNING 9**

Nature and purpose of planning - planning process - types of planning - objectives - setting objectives - policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process.

**UNIT III ORGANISING 9**

Nature and purpose - Formal and informal organization - organization chart - organization structure - types - Line and staff authority - departmentalization - delegation of authority - centralization and decentralization - Job Design - Human Resource Management - HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

**UNIT IV DIRECTING 9**

Foundations of individual and group behaviour - motivation - motivation theories - motivational techniques - job satisfaction - job enrichment - leadership - types and theories of leadership - communication - process of communication - barrier in communication - effective communication - communication and IT.

**UNIT V CONTROLLING 9**

System and process of controlling - budgetary and non-budgetary control techniques - use of computers and IT in Management control - Productivity problems and management - control and performance - direct and preventive control - reporting.

**TOTAL: 45 PERIODS****OUTCOME:**

- Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

**TEXT BOOKS:**

- JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.
- Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India) Pvt. Ltd., 10<sup>th</sup> Edition, 2009.

**REFERENCES:**

- Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 1998.
- Robert Kreitner & Mamata Mohapatra, "Management", Biztantra, 2008.
- Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management", 7<sup>th</sup> Edition, Pearson Education, 2011.
- Tripathy PC & Reddy PN, "Principles of Management", Tata McGraw Hill, 1999

ME8811

PROJECT WORK

| L | T | P  | C  |
|---|---|----|----|
| 0 | 0 | 20 | 10 |

**OBJECTIVE:**

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL: 300 PERIODS**

**OUTCOME:**

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

ME8091

AUTOMOBILE ENGINEERING

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system

**UNIT I VEHICLE STRUCTURE AND ENGINES 9**

Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines -components-functions and materials, variable valve timing (VVT).

**UNIT II ENGINE AUXILIARY SYSTEMS 9**

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

**UNIT III TRANSMISSION SYSTEMS 9**

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

**UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9**

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

**UNIT V ALTERNATIVE ENERGY SOURCES**

**9**

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required -Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 recognize the various parts of the automobile and their functions and materials.
- CO2 discuss the engine auxiliary systems and engine emission control.
- CO3 distinguish the working of different types of transmission systems.
- CO4 explain the Steering, Brakes and Suspension Systems.
- CO5 predict possible alternate sources of energy for IC Engines.

**TEXT BOOKS:**

1. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.
2. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 13th Edition 2014..

**REFERENCES:**

1. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012.
2. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
3. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.
4. Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart - Will Cox Company Inc, USA ,1978.
5. Newton ,Steeds and Garet, "Motor Vehicles", Butterworth Publishers,1989.

**PR8592**

**WELDING TECHNOLOGY**

**L T P C  
3 0 0 3**

**OBJECTIVE:**

- To understand the basics of welding and to know about the various types of welding processes

**UNIT I GAS AND ARC WELDING PROCESSES:**

**9**

Fundamental principles – Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electroslag welding processes - advantages, limitations and applications.

**UNIT II RESISTANCE WELDING PROCESSES:**

**9**

Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - advantages, limitations and applications.

**UNIT III SOLID STATE WELDING PROCESSES:**

**9**

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications.

**UNIT IV OTHER WELDING PROCESSES: 9**  
 Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stir welding, Under Water welding, Welding automation in aerospace, nuclear and surface transport vehicles.

**UNIT V DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS 9**  
 Various weld joint designs – Welding defects – causes and remedies - Weldability of Aluminium, Copper, and Stainless steels. Destructive and non destructive testing of weldments.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

Upon completion of this course, the students can able

- Understand the construction and working principles of gas and arc welding process.
- Understand the construction and working principles of resistance welding process.
- Understand the construction and working principles of various solid state welding process.
- Understand the construction and working principles of various special welding processes.
- Understand the concepts on weld joint design, weldability and testing of weldments.

**TEXT BOOKS**

1. Little R.L., “Welding and welding Technology”, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 34<sup>th</sup> reprint, 2008.
2. Parmer R.S., “Welding Engineering and Technology”, 1<sup>st</sup> Edition, Khanna Publishers, New Delhi, 2008.
3. Parmer R.S., “Welding Processes and Technology”, Khanna Publishers, New Delhi, 1992.

**REFERENCES**

1. AWS- Welding Hand Book. 8<sup>th</sup> Edition. Vol- 2. “Welding Process”
2. Christopher Davis. “Laser Welding- Practical Guide”. Jaico Publishing House.
3. Davis A.C., “The Science and Practice of Welding”, Cambridge University Press, Cambridge, 1993
4. Nadkarni S.V. “Modern Arc Welding Technology”, Oxford IBH Publishers, 1<sup>st</sup> Edition, 2005.
5. Schwartz M.M. “Metals Joining Manual”. McGraw Hill Books, 1979.
6. Tylecote R.F. “The Solid Phase Welding of Metals”. Edward Arnold Publishers Ltd. London.

|               |  |          |          |          |          |
|---------------|--|----------|----------|----------|----------|
| <b>ME8096</b> | <b>GAS DYNAMICS AND JET PROPULSION</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To understand the basic difference between incompressible and compressible flow.
- To understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion.  
 (Use of Standard Gas Tables permitted)

**UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 9**  
 Energy and momentum equations of compressible fluid flows - Stagnation states, Mach waves and Mach cone - Effect of Mach number on compressibility - Isentropic flow through variable ducts - Nozzle and Diffusers

**UNIT II FLOW THROUGH DUCTS 9**  
 Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties.





**UNIT III AGREEMENTS AND LEGISLATIONS 10**  
International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

**UNIT IV 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 V ENFORCEMENT OF IPRs 7**  
Infringement of IPRs, Enforcement Measures, Emerging issues - Case Studies.

**TOTAL :45 PERIODS**

**OUTCOME:**

- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

**TEXT BOOKS**

1. S.V. Satarkar, Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002.
2. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012

**REFERENCES**

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

**GE8073 FUNDAMENTALS OF NANOSCIENCE L T P C 3 0 0 3**

**OBJECTIVE:**

To learn about basis of nanomaterial science, preparation method, types and application

**UNIT I INTRODUCTION 8**  
Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

**UNIT II GENERAL METHODS OF PREPARATION 9**  
Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

**UNIT III NANOMATERIALS 12**  
Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO<sub>2</sub>,MgO, ZrO<sub>2</sub>, NiO, nanoalumina, CaO, AgTiO<sub>2</sub>, Ferrites, Nanoclays-

functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

**UNIT IV CHARACTERIZATION TECHNIQUES 9**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

**UNIT V APPLICATIONS 7**

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechnology: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

**TEXT BOOKS :**

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Characterization of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

**REFERENCES:**

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhlesh Lakhtakia, "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

|               |   |          |          |          |          |
|---------------|---|----------|----------|----------|----------|
| <b>ME8071</b> | <b>REFRIGERATION AND AIR CONDITIONING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To understand the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
- To provide knowledge on design aspects of Refrigeration & Air conditioning systems

**UNIT I INTRODUCTION 9**

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.- Ideal cycles- Refrigerants Desirable properties - Classification - Nomenclature - ODP & GWP.

**UNIT II VAPOUR COMPRESSION REFRIGERATION SYSTEM 9**

Vapor compression cycle : p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system - low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

**UNIT III OTHER REFRIGERATION SYSTEMS****9**

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic - Vortex and Pulse tube refrigeration systems.

**UNIT IV PSYCHROMETRIC PROPERTIES AND PROCESSES****9**

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

**UNIT V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION****9**

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

**TOTAL: 45 PERIODS****OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Explain the basic concepts of Refrigeration
- CO2 Explain the Vapor compression Refrigeration systems and to solve problems
- CO3 Discuss the various types of Refrigeration systems
- CO4 Calculate the Psychrometric properties and its use in psychrometric processes
- CO5 Explain the concepts of Air conditioning and to solve problems

**TEXT BOOK:**

1. Arora, C.P., "Refrigeration and Air Conditioning", 3<sup>rd</sup> edition, McGraw Hill, New Delhi, 2010.

**REFERENCES:**

1. ASHRAE Hand book, Fundamentals, 2010
2. Jones W.P., "Air conditioning engineering", 5<sup>th</sup> edition, Elsevier Butterworth-Heinemann, 2007
3. Roy J. Dossat, "Principles of Refrigeration", 4<sup>th</sup> edition, Pearson Education Asia, 2009.
4. Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986.

ME8072

**RENEWABLE SOURCES OF ENERGY**

L T P C  
3 0 0 3

**OBJECTIVE:**

- At the end of the course, the students are expected to identify the new methodologies / technologies for effective utilization of renewable energy sources.

**UNIT I INTRODUCTION 9**

World Energy Use - Reserves of Energy Resources - Environmental Aspects of Energy Utilisation – Renewable Energy Scenario in Tamil nadu, India and around the World – Potentials - Achievements / Applications - Economics of renewable energy systems.

**UNIT II SOLAR ENERGY 9**

Solar Radiation - Measurements of Solar Radiation - Flat Plate and Concentrating Collectors - Solar direct Thermal Applications - Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion - Solar Cells - Solar PV Power Generation - Solar PV Applications.

**UNIT III WIND ENERGY 9**

Wind Data and Energy Estimation - Types of Wind Energy Systems - Performance - Site Selection – Details of Wind Turbine Generator - Safety and Environmental Aspects

**UNIT IV BIO - ENERGY 9**

Biomass direct combustion - Biomass gasifiers - Biogas plants - Digesters - Ethanol production – Bio diesel - Cogeneration - Biomass Applications

**UNIT V OTHER RENEWABLE ENERGY SOURCES 9**

Tidal energy - Wave Energy - Open and Closed OTEC Cycles - Small Hydro-Geothermal Energy – Hydrogen and Storage - Fuel Cell Systems - Hybrid Systems.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Discuss the importance and Economics of renewable Energy
- CO2 Discuss the method of power generation from Solar Energy
- CO3 Discuss the method of power generation from Wind Energy
- CO4 Explain the method of power generation from Bio Energy
- CO5 Explain the Tidal energy, Wave Energy, OTEC, Hydro energy, Geothermal Energy, Fuel Cells and Hybrid Systems.

**TEXT BOOKS:**

1. Rai. G.D., "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.
2. Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 2006.

**REFERENCES:**

1. Chetan Singh Solanki, Solar Photovoltaics, "Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2015.
2. David M. Mousdale – "Introduction to Biofuels", CRC Press, Taylor & Francis Group, USA 2017
3. Freris. L.L., "Wind Energy Conversion Systems", Prentice Hall, UK, 1990.
4. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 2012.
5. Johnson Gary, L. "Wind Energy Systems", Prentice Hall, New York, 1985

**OBJECTIVES:**

- To introduce the concept of SQC
- To understand process control and acceptance sampling procedure and their application.
- To learn the concept of reliability.

**UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES 9**

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance, Quality control: Quality cost-Variation in process causes of variation – Theory of control chart- uses of control chart -X chart, R chart and chart - process capability – process capability studies and simple problems. Six sigma concepts

**UNIT II PROCESS CONTROL FOR ATTRIBUTES 9**

Control chart for attributes -control chart for non conformings- p chart and np chart – control chart for nonconformities- C and U charts, State of control and process out of control identification in charts, pattern study.

**UNIT III ACCEPTANCE SAMPLING 9**

Lot by lot sampling - types - probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer’s Risk and consumer’s Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

**UNIT IV LIFE TESTING – RELIABILITY 9**

Life testing - Objective - failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate - Weibull model, system reliability, series, parallel and mixed configuration - simple problems. Maintainability and availability - simple problems. Acceptance sampling based on reliability test - O.C Curves.

**UNIT V QUALITY AND RELIABILITY 9**

Reliability improvements - techniques- use of Pareto analysis - design for reliability - redundancy unit and standby redundancy - Optimization in reliability - Product design - Product analysis - Product development-Product life cycles.

**Note:** Use of approved statistical table permitted in the examination.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Summarize the concept of Quality and Process control for variables
- CO2 Apply the process control for attributes
- CO3 Explain the concept of sampling and to solve problems
- CO4 Explain the concept of Life testing
- CO5 Explain the concept Reliability and techniques involved

**TEXT BOOKS:**

1. Douglas.C. Montgomery, “Introduction to Statistical quality control”, 7<sup>th</sup> edition, John Wiley 2012.
2. Srinath. L.S., “Reliability Engineering”, Affiliated East west press, 2008.

**REFERENCES:**

1. Besterfield D.H., "Quality Control", Prentice Hall, 2013.
2. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 2012
3. Danny Samson, "Manufacturing & Operations Strategy", Prentice Hall, 1991
4. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 2017
5. Gupta. R.C, "Statistical Quality control", Khanna Publishers, 2001.

|               |   |          |          |          |          |
|---------------|---|----------|----------|----------|----------|
| <b>ME8073</b> | <b>UNCONVENTIONAL MACHINING PROCESSES</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVE:**

- To learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications

**UNIT I INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES 9**

Unconventional machining Process – Need – classification – merits, demerits and applications. Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR- Applications.

**UNIT II THERMAL AND ELECTRICAL ENERGY BASED PROCESSES 9**

Electric Discharge Machining (EDM) – Wire cut EDM – Working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing — Applications. Laser Beam machining and drilling, (LBM), plasma, Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications.

**UNIT III CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9**

Chemical machining and Electro-Chemical machining (CHM and ECM)- Etchants – Maskant - techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- equipments-Surface Roughness and MRR Electrical circuit-Process Parameters-ECG and ECH - Applications.

**UNIT IV ADVANCED NANO FINISHING PROCESSES 9**

Abrasive flow machining, chemo-mechanical polishing, magnetic abrasive finishing, magneto rheological finishing, magneto rheological abrasive flow finishing their working principles, equipments, effect of process parameters, applications, advantages and limitations.

**UNIT V RECENT TRENDS IN NON-TRADITIONAL MACHINING PROCESSES 9**

Recent developments in non-traditional machining processes, their working principles, equipments, effect of process parameters, applications, advantages and limitations. Comparison of non-traditional machining processes.

**TOTAL: 45 PERIODS****OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Explain the need for unconventional machining processes and its classification
- CO2 Compare various thermal energy and electrical energy based unconventional machining processes.
- CO3 Summarize various chemical and electro-chemical energy based unconventional machining processes.
- CO4 Explain various nano abrasives based unconventional machining processes.
- CO5 Distinguish various recent trends based unconventional machining processes.

**TEXT BOOKS:**

1. Vijay.K. Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd., New Delhi, 2007
2. Pandey P.C. and Shan H.S. “Modern Machining Processes” Tata McGraw-Hill, New Delhi, 2007.

**REFERENCES:**

1. Benedict. G.F. “Nontraditional Manufacturing Processes”, Marcel Dekker Inc., New York, 1987.
2. Mc Geough, “Advanced Methods of Machining”, Chapman and Hall, London, 1998.
3. Paul De Garmo, J.T.Black, and Ronald. A.Kohser, “Material and Processes in Manufacturing” Prentice Hall of India Pvt. Ltd., 8thEdition, New Delhi , 2001.

**MG8491****OPERATIONS RESEARCH**

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**OBJECTIVE:**

- To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.

**UNIT I          LINEAR MODELS****15**

The phase of an operation research study - Linear programming - Graphical method- Simplex algorithm - Duality formulation - Sensitivity analysis.

**UNIT II          TRANSPORTATION MODELS AND NETWORK MODELS****8**

Transportation Assignment Models -Traveling Salesman problem-Networks models - Shortest route - Minimal spanning tree - Maximum flow models -Project network - CPM and PERT networks - Critical path scheduling - Sequencing models.

**UNIT III          INVENTORY MODELS****6**

Inventory models - Economic order quantity models - Quantity discount models - Stochastic inventory models - Multi product models - Inventory control models in practice.

**UNIT IV          QUEUEING MODELS****6**

Queueing models - Queueing systems and structures - Notation parameter - Single server and multi server models - Poisson input - Exponential service - Constant rate service - Infinite population - Simulation.

**UNIT V          DECISION MODELS****10**

Decision models - Game theory - Two person zero sum games - Graphical solution- Algebraic solution- Linear Programming solution - Replacement models - Models based on service life - Economic life- Single / Multi variable search technique - Dynamic Programming - Simple Problem.

**TOTAL: 45 PERIODS****OUTCOME:**

- Upon completion of this course, the students can able to use the optimization techniques for use engineering and Business problems

**TEXT BOOK:**

1. Hillier and Libeberman, “Operations Research”, Holden Day, 2005
2. Taha H.A., “Operations Research”, Sixth Edition, Prentice Hall of India, 2003.



**REFERENCES:**

1. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley, 2009.
2. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.
3. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 1992.
4. Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.
5. Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002.

**MF8071****ADDITIVE MANUFACTURING****L T P C  
3 0 0 3****OBJECTIVES:**

- To know the principle, methods, possibilities and limitations as well as environmental effects of Additive Manufacturing technologies.
- To be familiar with the characteristics of the different materials those are used in Additive Manufacturing technologies.

**UNIT I INTRODUCTION****9**

Overview – Need - Development of Additive Manufacturing Technology -Principle – AM Process Chain- Classification –Rapid Prototyping- Rapid Tooling – Rapid Manufacturing – Applications- Benefits –Case studies.

**UNIT II DESIGN FOR ADDITIVE MANUFACTURING****9**

Design tools: Data processing - CAD model preparation – Part orientation and support structure generation – Model slicing –Tool path generation- Design for Additive Manufacturing: Concepts and objectives- AM unique capabilities – DFAM for part quality improvement- Customised design and fabrication for medical applications.

**UNIT III PHOTOPOLYMERIZATION AND POWDER BED FUSION PROCESSES****9**

Photo polymerization: SLA-Photo curable materials – Process - Advantages and Applications. Powder Bed Fusion: SLS-Process description – powder fusion mechanism – Process Parameters – Typical Materials and Application. Electron Beam Melting.

**UNIT IV EXTRUSION BASED AND SHEET LAMINATION PROCESSES****9**

Extrusion Based System: FDM-Introduction – Basic Principle – Materials – Applications and Limitations – Bioextrusion. Sheet Lamination Process:LOM- Gluing or Adhesive bonding – Thermal bonding.

**UNIT V PRINTING PROCESSES AND BEAM DEPOSITION PROCESSES****9**

Droplet formation technologies – Continuous mode – Drop on Demand mode – Three Dimensional Printing – Advantages – Bioplotter - Beam Deposition Process:LENS- Process description – Material delivery – Process parameters – Materials – Benefits – Applications.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- On completion of this course, students will learn about a working principle and construction of Additive Manufacturing technologies, their potential to support design and manufacturing, modern development in additive manufacturing process and case studies relevant to mass customized manufacturing.

**TEXT BOOKS:**

- 1 Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third edition, World Scientific Publishers, 2010.
- 2 Ian Gibson, David W.Rosen, Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing” Springer , 2010.

**REFERENCES:**

- 1 Andreas Gebhardt “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing” Hanser Gardner Publication 2011.
- 2 Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.
- 3 Liou L.W. and Liou F.W., “Rapid Prototyping and Engineering applications :A tool box for prototype development”, CRC Press, 2007.
- 4 Tom Page “Design for Additive Manufacturing” LAP Lambert Academic Publishing, 2012.

**GE8077**

**TOTAL QUALITY MANAGEMENT**

**L T P C  
3 0 0 3**

**OBJECTIVE:**

- To facilitate the understanding of Quality Management principles and process.

**UNIT I 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 - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

**UNIT II TQM PRINCIPLES**

**9**

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

**UNIT III TQM TOOLS AND 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 IV TQM TOOLS AND TECHNIQUES II**

**9**

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

**UNIT V QUALITY MANAGEMENT SYSTEM**

**9**

Introduction–Benefits of ISO Registration–ISO 9000 Series of Standards–Sector-Specific Standards–AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements–Implementation– Documentation–Internal Audits–Registration--**ENVIRONMENTAL MANAGEMENT SYSTEM:**

Introduction–ISO 14000 Series Standards–Concepts of ISO 14001–Requirements of ISO 14001–Benefits of EMS.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

**TEXT BOOK:**

1. Dale H.Besterfield, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

**REFERENCES:**

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8<sup>th</sup> Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO 9001-2015 standards

**ME8099**

**ROBOTICS**

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**OBJECTIVES:**

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

**UNIT I FUNDAMENTALS OF ROBOT**

**9**

Robot - Definition - Robot Anatomy - Co ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.

**UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS**

**9**

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

**UNIT III SENSORS AND MACHINE VISION**

**9**

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data-Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation.

**UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING****9**

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

**UNIT V IMPLEMENTATION AND ROBOT ECONOMICS****9**

RGV, AGV; Implementation of Robots in Industries-Variou Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

**TOTAL: 45 PERIODS****OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Explain the concepts of industrial robots, classification, specifications and coordinate systems. Also summarize the need and application of robots in different sectors.
- CO2 Illustrate the different types of robot drive systems as well as robot end effectors.
- CO3 Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
- CO4 Develop robotic programs for different tasks and familiarize with the kinematics motions of robot.
- CO5 Examine the implementation of robots in various industrial sectors and interpolate the economic analysis of robots.

**TEXT BOOKS:**

1. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2012.
2. Klaffer R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach",Prentice Hall, 2003.

**REFERENCES:**

1. Craig J.J., "Introduction to Robotics Mechanics and Control", Pearson Education, 2008.
2. Deb S.R., "Robotics Technology and Flexible Automation" Tata McGraw Hill Book Co., 2013.
3. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.
4. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill, 1995.
5. Koren Y., "Robotics for Engineers", Mc Graw Hill Book Co., 1992.

**ME8095****DESIGN OF JIGS, FIXTURES AND PRESS TOOLS**

| L | T | P | C |
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**OBJECTIVES:**

- To understand the functions and design principles of Jigs, fixtures and press tools
- To gain proficiency in the development of required views of the final design.

**UNIT I LOCATING AND CLAMPING PRINCIPLES:****9**

Objectives of tool design- Function and advantages of Jigs and fixtures - Basic elements - principles of location - Locating methods and devices - Redundant Location - Principles of clamping - Mechanical actuation - pneumatic and hydraulic actuation Standard parts - Drill bushes and Jig buttons - Tolerances and materials used.

**UNIT II JIGS AND FIXTURES****9**

Design and development of jigs and fixtures for given component- Types of Jigs - Post, Turnover, Channel, latch, box, pot, angular post jigs - Indexing jigs - General principles of milling, Lathe, boring, broaching and grinding fixtures - Assembly, Inspection and Welding fixtures - Modular fixturing systems- Quick change fixtures.

**UNIT III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 9**

Press Working Terminologies - operations - Types of presses - press accessories - Computation of press capacity - Strip layout - Material Utilization - Shearing action - Clearances - Press Work Materials - Center of pressure- Design of various elements of dies - Die Block - Punch holder, Die set, guide plates - Stops - Strippers - Pilots - Selection of Standard parts - Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

**UNIT IV BENDING AND DRAWING DIES 9**

Difference between bending and drawing - Blank development for above operations - Types of Bending dies - Press capacity - Spring back - knockouts - direct and indirect - pressure pads - Ejectors - Variables affecting Metal flow in drawing operations - draw die inserts - draw beads- ironing - Design and development of bending, forming, drawing, reverse redrawing and combination dies - Blank development for axisymmetric, rectangular and elliptic parts - Single and double action dies.

**UNIT V FORMING TECHNIQUES AND EVALUATION 9**

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies - recent trends in tool design- computer Aids for sheet metal forming Analysis - basic introduction - tooling for numerically controlled machines- setup reduction for work holding - Single minute exchange of dies - Poka Yoke.

**TOTAL: 45 PERIODS**

**Note:** (Use of P S G Design Data Book is permitted in the University examination)

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Summarize the different methods of Locating Jigs and Fixtures and Clamping principles
- CO2 Design and develop jigs and fixtures for given component
- CO3 Discuss the press working terminologies and elements of cutting dies
- CO4 Distinguish between Bending and Drawing dies.
- CO5 Discuss the different types of forming techniques

**TEXT BOOKS:**

1. Joshi, P.H. "Jigs and Fixtures", Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2010.
2. Joshi P.H "Press tools - Design and Construction", wheels publishing, 1996

**REFERENCES:**

1. ASTME Fundamentals of Tool Design Prentice Hall of India.
2. Design Data Hand Book, PSG College of Technology, Coimbatore.
3. Donaldson, Lecain and Goold "Tool Design", 5<sup>th</sup> Edition, Tata McGraw Hill, 2017.
4. Hoffman "Jigs and Fixture Design", Thomson Delmar Learning, Singapore, 2004.
5. Kempster, "Jigs and Fixture Design", Third Edition, Hoddes and Stoughton, 1974.
6. Venkataraman. K., "Design of Jigs Fixtures & Press Tools", Tata McGraw Hill, New Delhi, 2005.

**OBJECTIVES:**

- To introduce Governing Equations of viscous fluid flows
- To introduce numerical modeling and its role in the field of fluid flow and heat transfer
- To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
- To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.

**UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9**

Basics of computational fluid dynamics - Governing equations of fluid dynamics - Continuity, Momentum and Energy equations - Chemical species transport - Physical boundary conditions - Time-averaged equations for Turbulent Flow - Turbulent-Kinetic Energy Equations - Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

**UNIT II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9**

Derivation of finite difference equations - Simple Methods - General Methods for first and second order accuracy - Finite volume formulation for steady state One, Two and Three - dimensional diffusion problems -Parabolic equations - Explicit and Implicit schemes - Example problems on elliptic and parabolic equations - Use of Finite Difference and Finite Volume methods.

**UNIT III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9**

Steady one-dimensional convection and diffusion - Central, upwind differencing schemes properties of discretization schemes - Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

**UNIT IV FLOW FIELD ANALYSIS 9**

Finite volume methods -Representation of the pressure gradient term and continuity equation - Staggered grid - Momentum equations - Pressure and Velocity corrections - Pressure Correction equation, SIMPLE algorithm and its variants - PISO Algorithms.

**UNIT V TURBULENCE MODELS AND MESH GENERATION 9**

Turbulence models, mixing length model, Two equation (k- $\epsilon$ ) models - High and low Reynolds number models - Structured Grid generation - Unstructured Grid generation - Mesh refinement - Adaptive mesh - Software tools.

**TOTAL: 45 PERIODS****OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Derive the governing equations and boundary conditions for Fluid dynamics
- CO2 Analyze Finite difference and Finite volume methods for Diffusion
- CO3 Analyze Finite volume method for Convective diffusion
- CO4 Analyze Flow field problems
- CO5 Explain and solve the Turbulence models and Mesh generation techniques

**TEXT BOOKS:**

1. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 2017.
2. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd. Second Edition, 2007.

**REFERENCES:**

1. Anil W. Date "Introduction to Computational Fluid Dynamics" Cambridge University Press, 2005.
2. Chung, T.J. "Computational Fluid Dynamics", Cambridge University, Press, 2002.
3. Ghoshdastidar P.S., "Heat Transfer", Oxford University Press, 2005
4. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2014.
5. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004

**ME8097****NON DESTRUCTIVE TESTING AND EVALUATION**

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**OBJECTIVE:**

- To study and understand the various Non Destructive Evaluation and Testing methods, theory and their industrial applications.

**UNIT I OVERVIEW OF NDT 9**

NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT., Visual inspection – Unaided and aided.

**UNIT II SURFACE NDE METHODS 9**

Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

**UNIT III THERMOGRAPHY AND EDDY CURRENT TESTING (ET) 9**

Thermography- Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation - infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

**UNIT IV ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE) 9**

Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique – Principle, AE parameters, Applications

**UNIT V RADIOGRAPHY (RT) 9**

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films - graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon the completion of this course the students will be able to**

- CO1 Explain the fundamental concepts of NDT
- CO2 Discuss the different methods of NDE
- CO3 Explain the concept of Thermography and Eddy current testing
- CO4 Explain the concept of Ultrasonic Testing and Acoustic Emission
- CO5 Explain the concept of Radiography

**TEXT BOOKS:**

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2014.
2. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010

**REFERENCES:**

1. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook, Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing
3. Charles, J. Hellier, "Handbook of Nondestructive evaluation", McGraw Hill, New York 2001.
4. Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2<sup>nd</sup> Edition New Jersey, 2005

**ME8092****COMPOSITE MATERIALS AND MECHANICS**

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**OBJECTIVES:**

- To understand the fundamentals of composite material strength and its mechanical behavior
- Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.
- Thermo-mechanical behavior and study of residual stresses in Laminates during processing.
- Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.

**UNIT I INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS & MANUFACTURING 9**

Definition -Need - General Characteristics, Applications. Fibers - Glass, Carbon, Ceramic and Aramid fibers. Matrices - Polymer, Graphite, Ceramic and Metal Matrices - Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions - Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina - Isotropic limit case, Orthotropic Stiffness matrix ( $Q_{ij}$ ), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina -Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding Compression Moulding - Pultrusion - Filament Winding - Other Manufacturing Processes





**OBJECTIVES:**

- To understand the global trends and development methodologies of various types of products and services
- To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
- To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
- To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
- To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

**UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9**

**Global Trends Analysis and Product decision** - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends - **Introduction to Product Development Methodologies and Management** - Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies - Product Life Cycle - Product Development Planning and Management.

**UNIT II REQUIREMENTS AND SYSTEM DESIGN 9**

**Requirement Engineering** - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - **System Design & Modeling** - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

**UNIT III DESIGN AND TESTING 9**

**Conceptualization** - Industrial Design and User Interface Design - Introduction to Concept generation Techniques - **Challenges in Integration of Engineering Disciplines** - Concept Screening & Evaluation - **Detailed Design** - Component Design and Verification – **Mechanical, Electronics and Software Subsystems** - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing - **Prototyping** - Introduction to Rapid Prototyping and Rapid Manufacturing - **System Integration, Testing, Certification and Documentation**

**UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT 9**

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - **Sustenance** -Maintenance and Repair - Enhancements - **Product EoL** - Obsolescence Management - Configuration Management - EoL Disposal

**UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9**

**The Industry** - Engineering Services Industry - Product Development in Industry versus Academia -**The IPD Essentials** - Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

**TOTAL: 45 PERIODS**

**OUTCOMES:****Upon completion of the course, the students will be able to:**

- Define, formulate and analyze a problem
- Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

**TEXTBOOKS:**

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition, 2005.

**REFERENCES:**

1. Hiriyappa B, "Corporate Strategy - Managing the Business", Author House, 2013.
2. Peter F Drucker, "People and Performance", Butterworth - Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, "Enterprise Resource Planning – Concepts", Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013

**GE8074****HUMAN RIGHTS****L T P C  
3 0 0 3****OBJECTIVE:**

- To sensitize the Engineering students to various aspects of Human Rights.

**UNIT I****9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

**UNIT II****9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

**UNIT III****9**

Theories and perspectives of UN Laws - UN Agencies to monitor and compliance.

**UNIT IV****9**

Human Rights in India - Constitutional Provisions / Guarantees.

**UNIT V****9**

Human Rights of Disadvantaged People - Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights - National and State Human Rights Commission - Judiciary - Role of NGO's, Media, Educational Institutions, Social Movements.

**TOTAL : 45 PERIODS**

**OUTCOME :**

- Engineering students will acquire the basic knowledge of human rights.

**REFERENCES:**

1. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
2. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

**GE8071****DISASTER MANAGEMENT****L T P C  
3 0 0 3****OBJECTIVES:**

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

**UNIT I INTRODUCTION TO DISASTERS****9**

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

**UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR)****9**

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) - Early Warning System - Advisories from Appropriate Agencies.

**UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT****9**

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenou knowledge, appropriate technology and local resources.

**UNIT IV DISASTER RISK MANAGEMENT IN INDIA****9**

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster - Disaster Damage Assessment.



**UNIT III      PRODUCT PLANNING AND PROCESS PLANNING      9**

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.

**UNIT IV      PRODUCTION SCHEDULING      9**

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance – Flow production scheduling- Batch production scheduling-Product sequencing – Production Control systems-Periodic batch control-Material requirement planning kanban - Dispatching-Progress reporting and expediting- Manufacturing lead time-Techniques for aligning completion times and due dates.

**UNIT V      INVENTORY CONTROL AND RECENT TRENDS IN PPC      9**

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Upon completion of this course, the students can able to prepare production planning and control activities such as work study, product planning, production scheduling, Inventory Control.
- They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

**TEXT BOOKS:**

1. James. B. Dilworth, "Operations management – Design, Planning and Control for manufacturing and services" Mcgraw Hill International edition 1992.
2. Martand Telsang, "Industrial Engineering and Production Management", First edition, S. Chand and Company, 2000.

**REFERENCES:**

1. Chary. S.N., "Theory and Problems in Production & Operations Management", Tata McGraw Hill, 1995.
2. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", 8th Edition John Wiley and Sons, 2000.
3. Jain. K.C. & Aggarwal. L.N., "Production Planning Control and Industrial Management", Khanna Publishers, 1990.
4. Kanishka Bedi, "Production and Operations management", 2<sup>nd</sup> Edition, Oxford university press, 2007.
5. Melynk, Denzler, " Operations management - A value driven approach" Irwin Mcgraw hill.
6. Norman Gaither, G. Frazier, "Operations Management" 9<sup>th</sup> Edition, Thomson learning IE, 2007
7. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984
8. Upendra Kachru, " Production and Operations Management - Text and cases" 1<sup>st</sup> Edition, Excel books 2007

**MG8091**

**ENTREPRENEURSHIP DEVELOPMENT**

**L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

**UNIT I ENTREPRENEURSHIP**

**9**

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

**UNIT II MOTIVATION**

**9**

Major Motives Influencing an Entrepreneur - Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test - Stress Management, Entrepreneurship Development Programs - Need, Objectives.

**UNIT III BUSINESS**

**9**

Small Enterprises - Definition, Classification - Characteristics, Ownership Structures - Project Formulation - Steps involved in setting up a Business - identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment - Preparation of Preliminary Project Reports - Project Appraisal - Sources of Information - Classification of Needs and Agencies.

**UNIT IV FINANCING AND ACCOUNTING**

**9**

Need - Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation - Income Tax, Excise Duty - Sales Tax.

**UNIT V SUPPORT TO ENTREPRENEURS**

**9**

Sickness in small Business - Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators - Government Policy for Small Scale Enterprises - Growth Strategies in small industry - Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

**TOTAL : 45 PERIODS**

**OUTCOME:**

- Upon completion of the course, students will be able to gain knowledge and skills needed to run a business successfully.

**TEXT BOOKS :**

1. Donald F Kuratko, "Entrepreneurship – Theory, Process and Practice", 9<sup>th</sup> Edition, Cengage Learning, 2014.
2. Khanka. S.S., "Entrepreneurial Development" S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.

**REFERENCES :**

1. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.
2. Hisrich R D, Peters M P, "Entrepreneurship" 8<sup>th</sup> Edition, Tata McGraw-Hill, 2013.
3. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2<sup>nd</sup> Edition Dream tech, 2005.
4. Rajeev Roy, "Entrepreneurship" 2<sup>nd</sup> Edition, Oxford University Press, 2011.

|               |  |          |          |          |          |
|---------------|--|----------|----------|----------|----------|
| <b>ME8094</b> | <b>COMPUTER INTEGRATED MANUFACTURING SYSTEMS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVE:**

- To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

**UNIT I INTRODUCTION 9**

Brief introduction to CAD and CAM - Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM - Concurrent Engineering-CIM concepts - Computerised elements of CIM system - Types of production - Manufacturing models and Metrics - Mathematical models of Production Performance - Simple problems - Manufacturing Control - Simple Problems - Basic Elements of an Automated system - Levels of Automation - Lean Production and Just-In-Time Production.

**UNIT II PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING 9**

Process planning - Computer Aided Process Planning (CAPP) - Logical steps in Computer Aided Process Planning - Aggregate Production Planning and the Master Production Schedule - Material Requirement planning - Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

**UNIT III CELLULAR MANUFACTURING 9**

Group Technology(GT), Part Families - Parts Classification and coding - Simple Problems in Opitz Part Coding system - Production flow Analysis - Cellular Manufacturing - Composite part concept – Machine cell design and layout - Quantitative analysis in Cellular Manufacturing - Rank Order Clustering Method - Arranging Machines in a GT cell - Hollier Method - Simple Problems.

**UNIT IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS) 9**

Types of Flexibility - FMS - FMS Components - FMS Application & Benefits - FMS Planning and Control – Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) - AGVS Application - Vehicle Guidance technology - Vehicle Management & Safety.

**UNIT V INDUSTRIAL ROBOTICS 9**

Robot Anatomy and Related Attributes - Classification of Robots- Robot Control systems - End Effectors - Sensors in Robotics - Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming - Robot Accuracy and Repeatability - Simple Problems.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- CO1 Explain the basic concepts of CAD, CAM and computer integrated manufacturing systems
- CO2 Summarize the production planning and control and computerized process planning
- CO3 Differentiate the different coding systems used in group technology
- CO4 Explain the concepts of flexible manufacturing system (FMS) and automated guided vehicle (AGV) system
- CO5 Classification of robots used in industrial applications





## OUTCOMES:

Upon the completion of this course the students will be able to

- CO1 Summarize the Basics of Vibration
- CO2 Summarize the Basics of Noise
- CO3 Explain the Sources of Automotive Noise
- CO4 Discuss the Control techniques for vibration
- CO5 Describe the sources and control of Noise

## TEXT BOOK:

1. Singiresu S.Rao, "Mechanical Vibrations", 6<sup>th</sup> Edition, Pearson Education, 2016.

## REFERENCES:

1. Balakumar Balachandran and Edward B. Magrab, "Fundamentals of Vibrations", 1<sup>st</sup> Edition, Cengage Learning, 2009
2. Benson H. Tongue, "Principles of Vibrations", 2<sup>nd</sup> Edition, Oxford University, 2007
3. Bernard Challen and Rodica Baranescu - "Diesel Engine Reference Book", Second Edition, SAE International, 1999.
4. David Bies and Colin Hansen, "Engineering Noise Control - Theory and Practice", 4<sup>th</sup> Edition, E and FN Spon, Taylore & Francise e-Library, 2009
5. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros., 2009

EE8091

MICRO ELECTRO MECHANICAL SYSTEMS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

## OBJECTIVES

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

## UNIT I INTRODUCTION

9

Intrinsic Characteristics of MEMS - Energy Domains and Transducers- Sensors and Actuators - Introduction to Micro fabrication - Silicon based MEMS processes - New Materials - Review of Electrical and Mechanical concepts in MEMS - Semiconductor devices - Stress and strain analysis - Flexural beam bending- Torsional deflection.

## UNIT II SENSORS AND ACTUATORS-I

9

Electrostatic sensors - Parallel plate capacitors - Applications - Interdigitated Finger capacitor - Comb drive devices - Micro Grippers - Micro Motors - Thermal Sensing and Actuation - Thermal expansion - Thermal couples - Thermal resistors - Thermal Bimorph - Applications - Magnetic Actuators - Micromagnetic components - Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys

## UNIT III SENSORS AND ACTUATORS-II

9

Piezoresistive sensors - Piezoresistive sensor materials - Stress analysis of mechanical elements - Applications to Inertia, Pressure, Tactile and Flow sensors - Piezoelectric sensors and actuators - piezoelectric effects - piezoelectric materials - Applications to Inertia , Acoustic, Tactile and Flow sensors.

**UNIT IV MICROMACHINING****9**

Silicon Anisotropic Etching - Anisotropic Wet Etching - Dry Etching of Silicon - Plasma Etching - Deep Reaction Ion Etching (DRIE) - Isotropic Wet Etching - Gas Phase Etchants - Case studies - Basic surface micro machining processes - Structural and Sacrificial Materials - Acceleration of sacrificial Etch - Striction and Antistriction methods - LIGA Process - Assembly of 3D MEMS - Foundry process.

**UNIT V POLYMER AND OPTICAL MEMS****9**

Polymers in MEMS- Polimide - SU-8 - Liquid Crystal Polymer (LCP) - PDMS - PMMA - Parylene - Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS - Lenses and Mirrors - Actuators for Active Optical MEMS.

**TOTAL : 45 PERIODS****OUTCOMES**

- Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory control theory and apply them to electrical engineering problems.
- Ability to understand and analyse, linear and digital electronic circuits.

**TEXT BOOKS:**

1. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2006.
2. Stephen D Senturia, "Microsystem Design", Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

**REFERENCES:**

1. James J.Allen, "Micro Electro Mechanical System Design", CRC Press Publisher, 2010
2. Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", John Wiley & Son LTD,2002
3. Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2000
4. Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
5. Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer 2012.

**OBJECTIVE:**

- To enable the students to create an awareness on Engineering Ethics and Human Values to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

**UNIT I HUMAN VALUES 10**

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 - Introduction to Yoga and meditation for professional excellence and stress management.

**UNIT II ENGINEERING ETHICS 9**

Senses of 'Engineering Ethics' - Variety of moral issues - Types of inquiry - Moral dilemmas - Moral Autonomy - Kohlberg's theory - Gilligan's theory - Consensus and Controversy - Models of professional roles - Theories about right action - Self-interest - Customs and Religion - Uses of Ethical Theories.

**UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9**

Engineering as Experimentation - Engineers as responsible Experimenters - Codes of Ethics - A Balanced Outlook on Law.

**UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9**

Safety and Risk - Assessment of Safety and Risk - Risk Benefit Analysis and Reducing Risk - Respect for Authority - Collective Bargaining - Confidentiality - Conflicts of Interest - Occupational Crime - Professional Rights - Employee Rights - Intellectual Property Rights (IPR) - Discrimination.

**UNIT V GLOBAL ISSUES 8**

Multinational Corporations - Environmental Ethics - Computer Ethics - Weapons Development - Engineers as Managers - Consulting Engineers - Engineers as Expert Witnesses and Advisors - Moral Leadership - Code of Conduct - Corporate Social Responsibility.

**TOTAL: 45 PERIODS****OUTCOME:**

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

**TEXT BOOKS:**

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.
2. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.

**REFERENCES:**

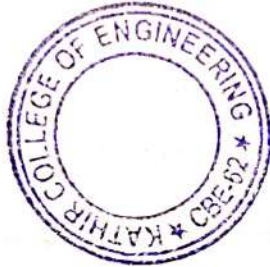
1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics - Concepts and Cases", Cengage Learning, 2009.
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
4. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd., New Delhi, 2013.
6. World Community Service Centre, 'Value Education', Vethathiri publications, Erode, 2011.


## REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics - Concepts and Cases", Cengage Learning, 2009.
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
4. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd., New Delhi, 2013.
6. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011.

## Web sources:

1. [www.onlineethics.org](http://www.onlineethics.org)
2. [www.nspe.org](http://www.nspe.org)
3. [www.globalethics.org](http://www.globalethics.org)
4. [www.ethics.org](http://www.ethics.org)



  
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**ANNA UNIVERSITY, CHENNAI**  
**AFFILIATED INSTITUTIONS**  
**B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**  
**REGULATIONS – 2017**  
**CHOICE BASED CREDIT SYSTEM**

**PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

1. To provide graduates with the proficiency to utilize the fundamental knowledge of basic sciences, mathematics, Artificial Intelligence, data science and statistics to build systems that require management and analysis of large volume of data.
2. To enrich graduates with necessary technical skills to pursue pioneering research in the field of AI and Data Science and create disruptive and sustainable solutions for the welfare of ecosystems.
3. To enable graduates to think logically, pursue lifelong learning and collaborate with an ethical attitude in a multidisciplinary team.
4. To enable the graduates to design and model AI based solutions to critical problem domains in the real world.
5. To enrich the innovative thoughts and creative ideas of the graduates for effective contribution towards economy building.

**PROGRAM OUTCOMES (POs) ENGINEERING GRADUATES WILL BE ABLE TO:**

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and Artificial Intelligence and Data Science basics to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.



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

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

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

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

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

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

### **Programme Specific Outcomes**

1. Graduates should be able to evolve AI based efficient domain specific processes for effective decision making in several domains such as business and governance domains.
2. Graduates should be able to arrive at actionable Fore sight, Insight, hind sight from data for solving business and engineering problems
3. Graduates should be able to create, select and apply the theoretical knowledge of AI and Data Analytics along with practical industrial tools and techniques to manage and solve wicked societal problems
4. Graduates should be capable of developing data analytics and data visualization skills, skills pertaining to knowledge acquisition, knowledge representation and knowledge engineering, and hence capable of coordinating complex projects.
5. Graduates should be able to carry out fundamental research to cater the critical needs of the society through cutting edge technologies of AI.

**ANNA UNIVERSITY, CHENNAI**  
**AFFILIATED INSTITUTIONS**  
**B.TECH. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**  
**REGULATIONS – 2017**  
**CHOICE BASED CREDIT SYSTEM**  
**I - VIII SEMESTERS CURRICULUM**  
**SEMESTER I**

| SI. No.           | COURSE CODE | COURSE TITLE                                      | CATE GORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---|-----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |           |                 |           |          |           |           |
| 1.                | HS8151      | Communicative English                             | HS        | 4               | 4         | 0        | 0         | 4         |
| 2.                | MA8151      | Engineering Mathematics - I                       | BS        | 4               | 4         | 0        | 0         | 4         |
| 3.                | PH8151      | Engineering Physics                               | BS        | 3               | 3         | 0        | 0         | 3         |
| 4.                | CY8151      | Engineering Chemistry                             | BS        | 3               | 3         | 0        | 0         | 3         |
| 5.                | GE8151      | Problem Solving and Python Programming            | ES        | 3               | 3         | 0        | 0         | 3         |
| 6.                | GE8152      | Engineering Graphics                              | ES        | 6               | 2         | 0        | 4         | 4         |
| <b>PRACTICALS</b> |             |   |           |                 |           |          |           |           |
| 7.                | GE8161      | Problem Solving and Python Programming Laboratory | ES        | 4               | 0         | 0        | 4         | 2         |
| 8.                | BS8161      | Physics and Chemistry Laboratory                  | BS        | 4               | 0         | 0        | 4         | 2         |
| <b>TOTAL</b>      |             |   |           | <b>31</b>       | <b>19</b> | <b>0</b> | <b>12</b> | <b>25</b> |

**SEMESTER II**

| SI. No.           | COURSE CODE | COURSE TITLE   | CATE GORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|--|-----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |  |           |                 |           |          |           |           |
| 1.                | HS8251      | Technical English  | HS        | 4               | 4         | 0        | 0         | 4         |
| 2.                | MA8252      | Linear Algebra   | BS        | 4               | 4         | 0        | 0         | 4         |
| 3.                | AD8251      | Data Structures Design                                     | PC        | 3               | 3         | 0        | 0         | 3         |
| 4.                | GE8291      | Environmental Science and Engineering                      | BS        | 3               | 3         | 0        | 0         | 3         |
| 5.                | BE8255      | Basic Electrical, Electronics, and Measurement Engineering | ES        | 3               | 3         | 0        | 0         | 3         |
| 6.                | AD8252      | Digital Principles and Computer Organization               | ES        | 5               | 3         | 0        | 2         | 4         |
| <b>PRACTICALS</b> |             |  |           |                 |           |          |           |           |
| 7.                | GE8261      | Engineering Practices Laboratory                           | ES        | 4               | 0         | 0        | 4         | 2         |
| 8.                | AD8261      | Data Structures Design Laboratory                          | PC        | 4               | 0         | 0        | 4         | 2         |
| <b>TOTAL</b>      |             |  |           | <b>30</b>       | <b>20</b> | <b>0</b> | <b>10</b> | <b>25</b> |



### SEMESTER III

| SI. No.           | COURSE CODE | COURSE TITLE                              | CATE GORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---|-----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |           |                 |           |          |           |           |
| 1.                | MA8351      | Discrete Mathematics                      | BS        | 4               | 4         | 0        | 0         | 4         |
| 2.                | AD8301      | Introduction to Operating Systems         | PC        | 5               | 3         | 0        | 2         | 4         |
| 3.                | AD8302      | Fundamentals of Data Science              | PC        | 3               | 3         | 0        | 0         | 3         |
| 4.                | CS8392      | Object Oriented Programming               | PC        | 3               | 3         | 0        | 0         | 3         |
| 5.                | AD8351      | Design and Analysis of Algorithms         | PC        | 5               | 3         | 0        | 2         | 4         |
| <b>PRACTICALS</b> |             |   |           |                 |           |          |           |           |
| 6.                | AD8311      | Data Science Laboratory                   | PC        | 4               | 0         | 0        | 4         | 2         |
| 7.                | CS8383      | Object Oriented Programming Laboratory    | PC        | 4               | 0         | 0        | 4         | 2         |
| 8.                | HS8381      | Interpersonal Skills/Listening & Speaking | HS        | 2               | 0         | 0        | 2         | 1         |
| <b>TOTAL</b>      |             |   |           | <b>30</b>       | <b>16</b> | <b>0</b> | <b>14</b> | <b>23</b> |

### SEMESTER IV

| SI. No.           | COURSE CODE | COURSE TITLE                              | CATE GORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---|-----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |           |                 |           |          |           |           |
| 1.                | MA8391      | Probability and Statistics                | BS        | 4               | 4         | 0        | 0         | 4         |
| 2.                | AD8401      | Database Design and Management            | PC        | 3               | 3         | 0        | 0         | 3         |
| 3.                | AD8402      | Artificial Intelligence I                 | PC        | 3               | 3         | 0        | 0         | 3         |
| 4.                | AD8403      | Data Analytics                            | PC        | 3               | 3         | 0        | 0         | 3         |
| 5.                |             | Professional Elective I                   | PE        | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |   |           |                 |           |          |           |           |
| 6.                | AD8411      | Database Design and Management Laboratory | PC        | 4               | 0         | 0        | 4         | 2         |
| 7.                | AD8412      | Data Analytics Laboratory                 | PC        | 4               | 0         | 0        | 4         | 2         |
| 8.                | AD8413      | Artificial Intelligence - I Laboratory    | PC        | 4               | 0         | 0        | 4         | 2         |
| 9.                | HS8461      | Advanced Reading and Writing              | HS        | 2               | 0         | 0        | 2         | 1         |
| <b>TOTAL</b>      |             |   |           | <b>30</b>       | <b>16</b> | <b>0</b> | <b>14</b> | <b>23</b> |

**SEMESTER V**

| Sl. No.           | COURSE CODE | COURSE TITLE                           | CATE GORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|--|-----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |  |           |                 |           |          |           |           |
| 1.                | AD8501      | Optimization Techniques                | PC        | 4               | 4         | 0        | 0         | 4         |
| 2.                | CW8691      | Computer Networks                      | PC        | 5               | 3         | 0        | 2         | 4         |
| 3.                | AD8502      | Data Exploration and Visualization     | PC        | 5               | 3         | 0        | 2         | 4         |
| 4.                | AD8551      | Business Analytics                     | PC        | 3               | 3         | 0        | 0         | 3         |
| 5.                | AD8552      | Machine Learning                       | PC        | 3               | 3         | 0        | 0         | 3         |
| 6.                |             | Open Elective I                        | OE        | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |  |           |                 |           |          |           |           |
| 7.                | AD8511      | Machine Learning Laboratory            | PC        | 4               | 0         | 0        | 4         | 2         |
| 8.                | AD8512      | Mini Project on Data Sciences Pipeline | PC        | 4               | 0         | 0        | 4         | 2         |
| <b>TOTAL</b>      |             |  |           | <b>31</b>       | <b>19</b> | <b>0</b> | <b>12</b> | <b>25</b> |

**SEMESTER VI**

| Sl. No            | COURSE CODE | COURSE TITLE                            | CATE GORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---|-----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |           |                 |           |          |           |           |
| 1.                | AD8601      | Artificial Intelligence II              | PC        | 3               | 3         | 0        | 0         | 3         |
| 2.                | AD8602      | Data and Information Security           | PC        | 3               | 3         | 0        | 0         | 3         |
| 3.                | IT8501      | Web Technology                          | PC        | 3               | 3         | 0        | 0         | 3         |
| 4.                |             | Professional Elective II                | PE        | 3               | 3         | 0        | 0         | 3         |
| 5.                |             | Professional Elective III               | PE        | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |   |           |                 |           |          |           |           |
| 6.                | IT8511      | Web Technology Laboratory               | PC        | 4               | 0         | 0        | 4         | 2         |
| 7.                | AD8611      | Artificial Intelligence - II Laboratory | PC        | 4               | 0         | 0        | 4         | 2         |
| 8.                | HS8581      | Professional Communication              | HS        | 2               | 0         | 0        | 2         | 1         |
| 9.                | AD8612      | Socially relevant Project               | PC        | 4               | 0         | 0        | 4         | 2         |
| <b>TOTAL</b>      |             |   |           | <b>29</b>       | <b>15</b> | <b>0</b> | <b>14</b> | <b>22</b> |

**SEMESTER VII**

| Sl. No            | COURSE CODE | COURSE TITLE              | CATE GORY | CONTACT PERIODS | L         | T        | P         | C         |
|-------------------|-------------|---------------------------|-----------|-----------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |                           |           |                 |           |          |           |           |
| 1.                | AD8701      | Deep Learning             | PC        | 3               | 3         | 0        | 0         | 3         |
| 2.                | AD8702      | Text Analytics            | PC        | 3               | 3         | 0        | 0         | 3         |
| 3.                | AD8703      | Basics of Computer Vision | PC        | 3               | 3         | 0        | 0         | 3         |
| 4.                | AD8704      | Big Data Management       | PC        | 5               | 3         | 0        | 2         | 4         |
| 5.                | AD8705      | AI and Robotics           | PC        | 5               | 3         | 0        | 2         | 4         |
| 6.                |             | Open Elective II          | OE        | 3               | 3         | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |                           |           |                 |           |          |           |           |
| 7.                | AD8711      | Deep Learning Laboratory  | PC        | 4               | 0         | 0        | 4         | 2         |
| 8.                | AD8712      | Mini Project on Analytics | PC        | 4               | 0         | 0        | 4         | 2         |
| <b>TOTAL</b>      |             |                           |           | <b>30</b>       | <b>18</b> | <b>0</b> | <b>12</b> | <b>24</b> |

**SEMESTER VIII**

| Sl. No.           | COURSE CODE | COURSE TITLE             | CATE GORY | CONTACT PERIODS | L        | T        | P         | C         |
|-------------------|-------------|--------------------------|-----------|-----------------|----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |                          |           |                 |          |          |           |           |
| 1.                |             | Professional Elective IV | PE        | 3               | 3        | 0        | 0         | 3         |
| 2.                |             | Professional Elective V  | PE        | 3               | 3        | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |                          |           |                 |          |          |           |           |
| 3.                | AD8811      | Project Work             | PC        | 20              | 0        | 0        | 20        | 10        |
| <b>TOTAL</b>      |             |                          |           | <b>26</b>       | <b>6</b> | <b>0</b> | <b>20</b> | <b>16</b> |

**TOTAL NO. OF CREDITS: 183**

**PROFESSIONAL ELECTIVES (PE)**

**SEMESTER IV, ELECTIVE - I**

| Sl. No. | COURSE CODE | COURSE TITLE                         | CATE GORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|--------------------------------------|-----------|-----------------|---|---|---|---|
| 1.      | EC8691      | Microprocessors and Microcontrollers | PE        | 3               | 3 | 0 | 0 | 3 |
| 2.      | AD8001      | Software Development Processes       | PE        | 3               | 3 | 0 | 0 | 3 |
| 3.      | AD8002      | Health care Analytics                | PE        | 3               | 3 | 0 | 0 | 3 |
| 4.      | AD8003      | Mobile Applications Development      | PE        | 3               | 3 | 0 | 0 | 3 |
| 5.      | AD8004      | Parallel Computing                   | PE        | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VI, ELECTIVE - II**

| SI. No. | COURSE CODE | COURSE TITLE                     | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|----------------------------------|----------|-----------------|---|---|---|---|
| 1.      | AD8005      | Embedded Systems and Programming | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.      | CW8591      | Software Architecture            | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.      | AD8006      | Engineering Predictive Analytics | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.      | CS8603      | Distributed Systems              | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.      | CS8072      | Agile Methodologies              | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VI, ELECTIVE - III**

| SI. No. | COURSE CODE | COURSE TITLE                           | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|--|----------|-----------------|---|---|---|---|
| 1.      | CS8081      | Internet of Things                     | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.      | AD8007      | Software Testing and Quality Assurance | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.      | CS8791      | Cloud Computing                        | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.      | CS8085      | Social Network Analytics               | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.      | AD8008      | Web Services and API Design            | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VIII, ELECTIVE - IV**

| SI. No. | COURSE CODE | COURSE TITLE                           | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|--|----------|-----------------|---|---|---|---|
| 1.      | AD8009      | Operations and Supply Chain Management | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.      | AD8010      | Speech Processing and Analytics        | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.      | AD8011      | Cyber Security                         | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.      | AD8012      | Nonlinear Optimization                 | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.      | AD8013      | Ethics Of Artificial Intelligence      | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER VIII, ELECTIVE - V**

| SI. No. | COURSE CODE | COURSE TITLE                         | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|--------------------------------------|----------|-----------------|---|---|---|---|
| 1.      | AD8014      | Engineering Economics                | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.      | AD8081      | Cognitive Science and Analytics      | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.      | MG8591      | Principles of Management             | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.      | AD8015      | Bio-inspired Optimization Techniques | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.      | AD8016      | Information Extraction and Retrieval | PE       | 3               | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

**UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 12**

**Reading-** short comprehension passages, practice in skimming-scanning and predicting- **Writing-** completing sentences- - developing hints. **Listening-** short texts- short formal and informal conversations. **Speaking-** introducing oneself - exchanging personal information- **Language development-** Wh- Questions- asking and answering-yes or no questions- parts of speech. **Vocabulary development--** prefixes- suffixes- articles.- count/ uncount nouns.

**UNIT II GENERAL READING AND FREE WRITING 12**

**Reading** - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register- **Writing** – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures -**Listening-** telephonic conversations. **Speaking** – sharing information of a personal kind–greeting – taking leave- **Language development** – prepositions, conjunctions **Vocabulary development-** guessing meanings of words in context.

**UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 12**

**Reading-** short texts and longer passages (close reading) **Writing-** understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences **Listening** – listening to longer texts and filling up the table- product description- narratives from different sources. **Speaking-** asking about routine actions and expressing opinions. **Language development-** degrees of comparison- pronouns- direct vs indirect questions- **Vocabulary development** – single word substitutes- adverbs.

**UNIT IV READING AND LANGUAGE DEVELOPMENT 12**

**Reading-** comprehension-reading longer texts- reading different types of texts- magazines **Writing-** letter writing, informal or personal letters-e-mails-conventions of personal email- **Listening-** listening to dialogues or conversations and completing exercises based on them. **Speaking-** speaking about oneself- speaking about one's friend- **Language development-** Tenses- simple present-simple past- present continuous and past continuous- **Vocabulary development-** synonyms-antonyms- phrasal verbs

**UNIT V EXTENDED WRITING**

12

**Reading-** longer texts- close reading **-Writing-** brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing-**Listening** – listening to talks- conversations- **Speaking** – participating in conversations- short group conversations-**Language development**-modal verbs- present/ past perfect tense - **Vocabulary development**-collocations- fixed and semi-fixed expressions.

**TOTAL: 60 PERIODS****OUTCOMES:****AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English
- Write short essays of a general kind and personal letters and emails in English.

**TEXT BOOKS:**

1. Board of Editors. **Using English** A Coursebook for Undergraduate Engineers and Technologists. Orient BlackSwan Limited, Hyderabad: 2015
2. Richards, C. Jack. **Interchange Students' Book-2** New Delhi: CUP, 2015.

**REFERENCES:**

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means,L. Thomas and Elaine Langlois. English & Communication For Colleges. CengageLearning ,USA: 2007
3. Redston, Chris & Gillies Cunningham Face2Face (Pre-intermediate Student's Book & Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013.

**MA8151****ENGINEERING MATHEMATICS – I**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>4</b> | <b>0</b> | <b>0</b> | <b>4</b> |

**OBJECTIVES :**

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus.
- The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions.
- This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

**UNIT I DIFFERENTIAL CALCULUS**

12

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

**UNIT II      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 - Lagrange's method of undetermined multipliers.

**UNIT III      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 IV      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.

**UNIT V      DIFFERENTIAL EQUATIONS      12**

Higher order linear differential equations with constant coefficients - Method of variation of parameters - Homogenous equation of Euler's and Legendre's type - System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**After completing this course, students should demonstrate competency in the following skills:**

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Apply various techniques in solving differential equations.

**TEXT BOOKS :**

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7<sup>th</sup> Edition, New Delhi, 2015. [For Units I & III - 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].

**REFERENCES:**

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10<sup>th</sup> Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3<sup>rd</sup> Edition, 2007.





## OUTCOMES:

### Upon completion of this course,

- The students will gain knowledge on the basics of properties of matter and its applications,
- The students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- The students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- The students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
- The students will understand the basics of crystals, their structures and different crystal growth techniques.

## TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

## REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics". W.H. Freeman, 2007.

CY8151

ENGINEERING CHEMISTRY

L T P C

3 0 0 3

## OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

## UNIT I WATER AND ITS TREATMENT

9

Hardness of water - types - expression of hardness - units - estimation of hardness of water by EDTA - numerical problems - boiler troubles (scale and sludge) - treatment of boiler feed water - Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment - Ion exchange process, zeolite process - desalination of brackish water - Reverse Osmosis.

## UNIT II SURFACE CHEMISTRY AND CATALYSIS

9

Adsorption: Types of adsorption - adsorption of gases on solids - adsorption of solute from solutions - adsorption isotherms - Freundlich's adsorption isotherm - Langmuir's adsorption isotherm - contact theory - kinetics of surface reactions, unimolecular reactions, Langmuir -

applications of adsorption on pollution abatement. Catalysis: Catalyst - types of catalysis - criteria - autocatalysis - catalytic poisoning and catalytic promoters - acid base catalysis - applications (catalytic convertor) - enzyme catalysis- Michaelis - Menten equation.

### **UNIT III ALLOYS AND PHASE RULE**

**9**

Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel. Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.

### **UNIT IV FUELS AND COMBUSTION**

**9**

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel. Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

### **UNIT V ENERGY SOURCES AND STORAGE DEVICES**

**9**

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H<sub>2</sub>-O<sub>2</sub> fuel cell.

**TOTAL: 45 PERIODS**

#### **OUTCOMES:**

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

#### **TEXT BOOKS:**

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

#### **REFERENCES:**

4. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
5. PrasantaRath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
6. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.



**TEXT BOOKS:**

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist”, 2<sup>nd</sup> edition, Updated for Python 3, Shroff/O’Reilly Publishers, 2016 (<http://greenteapress.com/wp/think-python/>)
2. Guido van Rossum and Fred L. Drake Jr, “An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

**REFERENCES:**

1. John V Guttag, “Introduction to Computation and Programming Using Python”, Revised and expanded Edition, MIT Press, 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, “Exploring Python”, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, CENGAGE Learning, 2012.
5. Charles Dierbach, “Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, “Practical Programming: An Introduction to Computer Science using Python 3”, Second edition, Pragmatic Programmers, LLC, 2013.

**GE8152****ENGINEERING GRAPHICS****L T P C****2 0 4 4****OBJECTIVES:**

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.

**CONCEPTS AND CONVENTIONS (Not for Examination)****1**

Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications - Size, layout and folding of drawing sheets - Lettering and dimensioning.

**UNIT I PLANE CURVES AND FREEHAND SKETCHING****7+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloid - construction of involutes of square and circle - Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles -Representation of Three Dimensional objects - Layout of views- Freehand sketching of multiple views from pictorial views of objects

**UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE****6+12**

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

**UNIT III PROJECTION OF SOLIDS****5+12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis

is inclined to one of the principal planes by rotating object method.

**UNIT IV          PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**

**5+12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other - obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids - Prisms, pyramids cylinders and cones.

**UNIT V          ISOMETRIC AND PERSPECTIVE PROJECTIONS**

**6+12**

Principles of isometric projection – isometric scale -Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

**TOTAL: 90 PERIODS**

**OUTCOMES:**

**On successful completion of this course, the student will be able to:**

- Familiarize with the fundamentals and standards of Engineering graphics
- Perform freehand sketching of basic geometrical constructions and multiple views of objects.
- Project orthographic projections of lines and plane surfaces.
- Draw projections and solids and development of surfaces.
- Visualize and to project isometric and perspective sections of simple solids.

**TEXT BOOKS:**

1. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008.

**REFERENCES:**

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50<sup>th</sup> Edition, 2010.
2. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N. S. Parthasarathy and Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2<sup>nd</sup> Edition, 2009.

**Publication of Bureau of Indian Standards:**

1. IS 10711 - 2001: Technical products Documentation - Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) - 2001: Technical products Documentation - Lettering.
3. IS 10714 (Part 20) - 2001 & SP 46 - 2003: Lines for technical drawings.
4. IS 11669 - 1986 & SP 46 - 2003: Dimensioning of Technical Drawings.

5. IS 15021 (Parts 1 to 4) - 2001: Technical drawings - Projection Methods.

**Special points applicable to University Examinations on Engineering Graphics:**

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only.
4. The students will be permitted to use appropriate scale to fit solution within A3 size.
5. The examination will be conducted in appropriate sessions on the same day

**GE8161      PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY      L T P C**  
**0 0 4 2**

**OBJECTIVES:**

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

**LIST OF PROGRAMS:**

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

**PLATFORM NEEDED**

Python 3 interpreter for Windows/Linux

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**Upon completion of the course, students will be able to:**

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

BS8161

**PHYSICS AND CHEMISTRY LABORATORY**  
(Common to all branches of B.E. / B.Tech Programmes)

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|---|---|---|---|
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**OBJECTIVES:**

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

**LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)**

- Determination of rigidity modulus - Torsion pendulum
- Determination of Young's modulus by non-uniform bending method
- (a) Determination of wavelength, and particle size using Laser  
(b) Determination of acceptance angle in an optical fiber.
- Determination of thermal conductivity of a bad conductor - Lee's Disc method.
- Determination of velocity of sound and compressibility of liquid - Ultrasonic interferometer
- Determination of wavelength of mercury spectrum - spectrometer grating
- Determination of band gap of a semiconductor
- Determination of thickness of a thin wire - Air wedge method

**TOTAL: 30 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the students will be able to**

- Apply principles of elasticity, optics and thermal properties for engineering applications.

**CHEMISTRY LABORATORY: (Any seven experiments to be conducted)**

**OBJECTIVES:**

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
  - To acquaint the students with the determination of molecular weight of a polymer by viscometry.
- Estimation of HCl using  $\text{Na}_2\text{CO}_3$  as primary standard and Determination of alkalinity in water sample.
  - Determination of total, temporary & permanent hardness of water by EDTA method.
  - Determination of DO content of water sample by Winkler's method.
  - Determination of chloride content of water sample by argentometric method.
  - Estimation of copper content of the given solution by Iodometry.
  - Determination of strength of given hydrochloric acid using pH meter.
  - Determination of strength of acids in a mixture of acids using conductivity meter.
  - Estimation of iron content of the given solution using potentiometer.
  - Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
  - Estimation of sodium and potassium present in water using flame photometer.
  - Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
  - Pseudo first order kinetics-ester hydrolysis.
  - Corrosion experiment-weight loss method.
  - Determination of CMC.
  - Phase change in a solid.

16. Conductometric titration of strong acid vs strong base.

**OUTCOMES:**

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

**TOTAL: 30 PERIODS**

**TEXTBOOK:**

1. Vogel's Textbook of Quantitative Chemical Analysis (8<sup>TH</sup> edition, 2014).

HS8251

**TECHNICAL ENGLISH**

| L | T | P | C |
|---|---|---|---|
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**OBJECTIVES:**

**The Course prepares second semester engineering and Technology students to:**

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.

**UNIT I INTRODUCTION TECHNICAL ENGLISH 12**

**Listening-** Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- **Speaking** -Asking for and giving directions- **Reading** – reading short technical texts from journals- newspapers- **Writing-** purpose statements - extended definitions - issue- writing instructions - checklists-recommendations-**Vocabulary Development-** technical vocabulary **Language Development** -subject verb agreement - compound words.

**UNIT II READING AND STUDY SKILLS 12**

**Listening-** Listening to longer technical talks and completing exercises based on them-**Speaking** - describing a process-**Reading** - reading longer technical texts- identifying the various transitions in a text- paragraphing- **Writing-** interpreting charts, graphs- **Vocabulary Development-** vocabulary used in formal letters/emails and reports**Language Development-** impersonal passive voice, numerical adjectives.

**UNIT III TECHNICAL WRITING AND GRAMMAR 12**

**Listening-** Listening to classroom lectures/ talks on engineering/technology -**Speaking** – introduction to technical presentations- **Reading** – longer texts both general and technical, practice in speed reading; **Writing-**Describing a process, use of sequence words- **Vocabulary Development-** sequence words- Misspelled words. **Language Development-** embedded sentences

**UNIT IV REPORT WRITING 12**

**Listening-** Listening to documentaries and making notes. **Speaking** – mechanics of presentations- **Reading** – reading for detailed comprehension- **Writing-** email etiquette- job





|  |  |           |
|--|--|-----------|
| <b>UNIT - I</b>  | <b>MATRICES AND SYSTEM OF LINEAR EQUATIONS</b>       | <b>12</b> |
| Matrices - Row echelon form - Rank - System of linear equations - Consistency - Gauss elimination method - Gauss Jordan method.  |  |           |
| <b>UNIT - II</b>   | <b>VECTOR SPACES</b>                                 | <b>12</b> |
| Real and Complex fields - Vector spaces over Real and Complex fields - Subspace - Linear space - Linear independence and dependence - Basis and dimension.   |  |           |
| <b>UNIT - III</b>  | <b>LINEAR TRANSFORMATION</b>                         | <b>12</b> |
| Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem - Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation. |  |           |
| <b>UNIT - IV</b>   | <b>INNER PRODUCT SPACES</b>                          | <b>12</b> |
| Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation.   |  |           |
| <b>UNIT - V</b>  | <b>EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION</b> | <b>12</b> |
| Eigen value Problems : Power method, Jacobi rotation method - Singular value decomposition - QR decomposition.   |  |           |

**TOTAL : 60 PERIODS**

**COURSE OUTCOMES :**

After the completion of the course the student will be able to

1. Test the consistency and solve system of linear equations
2. Find the basis and dimension of vector space
3. Obtain the matrix of linear transformation and its eigenvalues and eigenvectors
4. Find orthonormal basis of inner product space and find least square approximation
5. Find eigenvalues of a matrix using numerical techniques and perform matrix decomposition

**TEXT BOOKS :**

1. Friedberg A.H, Insel A.J. and Spence L, Linear Algebra, Prentice Hall of India, New Delhi, 2004.
2. Faires J.D. and Burden R., Numerical Methods, Brooks/Cole (Thomson Publications), New Delhi, 2002.

**REFERENCES:**

1. Kumaresan S, Linear Algebra - A geometric approach, Prentice Hall of India, New Delhi, Reprint, 2010.
2. Strang G, Linear Algebra and its applications, Thomson (Brooks / Cole) New Delhi, 2005.
3. Gerald C.F. and Wheatley P.O, Applied Numerical Analysis, Pearson Educations, New Delhi, 2002.
4. Sundarapandian V, Numerical Linear Algebra, Prentice Hall of India, New Delhi, 2008.
5. Richard Branson, Matrix Operations, Schaum's outline series, 1989.
6. Bernard Kolman, David R. Hill, Introductory Linear Algebra, Pearson Educations, New Delhi, First Reprint, 2009.

**OBJECTIVES:**

- To understand the concepts of ADTs
- To design linear data structures - lists, stacks, and queues
- To understand sorting, searching and hashing algorithms
- To apply Tree and Graph structures

**UNIT I ABSTRACT DATA TYPES****9**

Abstract Data Types (ADTs) - ADTs and classes - introduction to OOP - classes in Python - inheritance - namespaces - shallow and deep copying

Introduction to analysis of algorithms - asymptotic notations - recursion - analyzing recursive algorithms

**UNIT II LINEAR STRUCTURES****9**

List ADT - array-based implementations - linked list implementations - singly linked lists - circularly linked lists - doubly linked lists - applications of lists - Stack ADT - Queue ADT - double ended queues

**UNIT III SORTING AND SEARCHING****9**

Bubble sort - selection sort - insertion sort - merge sort - quick sort - linear search - binary search - hashing - hash functions - collision handling - load factors, rehashing, and efficiency

**UNIT IV TREE STRUCTURES****9**

Tree ADT - Binary Tree ADT - tree traversals - binary search trees - AVL trees - heaps - multi-way search trees

**UNIT V GRAPH STRUCTURES****9**

Graph ADT - representations of graph - graph traversals - DAG - topological ordering - shortest paths - minimum spanning trees

**TOTAL: 45 HOURS****OUTCOMES:**

At the end of the course, the student should be able to:

- explain abstract data types
- design, implement, and analyse linear data structures, such as lists, queues, and stacks, according to the needs of different applications
- design, implement, and analyse efficient tree structures to meet requirements such as searching, indexing, and sorting
- model problems as graph problems and implement efficient graph algorithms to solve them

**TEXT BOOK:**

1. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, "Data Structures & Algorithms in Python", John Wiley & Sons Inc., 2013
2. Lee, Kent D., Hubbard, Steve, "Data Structures and Algorithms with Python" Springer Edition 2015

**REFERENCES:**

1. Rance D. Ncaise, "Data Structures and Algorithms Using Python", John Wiley & Sons, 2011

2. Aho, Hopcroft, and Ullman, "Data Structures and Algorithms", Pearson Education, 1983.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", Second Edition, McGraw Hill, 2002.
4. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Fourth Edition, Pearson Education, 2014

**GE8291**

**ENVIRONMENTAL SCIENCE AND ENGINEERING**

**L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

**UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY**

**14**

Definition, scope and importance of environment - need for public awareness - concept of an ecosystem - structure and function of an ecosystem - producers, consumers and decomposers - energy flow in the ecosystem - ecological succession - food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) - Introduction to biodiversity definition: genetic, species and ecosystem diversity - biogeographical classification of India - value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, national and local levels - India as a mega-diversity nation - hot-spots of biodiversity - threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - endangered and endemic species of India - conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems - pond, river, hill slopes, etc.

**UNIT II ENVIRONMENTAL POLLUTION**

**8**

Definition - causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards - solid waste management: causes, effects and control measures of municipal solid wastes - role of an individual in prevention of pollution - pollution case studies - disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site - Urban / Rural / Industrial / Agricultural.

**UNIT III NATURAL RESOURCES**

**10**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people - Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems -

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets - river / forest / grassland / hill / mountain.

#### **UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT**

**7**

From unsustainable to sustainable development - urban problems related to energy - water conservation, rain water harvesting, watershed management - resettlement and rehabilitation of people; its problems and concerns, case studies - role of non-governmental organization- environmental ethics: Issues and possible solutions - climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. - wasteland reclamation - consumerism and waste products - environment production act - Air (Prevention and Control of Pollution) act - Water (Prevention and control of Pollution) act - Wildlife protection act - Forest conservation act - enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

#### **UNIT V HUMAN POPULATION AND THE ENVIRONMENT**

**6**

Population growth, variation among nations - population explosion - family welfare programme - environment and human health - human rights - value education - HIV / AIDS - women and child welfare - role of information technology in environment and human health - Case studies.

**TOTAL: 45 PERIODS**

#### **OUTCOMES:**

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

#### **TEXTBOOKS:**

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2<sup>nd</sup> edition, Pearson Education, 2004.

#### **REFERENCES :**

1. Dharmendra S.Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hyderabad, 2015.
3. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
4. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.

**OBJECTIVES:**

- To understand the fundamentals of electronic circuit constructions.
- To learn the fundamental laws, theorems of electrical circuits and also to analyze them
- To study the basic principles of electrical machines and their performance
- To study the different energy sources, protective devices and their field applications
- To understand the principles and operation of measuring instruments and transducers

**UNIT I ELECTRICAL CIRCUITS ANALYSIS 9**

Ohms Law, Kirchhoff's Law-Instantaneous power- series and parallel circuit analysis with resistive, capacitive and inductive network - nodal analysis, mesh analysis- network theorems - Thevenins theorem, Norton theorem, maximum power transfer theorem and superposition theorem, three phase supply-Instantaneous, Reactive and apparent power-star delta conversion.

**UNIT II ELECTRICAL MACHINES 9**

DC and AC ROTATING MACHINES:Types, Construction, principle, Emf and torque equation, application Speed Control- Basics of Stepper Motor – Brushless DC motors- Transformers-Introduction- types and construction, working principle of Ideal transformer-Emf equation- All day efficiency calculation.

**UNIT III UTILIZATION OF ELECTRICAL POWER 9**

Renewable energy sources-wind and solar panels. Illumination by lamps- Sodium Vapour, Mercury vapour, Fluorescent tube. Domestic refrigerator and air conditioner-Electric circuit, construction and working principle. Batteries-NiCd, Pb Acid and Li ion-Charge and Discharge Characteristics. Protection-need for earthing, fuses and circuit breakers.Energy Tariff calculation for domestic loads.

**UNIT IV ELECTRONIC CIRCUITS 9**

PN Junction-VI Characteristics of Diode, zener diode, Transistors configurations - amplifiers. Op amps- Amplifiers, oscillator,rectifiers, differentiator, integrator, ADC, DAC. Multi vibrator using 555 Timer IC . Voltage regulator IC using LM 723,LM 317.

**UNIT V ELECTRICAL MEASUREMENT 9**

Characteristic of measurement-errors in measurement, torque in indicating instruments- moving coil and moving iron meters, Energy meter and watt meter. Transducers- classification-thermo electric, RTD, Strain gauge, LVDT, LDR and piezoelectric. Oscilloscope-CRO.

**TOTAL: 45 PERIODS****OUTCOMES:**

**Upon completion of the course, the students will be able to:**

- Discuss the essentials of electric circuits and analysis.
- Discuss the basic operation of electric machines and transformers
- Introduction of renewable sources and common domestic loads.
- Introduction to measurement and metering for electric circuits.

**TEXT BOOKS:**

1. D.P. Kotharti and I.J Nagarath, Basic Electrical and Electronics Engineering, Mc Graw Hill, 2016,Third Edition.



6. Implementation of functions using Multiplexers.
7. Implementation of any one of the synchronous counters.
8. Implementation of a Universal Shift register.
9. Simulator based study of Computer architecture.

**TOTAL :75 PERIODS**

**TEXT BOOK:**

1. M. Morris Mano, Michael D. Ciletti, "Digital Design", Fifth Edition, Pearson Education, 2013.
2. David A. Patterson, John L. Hennessy, "Computer Organization and Design, The Hardware/Software Interface", Fifth Edition, Morgan Kaufmann/Elsevier, 2013.

**REFERENCES:**

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, 2008.

**GE8261**

**ENGINEERING PRACTICES LABORATORY**

**L T P C  
0 0 4 2**

**OBJECTIVES:**

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

**GROUP A (CIVIL & MECHANICAL)**

**I CIVIL ENGINEERING PRACTICE**

**13**

**BUILDINGS:**

- (a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

**PLUMBING WORKS:**

- (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
- (b) Study of pipe connections requirements for pumps and turbines.
- (c) Preparation of plumbing line sketches for water supply and sewage works.
- (d) Hands-on-exercise:

Basic pipe connections - Mixed pipe material connection - Pipe connections with different joining components.

- (e) Demonstration of plumbing requirements of high-rise buildings.

**CARPENTRY USING POWER TOOLS ONLY:**

- (a) Study of the joints in roofs, doors, windows and furniture.
- (b) Hands-on-exercise:  
Wood work, joints by sawing, planing and cutting.



## II MECHANICAL ENGINEERING PRACTICE

18

### WELDING:

- (a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
- (b) Gas welding practice

### BASIC MACHINING:

- (a) Simple Turning and Taper turning
- (b) Drilling Practice

### SHEET METAL WORK:

- (a) Forming & Bending:
- (b) Model making - Trays and funnels.
- (c) Different type of joints.

### MACHINE ASSEMBLY PRACTICE:

- (a) Study of centrifugal pump
- (b) Study of air conditioner

### DEMONSTRATION ON:

- (a) Smithy operations, upsetting, swaging, setting down and bending. Example - Exercise - Production of hexagonal headed bolt.
- (b) Foundry operations like mould preparation for gear and step cone pulley.
- (c) Fitting - Exercises - Preparation of square fitting and V - fitting models.

## GROUP B (ELECTRICAL & ELECTRONICS)

## III ELECTRICAL ENGINEERING PRACTICE

13

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

## IV ELECTRONICS ENGINEERING PRACTICE

16

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice - Components Devices and Circuits - Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

**TOTAL: 60 PERIODS**

## OUTCOMES:

### On successful completion of this course, the student will be able to

- Fabricate carpentry components and pipe connections including plumbing works.
- Use welding equipments to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundry and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

## LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

### CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. 15 Sets.
2. Carpentry vice (fitted to work bench) 15 Nos.
3. Standard woodworking tools 15 Sets.
4. Models of industrial trusses, door joints, furniture joints 5 each
5. Power Tools: (a) Rotary Hammer 2 Nos  
(b) Demolition Hammer 2 Nos  
(c) Circular Saw 2 Nos  
(d) Planer 2 Nos  
(e) Hand Drilling Machine 2 Nos  
(f) Jigsaw 2 Nos

### MECHANICAL

1. Arc welding transformer with cables and holders 5 Nos.
2. Welding booth with exhaust facility 5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc. 5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit. 2 Nos.
5. Centre lathe 2 Nos.
6. Hearth furnace, anvil and smithy tools 2 Sets.
7. Moulding table, foundry tools 2 Sets.
8. Power Tool: Angle Grinder 2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner One each.

### ELECTRICAL

1. Assorted electrical components for house wiring 15 Sets
2. Electrical measuring instruments 10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp 1 each
4. Megger (250V/500V) 1 No.
5. Power Tools: (a) Range Finder 2 Nos  
(b) Digital Live-wire detector 2 Nos

## **ELECTRONICS**

- |   |         |
|---|---------|
| 1. Soldering guns   | 10 Nos. |
| 2. Assorted electronic components for making circuits                 | 50 Nos. |
| 3. Small PCBs   | 10 Nos. |
| 4. Multimeters  | 10 Nos. |
| 5. Study purpose items: Telephone, FM radio, low-voltage power supply |         |

**AD8261**

**DATA STRUCTURES DESIGN LABORATORY**

**L T P C**  
**0 0 4 2**

### **OBJECTIVES:**

- To implement ADTs in Python
- To design and implement linear data structures - lists, stacks, and queues
- To implement sorting, searching and hashing algorithms
- To solve problems using tree and graph structures

1. Implement simple ADTs as Python classes
2. Implement recursive algorithms in Python
3. Implement List ADT using Python arrays
4. Linked list implementations of List
5. Implementation of Stack and Queue ADTs
6. Applications of List, Stack and Queue ADTs
7. Implementation of sorting and searching algorithms
8. Implementation of Hash tables
9. Tree representation and traversal algorithms
10. Implementation of Binary Search Trees
11. Implementation of Heaps
12. Graph representation and Traversal algorithms
13. Implementation of single source shortest path algorithm
14. Implementation of minimum spanning tree algorithms

### **OUTCOMES:**

At the end of the course, the student should be able to:

- implement ADTs as Python classes
- design, implement, and analyse linear data structures, such as lists, queues, and stacks, according to the needs of different applications
- design, implement, and analyse efficient tree structures to meet requirements such as searching, indexing, and sorting
- model problems as graph problems and implement efficient graph algorithms to solve them

**TOTAL:60 PERIODS**

### **TEXT BOOK:**

1. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, "Data Structures & Algorithms in Python", John Wiley & Sons Inc., 2013

### **REFERENCES:**

1. Rance D. Necaie, "Data Structures and Algorithms Using Python", John Wiley & Sons, 2011

2. Aho, Hopcroft, and Ullman, "Data Structures and Algorithms", Pearson Education, 1983.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, "Introduction to Algorithms", Second Edition, McGraw Hill, 2002.
4. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Fourth Edition, Pearson Education, 2014

**MA8351**

**DISCRETE MATHEMATICS**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| 4        | 0        | 0        | 4        |

**OBJECTIVES:**

- To extend student's logical and mathematical maturity and ability to deal with abstraction.
- To introduce most of the basic terminologies used in computer science courses and application of ideas to solve practical problems.
- To understand the basic concepts of combinatorics and graph theory.
- To familiarize the applications of algebraic structures.
- To understand the concepts and significance of lattices and boolean algebra which are widely used in computer science and engineering.

**UNIT I LOGIC AND PROOFS**

**12**

Propositional logic - Propositional equivalences - Predicates and quantifiers - Nested quantifiers - Rules of inference - Introduction to proofs - Proof methods and strategy.

**UNIT II COMBINATORICS**

**12**

Mathematical induction - Strong induction and well ordering - The basics of counting - The pigeonhole principle - Permutations and combinations - Recurrence relations - Solving linear recurrence relations - Generating functions - Inclusion and exclusion principle and its applications

**UNIT III GRAPHS**

**12**

Graphs and graph models - Graph terminology and special types of graphs - Matrix representation of graphs and graph isomorphism - Connectivity - Euler and Hamilton paths.

**UNIT IV ALGEBRAIC STRUCTURES**

**12**

Algebraic systems - Semi groups and monoids - Groups - Subgroups - Homomorphism's - Normal subgroup and cosets - Lagrange's theorem - Definitions and examples of Rings and Fields.

**UNIT V LATTICES AND BOOLEAN ALGEBRA**

**12**

Partial ordering - Posets - Lattices as posets - Properties of lattices - Lattices as algebraic systems - Sub lattices - Direct product and homomorphism - Some special lattices - Boolean algebra.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**At the end of the course, students would:**

- Have knowledge of the concepts needed to test the logic of a program.
- Have an understanding in identifying structures on many levels.
- Be aware of a class of functions which transform a finite set into another finite set which relates to input and output functions in computer science.
- Be aware of the counting principles.

- Be exposed to concepts and properties of algebraic structures such as groups, rings and fields.

#### TEXTBOOKS:

1. Rosen, K.H., "Discrete Mathematics and its Applications", 7<sup>th</sup> Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, Special Indian Edition, 2011.
2. Tremblay, J.P. and Manohar.R, " Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub. Co. Ltd, New Delhi, 30<sup>th</sup> Reprint, 2011.

#### REFERENCES:

1. Grimaldi, R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 4<sup>th</sup> Edition, Pearson Education Asia, Delhi, 2007.
2. Lipschutz, S. and Mark Lipson., "Discrete Mathematics", Schaum's Outlines, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 3<sup>rd</sup> Edition, 2010.
3. Koshy, T. "Discrete Mathematics with Applications", Elsevier Publications, 2006.

### AD8301 INTRODUCTION TO OPERATING SYSTEMS

LT P C  
3 0 2 4

#### COURSE OBJECTIVES

- To understand the structure and functions of OS
- To learn about Processes, Threads and Scheduling algorithms
- To understand the principles of concurrency and Deadlocks
- To learn various memory management schemes
- To study I/O management and File systems.

#### UNIT I OPERATING SYSTEMS OVERVIEW

9

Computer System Overview: Basic elements - Instruction execution - Interrupts - Memory hierarchy - Cache memory - Direct memory access - Multiprocessor and multicore organization; Operating System Overview: Objectives and functions - Evolution of operating system; Computer system organization; Operating System Structure and Operations: System calls - System programs; Operating-System Design and Implementation; Operating-System Debugging

#### UNIT II PROCESS MANAGEMENT

12

Processes: Process concept - Process scheduling - Operations on processes - Interprocess communication; Threads: Overview - Multithreading models - Thread issues; CPU Scheduling: FCFS, SJF, Priority, Round robin, Rate Monotonic and EDF scheduling; Process synchronization - Critical section problem - Mutex locks - Semaphores; Deadlocks - Avoidance - Prevention - Detection and Recovery.

#### UNIT III MEMORY MANAGEMENT

8

Main Memory: Contiguous memory allocation – Segmentation – Paging – 32 and 64 bit architecture Examples; Virtual Memory: Demand paging - Page replacement algorithms - Allocation of Frames – Thrashing.

#### UNIT IV STORAGE MANAGEMENT

9

Mass Storage Structure: Overview - Disk scheduling and management; File System Storage: File concepts - Directory and disk structure - Sharing and protection; File System Implementation: File system structure - Directory structure - Allocation methods - Free space management.

**UNIT V****CASE STUDY****7**

Linux Vs Windows: Design principles – Process management – Scheduling – Memory management - File systems; Mobile OS: iOS and Android - Introduction and architecture.

**TOTAL: 45 PERIODS****SUGGESTIVE EXPERIMENTS:**

1. Implement the various CPU Scheduling Algorithms
2. Implement Semaphores
3. Implement Bankers Algorithm for Deadlock Avoidance
4. Develop an application using Threads
5. Implement the following Memory Allocation Methods for variable sized partition: a) First Fit b) Worst Fit c) Best Fit
6. Implement Paging Technique of Memory Management
7. Implement the following Page Replacement Algorithms a) FIFO b) LRU c) LFU
8. Implement the following File Allocation Strategies a) Sequential b) Indexed c) Linked
9. Implement Shared memory and IPC
10. Implement Shared memory and IPC

**PRACTICAL: 30 PERIODS****TOTAL: 75 PERIODS****COURSE OUTCOMES**

Upon completion of the course, students will be able to:

- Outline the basic services and functionalities of operating systems
- Analyse various scheduling algorithms, and understand the different deadlock, prevention and avoidance schemes
- Illustrate the different memory management schemes
- Outline the functionality of file systems
- Compare and contrast Linux, Windows and mobile operating systems

**TEXT BOOKS**

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc, 2012.
2. Neil Smyth, "iPhone iOS 4 Development Essentials - Xcode", 4th Edition, Payload media, 2011.

**REFERENCES**

1. Ramez Elmasri, A Gil Carrick, David Levine, "Operating Systems A Spiral Approach", Tata McGraw Hill Edition, 2010.
2. Achyut S Godbole, Atul Kahate, "Operating Systems", McGraw Hill Education, 2016.
3. Andrew S Tanenbaum, "Modern Operating Systems", 2nd Edition, Pearson Education, 2004.
4. Harvey M Deitel, "Operating Systems", 3rd Edition, Pearson Education, 2004.
5. Daniel P Bovet, Marco Cesati, "Understanding the Linux Kernel", 3rd edition, O'Reilly, 2005.

**HARDWARE:**

1. Standalone Desktops with Linux OS

**SOFTWARE:**

1. Python

**COURSE OBJECTIVES**

- Will gain knowledge in the basic concepts of Data Analysis
- To acquire skills in data preparatory and preprocessing steps
- To understand the mathematical skills in statistics
- To learn the tools and packages in Python for data science
- To gain understanding in classification and Regression Model
- To acquire knowledge in data interpretation and visualization techniques

**UNIT I INTRODUCTION 9**

Need for data science - benefits and uses - facets of data - data science process - setting the research goal - retrieving data - cleansing, integrating, and transforming data - exploratory data analysis - build the models - presenting and building applications

**UNIT II DESCRIBING DATA I 9**

Frequency distributions - Outliers - relative frequency distributions - cumulative frequency distributions - frequency distributions for nominal data - interpreting distributions - graphs - averages - mode - median - mean - averages for qualitative and ranked data - describing variability - range - variance - standard deviation - degrees of freedom - interquartile range - variability for qualitative and ranked data

**UNIT III PYTHON FOR DATA HANDLING 9**

Basics of Numpy arrays - aggregations - computations on arrays - comparisons, masks, boolean logic - fancy indexing - structured arrays - Data manipulation with Pandas - data indexing and selection - operating on data - missing data - hierarchical indexing - combining datasets - aggregation and grouping - pivot tables

**UNIT IV DESCRIBING DATA II 9**

Normal distributions - z scores - normal curve problems - finding proportions - finding scores - more about z scores - correlation - scatter plots - correlation coefficient for quantitative data - computational formula for correlation coefficient - regression - regression line - least squares regression line - standard error of estimate - interpretation of  $r^2$  - multiple regression equations - regression toward the mean

**UNIT V PYTHON FOR DATA VISUALIZATION 9**

Visualization with matplotlib - line plots - scatter plots - visualizing errors - density and contour plots - histograms, binnings, and density - three dimensional plotting - geographic data - data analysis using statmodels and seaborn - graph plotting using Plotly - interactive data visualization using Bokeh

**COURSE OUTCOMES**

At the end of the course Students will be able to:

- Apply the skills of data inspecting and cleansing.
- Determine the relationship between data dependencies using statistics
- Can handle data using primary tools used for data science in Python
- Represent the useful information using mathematical skills
- Can apply the knowledge for data describing and visualization using tools.

**TOTAL:45 PERIODS**

## TEXT BOOKS

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016. (first two chapters for Unit I)
2. Robert S. Witte and John S. Witte, "Statistics", Eleventh Edition, Wiley Publications, 2017. (Chapters 1-7 for Units II and III)
3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016. (Parts of chapters 2-4 for Units IV and V)

## REFERENCES

1. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.

**CS8392**

**OBJECT ORIENTED PROGRAMMING**

**L T P C**  
**3 0 0 3**

### OBJECTIVES:

- To understand Object Oriented Programming concepts and basic characteristics of Java
- To know the principles of packages, inheritance and interfaces
- To define exceptions and use I/O streams
- To develop a java application with threads and generics classes
- To design and build simple Graphical User Interfaces

### **UNIT I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 10**

Object Oriented Programming - Abstraction - objects and classes - Encapsulation- Inheritance - Polymorphism- OOP in Java - Characteristics of Java - The Java Environment - Java Source File -Structure - Compilation. Fundamental Programming Structures in Java - Defining classes in Java - constructors, methods -access specifiers - static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays , Packages - JavaDoc comments.

### **UNIT II INHERITANCE AND INTERFACES 9**

Inheritance - Super classes- sub classes -Protected members - constructors in sub classes- the Object class - abstract classes and methods- final methods and classes - Interfaces - defining an interface, implementing interface, differences between classes and interfaces and extending interfaces - Object cloning -inner classes, Array Lists - Strings

### **UNIT III EXCEPTION HANDLING AND I/O 9**

Exceptions - exception hierarchy - throwing and catching exceptions - built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics - Streams - Byte streams and Character streams - Reading and Writing Console - Reading and Writing Files

### **UNIT IV MULTITHREADING AND GENERIC PROGRAMMING 8**

Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups. Generic Programming - Generic classes - generic methods - Bounded Types - Restrictions and Limitations.





#### **UNIT IV      BACKTRACKING , ITERATIVE IMPROVEMENT, AND BRANCH & BOUND      10**

Backtracking and permutations - N-queens problem - Hamilton circuits - best-first search -- Iterative Improvement: Stable marriage -- Maximum matching in bipartite graphs - maximum flow - -- Branch and Bound: Knapsack problem -- Traveling salesman problem

#### **UNIT V      INTRACTABILITY      8**

Introduction to intractability -- Polynomial reductions - SAT and 3-SAT - NP-complete and NP-Hard problems -- Approximation algorithms: Traveling salesman problem -- Knapsack problem - Introduction to randomized and parallel algorithms

**THEORY PERIODS: 45**

#### **SUGGESTIVE EXERCISES**

1. Implementation of iterative and recursive algorithms for the given problem
2. Empirical analysis of algorithms
3. Implementation of divide-and-conquer sorting algorithms
4. Implementation of closest-pairs algorithm
5. Implementation of Huffman coding
6. Implementation of Dijkstra's and Prim's algorithms
7. Implementation of disjoint sets and Kruskal's algorithm
8. Implementation of dynamic programming algorithm for knapsack problem
9. Implementation of backtracking to solve n-Queens and Hamilton circuits problems
10. Implementation of iterative improvement strategy for stable marriage and maxflow problems
11. Implementation of Branch and Bound technique to solve knapsack and TSP problems
12. Implementation of approximation algorithms for knapsack and TSP problems

**PRACTICAL PERIODS: 30**

**TOTAL PERIODS: 75**

#### **OUTCOMES:**

At the end of the course, the students should be able to:

- Design algorithms for various computing problems.
- Analyze the time and space complexity of algorithms.
- Critically analyze the different algorithm design techniques for a given problem.
- Modify existing algorithms to improve efficiency
- Ability to implement techniques in solving real time problems

#### **TEXT BOOKS**

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2012.
2. Jon Kleinberg and Eva Tardos, "Algorithm Design", Pearson Education, 2006.

#### **REFERENCES**

1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest, Clifford Stein, "Introduction to Algorithms", 3rd Edition, PHI Learning Private Limited, 2012.
2. Steven S Skiena, "The Algorithm Design Manual", 2nd Edition, Springer, 2008.
3. S Dasgupta, C H Papadimitriou, U V Vazirani, "Algorithms", 1st Edition, McGraw Hill Education, 2017.
4. S. Sridhar, "Design and Analysis of Algorithms", Oxford University Press, 2015.
5. Sara Baase and Allen Van Gelder, Computer Algorithms, Third Edition, Pearson Education, 2000.
6. Dexter C. Kozen, The Design and Analysis of Algorithms, Springer-Verlag, 1992.

**COURSE OBJECTIVES**

- Understand the Python Programming packages Python, Numpy, Scipy, Matplotlib, Pandas, statmodels, seaborn, plotly, bokeh Language.
- To prepare data for data analysis through understanding its distribution.
- Exposure on data processing using NUMPY and PANDAS
- To acquire knowledge in plotting using visualization tools.
- To understand and implement classification and Regression Model.

**Tools:** Python, Numpy, Scipy, Matplotlib, Pandas, statmodels, seaborn, plotly, bokeh

1. Working with Numpy arrays
2. Working with Pandas data frames
3. Basic plots using Matplotlib
4. Frequency distributions
5. Averages
6. Variability
7. Normal curves
8. Correlation and scatter plots
9. Correlation coefficient
10. Regression

**TOTAL:60 PERIODS**

**COURSE OUTCOMES**

Upon completion of the course, the students will be able to

- Develop relevant programming abilities.
- Demonstrate knowledge of statistical data analysis techniques
- Exhibit proficiency to build and assess data-based models.
- Demonstrate skill in Data management & processing tasks using Python
- Apply data science concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively

**REFERENCES:**

1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016.
2. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.
3. Data Science From Scratch: First Principles with Python, Second Edition by Joel Grus, 2019

**OBJECTIVES**

- To build software development skills using java programming for real-world applications.
- To understand and apply the concepts of classes, packages, interfaces, arraylist, exception handling and file processing.
- To develop applications using generic programming and event handling.

## LIST OF EXPERIMENTS

1. Develop a Java application to generate Electricity bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection (i.e domestic or commercial). Compute the bill amount using the following tariff.

If the type of the EB connection is domestic, calculate the amount to be paid as follows:

- First 100 units - Rs. 1 per unit
- 101-200 units - Rs. 2.50 per unit
- 201 -500 units - Rs. 4 per unit
- > 501 units - Rs. 6 per unit

If the type of the EB connection is commercial, calculate the amount to be paid as follows:

- First 100 units - Rs. 2 per unit
- 101-200 units - Rs. 4.50 per unit
- 201 -500 units - Rs. 6 per unit
- > 501 units - Rs. 7 per unit

2. Develop a java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa) , time converter (hours to minutes, seconds and vice versa) using packages.
3. Develop a java application with Employee class with Emp\_name, Emp\_id, Address, Mail\_id, Mobile\_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.
4. Design a Java interface for ADT Stack. Implement this interface using array. Provide necessary exception handling in both the implementations.
5. Write a program to perform string operations using ArrayList. Write functions for the following
  - a. Append - add at end
  - b. Insert - add at particular index
  - c. Search
  - d. List all string starts with given letter
6. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape.
7. Write a Java program to implement user defined exception handling.
8. Write a Java program that reads a file name from the user, displays information about whether the file exists, whether the file is readable, or writable, the type of file and the length of the file in bytes.
9. Write a java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.
10. Write a java program to find the maximum value from the given type of elements using a generic function.

11. Design a calculator using event-driven programming paradigm of Java with the following options.
  - a) Decimal manipulations
  - b) Scientific manipulations
12. Develop a mini project for any application using Java concepts.

**TOTAL : 60 PERIODS**

**OUTCOMES**

**Upon completion of the course, the students will be able to**

- Develop and implement Java programs for simple applications that make use of classes, packages and interfaces.
- Develop and implement Java programs with arraylist, exception handling and multithreading .
- Design applications using file processing, generic programming and event handling.

|               |  |          |          |          |          |
|---------------|--|----------|----------|----------|----------|
| <b>HS8381</b> | <b>INTERPERSONAL SKILLS/LISTENING&amp;SPEAKING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |  | <b>0</b> | <b>0</b> | <b>2</b> | <b>1</b> |

**OBJECTIVES:**

**The Course will enable learners to:**

- Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities.
- improve general and academic listening skills
- Make effective presentation

**UNIT I**

Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics taking lecture notes - preparing to listen to a lecture - articulate a complete idea as opposed to producing fragmented utterances.

**UNIT II**

Listen to a process information- give information, as part of a simple explanation - conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.

**UNIT III**

Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept - decline - take leave - listen for and follow the gist- listen for detail

## UNIT IV

Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures conversational speech listening to and participating in conversations - persuade.

## UNIT V

Formal and informal talk - listen to follow and respond to explanations, directions and instructions in academic and business contexts - strategies for presentations and interactive communication - group/pair presentations - negotiate disagreement in group work.

**TOTAL :30PERIODS**

### OUTCOMES:

**At the end of the course Learners will be able to:**

- Listen and respond appropriately.
- Participate in group discussions
- Make effective presentations
- Participate confidently and appropriately in conversations both formal and informal

### TEXT BOOKS:

1. Brooks, Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.
2. Richards, C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010

### REFERENCES:

1. Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
3. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.
4. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
5. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014

**MA8391**

**PROBABILITY AND STATISTICS**

**L T P C**

**4 0 0 4**

### OBJECTIVES:

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To familiarize the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

## UNIT I      **PROBABILITY AND RANDOM VARIABLES**

**12**

Probability - The axioms of probability - Conditional probability - Baye's theorem - Discrete and continuous random variables - Moments - Moment generating functions - Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

**UNIT II 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 III TESTING OF HYPOTHESIS 12**

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means - Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

**UNIT IV DESIGN OF EXPERIMENTS 12**

One way and Two way classifications - Completely randomized design - Randomized block design - Latin square design -  $2^2$  factorial design.

**UNIT V STATISTICAL QUALITY CONTROL 12**

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**Upon successful completion of the course, students will be able to:**

- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
- Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

**TEXT BOOKS:**

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.

**REFERENCES:**

1. Probability and Statistics for Engineering and the Sciences, 9E by Jay L. Devore, 2020.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8<sup>th</sup> Edition, 2014.
3. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4<sup>th</sup> Edition, New Delhi, 2010.
4. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3<sup>rd</sup> Edition, Elsevier, 2004.
5. Spiegel. M.R., Schiller. J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.

6. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8<sup>th</sup> Edition, 2007.

**AD8401**

**DATABASE DESIGN AND MANAGEMENT**

**L T P C**  
**3 0 0 3**

**COURSE OBJECTIVES:**

- To introduce database development life cycle and conceptual modelling
- To learn SQL for data definition, manipulation and querying a database
- To learn relational database design using conceptual mapping and normalization
- To learn transaction concepts and serializability of schedules
- To learn data model and querying in object-relational and No-SQL databases

**UNIT I CONCEPTUAL DATA MODELING 8**

Database environment - Database system development lifecycle - Requirements collection - Database design -- Entity-Relationship model - Enhanced-ER model - UML class diagrams.

**UNIT II RELATIONAL MODEL AND SQL 10**

Relational model concepts -- Integrity constraints -- SQL Data manipulation - SQL Data definition - Views -- SQL programming.

**UNIT III RELATIONAL DATABASE DESIGN AND NORMALIZATION 10**

ER and EER-to-Relational mapping - Update anomalies - Functional dependencies - Inference rules - Minimal cover - Properties of relational decomposition - Normalization (upto BCNF).

**UNIT IV TRANSACTION MANAGEMENT 8**

Transaction concepts - properties - Schedules - Serializability - Concurrency Control - Two-phase locking techniques.

**UNIT V OBJECT RELATIONAL AND NO-SQL DATABASES 9**

Mapping EER to ODB schema - Object identifier - reference types - rowtypes - UDTs - Subtypes and supertypes - user-defined routines - Collection types - Object Query Language; No-SQL: CAP theorem - Document-based: MongoDB data model and CRUD operations; Column-based: Hbase data model and CRUD operations.

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES**

After the completion of this course, students will be able to:

- Understand the database development life cycle and apply conceptual modeling
- Apply SQL and programming in SQL to create, manipulate and query the database
- Apply the conceptual-to-relational mapping and normalization to design relational database
- Determine the serializability of any non-serial schedule using concurrency techniques
- Apply the data model and querying in Object-relational and No-SQL databases.

**TEXT BOOKS:**

1. Thomas M. Connolly, Carolyn E. Begg, *Database Systems – A Practical Approach to Design, Implementation, and Management*, Sixth Edition, Global Edition, Pearson Education, 2015.
2. Ramez Elmasri, Shamkant B. Navathe, *Fundamental of Database Systems*, 7<sup>th</sup> Edition,



Pearson, 2017.

## REFERENCES:

1. Toby Teorey, Sam Lightstone, Tom Nadeau, H. V. Jagadish, "DATABASE MODELING AND DESIGN - Logical Design", Fifth Edition, Morgan Kaufmann Publishers, 2011.
2. Carlos Coronel, Steven Morris, and Peter Rob, Database Systems: Design, Implementation, and Management, Ninth Edition, Cengage learning, 2012
3. Abraham Silberschatz, Henry F Korth, S Sudharshan, "Database System Concepts", 6th Edition, Tata Mc Graw Hill, 2011.
4. Hector Garcia-Molina, Jeffrey D Ullman, Jennifer Widom, "Database Systems:The Complete Book", 2<sup>nd</sup> edition, Pearson.
5. S Sumathi, S Esakkirajan, " Fundamentals of Relational Database Management Systems ", (Studies in Computational Intelligence), Springer-Verlag, 2007.
6. Raghu Ramakrishnan, "Database Management Systems", 4th Edition, Tata Mc Graw Hill, 2010.

**AD8402**

**ARTIFICIAL INTELLIGENCE I**

**L T P C**

**3 0 0 3**

## OBJECTIVES:

The objective of this course is to enable the students to

- Understand the basic concepts of intelligent agents
- Develop general-purpose problem solving agents, logical reasoning agents, and agents that reason under uncertainty
- Employ AI techniques to solve some of today's real world problems.

### **UNIT I INTELLIGENT AGENTS**

**9**

Introduction to AI - Agents and Environments - Concept of rationality - Nature of environments - Structure of agents  
Problem solving agents - search algorithms - uninformed search strategies

### **UNIT II PROBLEM SOLVING**

**9**

Heuristic search strategies - heuristic functions  
Local search and optimization problems - local search in continuous space - search with non-deterministic actions - search in partially observable environments - online search agents and unknown environments

### **UNIT III GAME PLAYING AND CSP**

**9**

Game theory - optimal decisions in games - alpha-beta search - monte-carlo tree search - stochastic games - partially observable games  
Constraint satisfaction problems - constraint propagation - backtracking search for CSP - local search for CSP - structure of CSP

### **UNIT IV LOGICAL AGENTS**

**9**

Knowledge-based agents - propositional logic - propositional theorem proving - propositional model checking - agents based on propositional logic  
First-order logic - syntax and semantics - knowledge representation and engineering - inferences in first-order logic - forward chaining - backward chaining -- resolution

**UNIT V KNOWLEDGE REPRESENTATION AND PLANNING 9**

Ontological engineering - categories and objects - events - mental objects and modal logic - reasoning systems for categories - reasoning with default information

Classical planning - algorithms for classical planning - heuristics for planning - hierarchical planning - non-deterministic domains - time, schedule, and resources -- analysis

**COURSE OUTCOMES:**

**On successful completion of this course, the students will be able to**

1. Explain autonomous agents that make effective decisions in fully informed, partially observable, and adversarial settings
2. Choose appropriate algorithms for solving given AI problems
3. Design and implement logical reasoning agents
4. Design and implement agents that can reason under uncertainty

**TOTAL : 45 PERIODS**

**TEXT BOOK:**

1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020.

**REFERENCES:**

1. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007
2. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008
3. Patrick H. Winston, "Artificial Intelligence", Third edition, Pearson Edition, 2006
4. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013 (<http://nptel.ac.in/>)
5. Artificial Intelligence by Example: Develop machine intelligence from scratch using real artificial intelligence use cases - by Dennis Rothman, 2018

**AD8403**

**DATA ANALYTICS**

**L T P C**

**3 0 0 3**

**COURSE OBJECTIVES**

- To study the basic inferential statistics and sampling distribution.
- To understand the concept of estimation of parameters using fundamental tests and testing of hypotheses.
- To understand the techniques of analysis of variance.
- To gain knowledge in predictive analytics techniques.
- To perform a case study with any available sample data sets.

**UNIT I INFERENCE STATISTICS I 9**

Populations - samples - random sampling - probability and statistics

Sampling distribution - creating a sampling distribution - mean of all sample means - standard error of the mean - other sampling distributions

Hypothesis testing - z-test - z-test procedure - statement of the problem - null hypothesis - alternate hypotheses - decision rule - calculations - decisions - interpretations

**UNIT II INFERENCE STATISTICS II 9**

Why hypothesis tests? - Strong or weak decisions - one-tailed and two-tailed tests - case studies

Influence of sample size - power and sample size

Estimation - point estimate - confidence interval - level of confidence - effect of sample size

**UNIT III T-TEST 9**

t-test for one sample – sampling distribution of t – t-test procedure – degrees of freedom – estimating the standard error - case studies

t-test for two independent samples - statistical hypotheses - sampling distribution - test procedure - p-value - statistical significance - estimating effect size - meta analysis

t-test for two related samples

**UNIT IV ANALYSIS OF VARIANCE 9**

F-test - ANOVA - estimating effect size - multiple comparisons - case studies

Analysis of variance with repeated measures

Two-factor experiments - three f-tests - two-factor ANOVA - other types of ANOVA

Introduction to chi-square tests

**UNIT V PREDICTIVE ANALYTICS 9**

Linear least squares – implementation – goodness of fit – testing a linear model – weighted resampling

Regression using StatsModels - multiple regression - nonlinear relationships - logistic regression – estimating parameters - accuracy

Time series analysis - moving averages - missing values - serial correlation - autocorrelation

Introduction to survival analysis

**TOTAL: 45 PERIODS**

**COURSE OUTCOME**

- Understand the concept of sampling
- Apply the knowledge to derive hypotheses for given data
- Demonstrate the skills to perform various tests in the given data
- Ability to derive inference using Predictive Analytics
- Perform statistical analytics on a data set

**TEXT BOOKS**

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. [Unit V]

**REFERENCES**

1. David Spiegelhalter, “The Art of Statistics: Learning from Data”, Pelican Books, 2020.
2. Peter Bruce, Andrew Bruce, and Peter Gedek, “Practical Statistics for Data Scientists”, Second Edition, O’Reilly Publishers, 2020.
3. Charles R. Severance, “Python for Everybody: Exploring Data in Python 3”, Shroff Publishers, 2017.
4. Bradley Efron and Trevor Hastie, “Computer Age Statistical Inference”, Cambridge University Press, 2016.

**COURSE OBJECTIVES:**

- To understand the database development life cycle
- To learn database design using conceptual modelling, Normalization
- To implement database using Data definition, Querying using SQL manipulation and SQL programming
- To implement database applications using IDE/RAD tools
- To learn querying Object-relational databases

**SUGGESTIVE EXPERIMENTS**

1. Database Development Life cycle:
  - Problem definition and Requirement analysis
  - Scope and Constraints
2. Database design using Conceptual modeling (ER-EER) - top-down approach
  - Mapping conceptual to relational database and validate using Normalization
3. Implement the database using SQL Data definition with constraints, Views
4. Query the database using SQL Manipulation
5. Querying/Managing the database using SQL Programming
  - Stored Procedures/Functions
  - Constraints and security using Triggers
6. Database design using Normalization - bottom-up approach
7. Develop database applications using IDE/RAD tools (Eg., NetBeans, VisualStudio)
8. Database design using EER-to-ODB mapping / UML class diagrams
9. Object features of SQL-UDTs and sub-types, Tables using UDTs, Inheritance, Method definition
10. Querying the Object-relational database using Object Query language

**COURSE OUTCOMES**

After the completion of this course, students will be able to:

- Understand the database development life cycle
- Design relational database using conceptual-to-relational mapping, Normalization
- Apply SQL for creation, manipulation and retrieval of data
- Develop a database applications for real-time problems
- Design and query object-relational databases

**TOTAL : 60 PERIODS**

**HARDWARE:**

- Standalone Desktops

**SOFTWARE:**

- PostgreSQL

**COURSE OBJECTIVES**

- To study and write simple programs using the basic packages for handling data
- To do various sampling and T,Z, Anova test in various samples
- To perform case study and design a system
- To demonstrate Time Series Analysis in any real time application

**Tools:** Python, Numpy, Scipy, Matplotlib, Pandas, statmodels, seaborn, plotly, bokeh

**Suggested Exercises:**

1. Random Sampling
2. Z-test case study
3. T-test case studies
4. ANOVA case studies
5. Regression
6. Logistic Regression
7. Time series Analysis

**COURSE OUTCOME**

- After the completion of this course, students will be able to:
- To become skilled to use various packages in Python
- Demonstrate the understanding of data distribution with various samples
- Ability to Implement T-Test ,Anova and Z-Test on sample data sets
- Understanding of Mathematical models in real world problems.
- Conduct time series analysis and draw conclusion.

**TOTAL : 60 PERIODS**

**REFERENCES:**

1. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.
2. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014.

**HARDWARE:**

- Standalone Desktops with Linux OS

**SOFTWARE:**

- Python with statistical Packages

**AD8413**

**ARTIFICIAL INTELLIGENCE – I LABORATORY**

**L T P C  
0 0 4 2**

**COURSE OBJECTIVES**

- To design and implement different techniques to develop simple autonomous agents that make effective decisions in fully informed, and partially observable, settings.
- To apply appropriate algorithms for solving given AI problems.
- To Design and implement logical reasoning agents.
- To Design and implement agents that can reason under uncertainty.
- To understand the Implementation of these reasoning systems using either backward or forward inference mechanisms

**LIST OF EXPERIMENTS:**

1. Develop PEAS descriptions for given AI tasks
2. Implement basic search strategies for selected AI applications
3. Implement A\* and memory bounded A\* algorithms
4. Implement genetic algorithms for AI tasks
5. Implement simulated annealing algorithms for AI tasks
6. Implement alpha-beta tree search
7. Implement backtracking algorithms for CSP

8. Implement local search algorithms for CSP
9. Implement propositional logic inferences for AI tasks
10. Implement resolution based first order logic inferences for AI tasks
11. Implement classical planning algorithms
12. Mini-Project

**TOTAL : 60 PERIODS**

### **COURSE OUTCOMES**

After the completion of this course, students will be able to:

- Implement simple PEAS descriptions for given AI tasks
- Develop programs to implement simulated annealing and genetic algorithms
- Demonstrate the ability to solve problems using searching and backtracking
- Ability to Implement simple reasoning systems using either backward or forward inference mechanisms
- Will be able to choose and implement a suitable technique for a given AI task

### **SOFTWARE:**

- C++ or Java Software

|               |                                     |          |          |          |          |
|---------------|-------------------------------------|----------|----------|----------|----------|
| <b>HS8461</b> | <b>ADVANCED READING AND WRITING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                     | <b>0</b> | <b>0</b> | <b>2</b> | <b>1</b> |

### **OBJECTIVES:**

- Strengthen the reading skills of students of engineering.
- Enhance their writing skills with specific reference to technical writing.
- Develop students' critical thinking skills.
- Provide more opportunities to develop their project and proposal writing skills.

#### **UNIT I 6**

**Reading** - Strategies for effective reading-Use glosses and footnotes to aid reading comprehension- Read and recognize different text types-Predicting content using photos and title  
**Writing**-Plan before writing- Develop a paragraph: topic sentence, supporting sentences, concluding sentence -Write a descriptive paragraph

#### **UNIT II 6**

**Reading**-Read for details-Use of graphic organizers to review and aid comprehension **Writing**- State reasons and examples to support ideas in writing- Write a paragraph with reasons and examples- Write an opinion paragraph

#### **UNIT III 6**

**Reading**- Understanding pronoun reference and use of connectors in a passage- speed reading techniques-**Writing**- Elements of a good essay-Types of essays- descriptive-narrative- issue-based-argumentative-analytical.

#### **UNIT IV 6**

**Reading**- Genre and Organization of Ideas- **Writing**- Email writing- resumes - Job application- project writing-writing convincing proposals.

## UNIT V

6

**Reading-** Critical reading and thinking- understanding how the text positions the reader- identify

**Writing-** Statement of Purpose- letter of recommendation- Vision statement

**TOTAL: 30 PERIODS**

### OUTCOMES:

**At the end of the course Learners will be able to:**

- Write different types of essays.
- Write winning job applications.
- Read and evaluate texts critically.
- Display critical thinking in various professional contexts.

### TEXT BOOKS:

1. Gramer F. Margot and Colin S. Ward **Reading and Writing (Level 3)** Oxford University Press: Oxford, 2011
2. Debra Daise, CharlNorloff, and Paul Carne **Reading and Writing (Level 4)** Oxford University Press: Oxford, 2011

### REFERENCES:

1. Davis, Jason and Rhonda Llss. **Effective Academic Writing (Level 3)** Oxford University Press: Oxford, 2006
2. E. Suresh Kumar and et al. **Enriching Speaking and Writing Skills.** Second Edition. Orient Black swan: Hyderabad, 2012
3. Withrow, Jeans and et al. **Inspired to Write. Readings and Tasks to develop writing skills.** Cambridge University Press: Cambridge, 2004
4. Goatly, Andrew. **Critical Reading and Writing.** Routledge: United States of America, 2000
5. Petelin, Roslyn and Marsh Durham. **The Professional Writing Guide: Knowing Well and Knowing Why.** Business & Professional Publishing: Australia, 2004

**AD8501**

## OPTIMIZATION TECHNIQUES

|   |   |   |   |
|---|---|---|---|
| L | T | P | C |
| 4 | 0 | 0 | 4 |

### OBJECTIVES:

The objective of this course is to enable the student to

- Formulate and solve linear programming problems (LPP)
- Evaluate Integer Programming Problems, Transportation and Assignment Problems.
- Obtain solution to network problems using CPM and PERT techniques.
- Able to optimize the function subject to the constraints.
- Identify and solve problems under Markovian queuing models.

## UNIT I LINEAR MODELS

12

Introduction of Operations Research - mathematical formulation of LPP- Graphical Methods to solve LPP- Simplex Method- Big M method, Two-Phase method

|  |           |
|--|-----------|
| <b>UNIT II INTEGER PROGRAMMING AND TRANSPORTATION PROBLEMS</b>   | <b>12</b> |
| Integer programming: Branch and bound method- Transportation and Assignment problems - Travelling salesman problem.  |           |
| <b>UNIT III PROJECT SCHEDULING</b>   | <b>12</b> |
| Project network -Diagram representation - Floats - Critical path method (CPM) - PERT- Cost considerations in PERT and CPM  |           |
| <b>UNIT IV CLASSICAL OPTIMISATION THEORY</b>   | <b>12</b> |
| Unconstrained problems - necessary and sufficient conditions - Newton-Raphson method, Constrained problems - equality constraints - inequality constraints - Kuhn-Tucker conditions.                 |           |
| <b>UNIT V QUEUING MODELS</b>   | <b>12</b> |
| Introduction, Queuing Theory, Operating characteristics of a Queuing system, Constituents of a Queuing system, Service facility, Queue discipline, Single channel models, multiple service channels. |           |

**TOTAL PERIODS: 60**

**COURSE OUTCOMES:**

On successful completion of this course, the student will be able to

- Formulate and solve linear programming problems (LPP)
- Evaluate Integer Programming Problems, Transportation and Assignment Problems.
- Obtain solution to network problems using CPM and PERT techniques.
- Able to optimize the function subject to the constraints.
- Identify and solve problems under Markovian queuing models

**TEXT BOOK:**

1. Hamdy A Taha, Operations Research: An Introduction, Pearson, 10<sup>th</sup> Edition, 2017.

**REFERENCES:**

1. ND Vohra, Quantitative Techniques in Management, Tata McGraw Hill, 4<sup>th</sup> Edition, 2011.
2. J. K. Sharma, Operations Research Theory and Applications, Macmillan, 5<sup>th</sup> Edition, 2012.
3. Hiller F.S, Liberman G.J, Introduction to Operations Research, 10<sup>th</sup> Edition McGraw Hill, 2017.
4. Jit. S. Chandran, Mahendran P. Kawatra, KiHoKim, Essentials of Linear Programming, Vikas Publishing House Pvt.Ltd. New Delhi, 1994.
5. Ravindran A., Philip D.T., and Solberg J.J., Operations Research, John Wiley, 2<sup>nd</sup> Edition, 2007.

**CW8691**

**COMPUTER NETWORKS**

**L T P C**  
**3 0 2 4**

**OBJECTIVES:**

- To understand the protocol layering and physical level communication
- To analyze the performance of a network
- To understand the various components required to build different networks
- To learn the functions of network layer and the various routing protocols
- To familiarize the functions and protocols of the Transport layer



|  |   |          |
|--|---|----------|
| <b>UNIT I</b>  | <b>INTRODUCTION AND PHYSICAL LAYER</b>    | <b>9</b> |
| Networks - Network Types - Protocol Layering - TCP/IP Protocol suite - OSI Model - Physical Layer: Performance - Transmission media - Switching - Circuit-switched Networks - Packet Switching.  |   |          |
| <b>UNIT II</b>   | <b>DATA-LINK LAYER &amp; MEDIA ACCESS</b> | <b>9</b> |
| Introduction - Link-Layer Addressing - DLC Services - Data-Link Layer Protocols - HDLC - PPP - Media Access Control - Wired LANs: Ethernet - Wireless LANs - Introduction - IEEE 802.11, Bluetooth - Connecting Devices.                     |   |          |
| <b>UNIT III</b>  | <b>NETWORK LAYER</b>                      | <b>9</b> |
| Network Layer Services - Packet switching - Performance - IPV4 Addresses - Forwarding of IP Packets - Network Layer Protocols: IP, ICMP v4 - Unicast Routing Algorithms - Protocols - Multicasting Basics - IPV6 Addressing - IPV6 Protocol. |   |          |
| <b>UNIT IV</b>   | <b>TRANSPORT LAYER</b>                    | <b>9</b> |
| Introduction - Transport Layer Protocols - Services - Port Numbers - User Datagram Protocol - Transmission Control Protocol - SCTP.  |   |          |
| <b>UNIT V</b>  | <b>APPLICATION LAYER</b>                  | <b>9</b> |
| WWW and HTTP - FTP - Email -Telnet -SSH - DNS - SNMP.  |   |          |

**LIST OF EXPERIMENTS :**

1. Learn to use commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and trace route PDUs using a network protocol analyzer and examine.
2. Write a HTTP web client program to download a web page using TCP sockets.
3. Applications using TCP sockets like:
  - a) Echo client and echo server
  - b) Chat
  - c) File Transfer
4. Simulation of DNS using UDP sockets.
5. Write a code simulating ARP /RARP protocols.
6. Study of Network simulator (NS) and Simulation of Congestion Control Algorithms using NS.
7. Study of TCP/UDP performance using Simulation tool.
8. Simulation of Distance Vector/ Link State Routing algorithm.
9. Performance evaluation of Routing protocols using Simulation tool.
10. Simulation of an error correction code (like CRC).

**SOFTWARE:**

- C/C++/JAVA/Equivalent compiler
- Network Simulator like NS2/OPNET/Wireshark

**OUTCOMES:**

**Upon completion of the course, the students should be able to :**

- Comprehend the basic layers and its functions in computer networks.
- Evaluate the performance of a network.
- Understand the basics of how data flows from one node to another.

- Analyze and design routing algorithms.
- Design protocols for various functions in the network.
- Understand the working of various application layer protocols.

|                   |                   |
|-------------------|-------------------|
| <b>PRACTICALS</b> | <b>30 PERIODS</b> |
| <b>THEORY</b>     | <b>45 PERIODS</b> |
| <b>TOTAL</b>      | <b>75 PERIODS</b> |

#### TEXT BOOK:

1. Behrouz A. Forouzan, Data Communications and Networking, **Fifth Edition TMH, 2013.**
2. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012.

#### REFERENCES:

1. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", Seventh Edition, Pearson Education, 2017.
2. William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2013.
3. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
4. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open Source Approach, McGraw Hill Publisher, 2011.

**AD8502**

### **DATA EXPLORATION AND VISUALIZATION**

**L T P C**  
**3 0 2 4**

#### OBJECTIVES:

- To understand the basics of Data Explorations
- To understand the basic concepts of Data visualization
- To study the linear and non-linear ways of Data visualization
- To explore the data visualization using R language
- To apply various data visualization techniques for a variety of tasks

#### **UNIT I INTRODUCTION TO DATA EXPLORATION 9**

Introduction to Single variable: Distribution Variables - Numerical Summaries of Level and Spread - Scaling and Standardising - Inequality - Smoothing Time Series.

#### **UNIT II INTRODUCING TWO VARIABLE AND THIRD VARIABLE 9**

Relationships between Two Variables - Percentage Tables - Analysing Contingency Tables - Handling Several Batches - Scatterplots and Resistant Lines – Transformations - Introducing a Third Variable - Causal Explanations - Three-Variable Contingency Tables and Beyond - Longitudinal Data.

#### **UNIT III BASICS OF DATA VISUALIZATION 9**

The Seven Stages of Visualizing Data - Getting Started with Processing - Mapping - Time Series - Connections and Correlations - Scatterplot Maps - Trees, Hierarchies, and Recursion - Networks and Graphs - Acquiring Data - Parsing Data

**UNIT IV DATA EXPLORATION AND DATA VISUALIZATION IN R 9**

Introduction to R and RStudio - The Basics of Data Exploration - Loading Data into R - Transforming Data - Creating Tidy Data

**UNIT V TECHNIQUES AND APPLICATIONS OF DATA EXPLORATION AND VISUALIZATION IN R 9**

Basic Data Exploration Techniques - Basic Data Visualization Techniques - Visualizing Geographic Data with ggmap - R Markdown - Case Study – Wildfire Activity in the Western United States - Case Study – Single Family Residential Home and Rental Values

**LIST OF EXPERIMENTS:**

1. Install standalone R.
2. Use R tool to explore various commands for descriptive data analytics using bench mark datasets.
3. Explore various variable and row filters in R for cleaning data.
4. Use R commands for probability distributions and probability statistics.
5. Formulate real business problems scenarios to hypothesis and solve using R statistical testing features.
6. Apply various plot features in R on sample data sets and visualize.
7. Write and execute word count, word search and pattern search problems from large text files.
8. Explore various data preprocessing options using bench mark data sets.

**SOFTWARE:**

- R-Studio

|                   |                   |
|-------------------|-------------------|
| <b>PRACTICALS</b> | <b>30 PERIODS</b> |
| <b>THEORY</b>     | <b>45 PERIODS</b> |
| <b>TOTAL</b>      | <b>75 PERIODS</b> |

**OUTCOMES:**

- Understand the basics of Data Exploration
- Use Univariate and Multivariate Analysis for Data Exploration
- Explain various Data Visualization methods
- Apply the concept of Data Visualization on various datasets
- Apply the data visualization techniques using R language

**TEXT BOOKS**

1. Catherine Marsh, Jane Elliott, Exploring Data: An Introduction to Data Analysis for Social Scientists, Wiley Publications, 2nd Edition, 2008.
2. Visualizing Data: Exploring and Explaining Data with the processing Environment, O Reily Publications, 2007
3. Eric Pimpler, Data Visualization and Exploration with R, Geo Spatial Training service, 2017
4. Authors: Xiang Zhou, Sean, Yong Rui, Huang, Thomas S., Exploration of Visual Data, Springer Publications, 2003
5. Claus.O.Wlike, Fundamentals of Data Visualization, A primer on making informative and compelling Figures, O'Reily Publications, 2019

**OBJECTIVES:**

1. To understand the Analytics Life Cycle.
2. To comprehend the process of acquiring Business Intelligence
3. To understand various types of analytics for Business Forecasting
4. To model the supply chain management for Analytics.
5. To apply analytics for different functions of a business

**UNIT I INTRODUCTION TO BUSINESS ANALYTICS 9**

Analytics and Data Science - Analytics Life Cycle - Types of Analytics - Business Problem Definition - Data Collection - Data Preparation - Hypothesis Generation - Modeling - Validation and Evaluation - Interpretation - Deployment and Iteration

**UNIT II BUSINESS INTELLIGENCE 9**

Data Warehouses and Data Mart - Knowledge Management - Types of Decisions - Decision Making Process - Decision Support Systems - Business Intelligence - OLAP -, Analytic functions

**UNIT III BUSINESS FORECASTING 9**

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models - Data Mining and Predictive Analysis Modeling - Machine Learning for Predictive analytics.

**UNIT IV HR & SUPPLY CHAIN ANALYTICS 9**

Human Resources - Planning and Recruitment - Training and Development - Supply chain network - Planning Demand, Inventory and Supply - Logistics - Analytics applications in HR & Supply Chain

**UNIT V MARKETING & SALES ANALYTICS 9**

Marketing Strategy, Marketing Mix, Customer Behavior - selling Process - Sales Planning - Analytics applications in Marketing and Sales

**TOTAL: 45 PERIODS****COURSE OUTCOMES:**

- Explain the real world business problems and model with analytical solutions.
- Identify the business processes for extracting Business Intelligence
- Apply predictive analytics for business fore-casting
- Apply analytics for supply chain and logistics management
- Use analytics for marketing and sales.

**REFERENCES:**

1. R. Evans James, Business Analytics, 2017
2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2016
3. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
4. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
5. Mahadevan B, "Operations Management -Theory and Practice",3rd Edition, Pearson Education, 2018.

**OBJECTIVES:**

- To understand the basics of Machine Learning (ML)
- To understand the methods of Machine Learning
- To know about the implementation aspects of machine learning
- To understand the concepts of Data Analytics and Machine Learning
- To understand and implement usecases of ML

**UNIT I MACHINE LEARNING BASICS 8**

Introduction to Machine Learning (ML) - Essential concepts of ML - Types of learning - Machine learning methods based on Time - Dimensionality - Linearity and Non linearity - Early trends in Machine learning - Data Understanding Representation and visualization.

**UNIT II MACHINE LEARNING METHODS 11**

Linear methods - Regression -Classification -Perceptron and Neural networks - Decision trees - Support vector machines - Probabilistic models –Unsupervised learning - Featurization

**UNIT III MACHINE LEARNING IN PRACTICE 9**

Ranking - Recommendation System - Designing and Tuning model pipelines- Performance measurement - Azure Machine Learning - Open-source Machine Learning libraries - Amazon's Machine Learning Tool Kit: Sagemaker

**UNIT IV MACHINE LEARNING AND DATA ANALYTICS 9**

Machine Learning for Predictive Data Analytics - Data to Insights to Decisions - Data Exploration - Information based Learning - Similarity based learning - Probability based learning - Error based learning - Evaluation - The art of Machine learning to Predictive Data Analytics.

**UNIT V APPLICATIONS OF MACHINE LEARNING 8**

Image Recognition - Speech Recognition - Email spam and Malware Filtering - Online fraud detection - Medical Diagnosis.

**TOTAL: 45 PERIODS****OUTCOMES:**

- Understand the basics of ML
- Explain various Machine Learning methods
- Demonstrate various ML techniques using standard packages.
- Explore knowledge on Machine learning and Data Analytics
- Apply ML to various real time examples

**TEXT BOOKS:**

1. Ameet V Joshi, Machine Learning and Artificial Intelligence, Springer Publications, 2020
2. John D. Kelleher, Brian Mac Namee, Aoife D' Arcy, Fundamentals of Machine learning for Predictive Data Analytics, Algorithms, Worked Examples and case studies, MIT press,2015

**REFERENCES:**

1. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer Publications, 2011
2. Stuart Jonathan Russell, Peter Norvig, John Canny, Artificial Intelligence: A Modern Approach, Prentice Hall, 2020
3. Machine Learning Dummies, John Paul Muller, Luca Massaron, Wiley Publications, 2021

**OBJECTIVES:**

- To get practical knowledge on implementing machine learning algorithms in real time problem for getting solutions
- To implement supervised learning and their applications
- To understand unsupervised learning like clustering and EM algorithms
- To understand the theoretical and practical aspects of probabilistic graphical models.

**LIST OF EXPERIMENTS:**

1. Implement the concept of decision trees with suitable data set from real world problem and classify the data set to produce new sample.
2. Detecting Spam mails using Support vector machine
3. Implement facial recognition application with artificial neural network
4. Study and implement amazon toolkit: Sagemaker
5. Implement character recognition using Multilayer Perceptron
6. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.
7. Implement sentiment analysis using random forest optimization algorithm
8. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
9. Choose best machine learning algorithm to implement online fraud detection
10. Mini-project: students work in team on any socially relevant problem that needs a machine learning based solution, and evaluate the model performance.

**TOTAL : 60 PERIODS****OUTCOMES:**

- Understand the implementation procedures for the machine learning algorithms.
- Design Java/Python programs for various Learning algorithms.
- Apply appropriate Machine Learning algorithms to data sets
- Identify and apply Machine Learning algorithms to solve real world problems.

**REFERENCES**

1. Sebastain Raschka, "Python Machine Learning", Packt publishing (open source).
2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
3. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020.

**SOFTWARE:**

- Python/Java with ML packages

**OBJECTIVES:**

- The students are expected to develop a mini project for solving real world problems with the concepts and tools they are familiar with.
- To use the Python packages for performing analytics.

- To learn using analytical tools for real world problems.
- The students are expected to use different platforms and tools that support data analysis, machine learning, deep learning, Apache Spark, R, Weka, Tensor Flow,

#### LIST OF EXPERIMENTS:

1. Use Twitter data for Sentiment Analysis
2. Mail classification for Spam Detection
3. Use of ML algorithms for Stock market Prediction
4. Designing a Recommendation System
5. Using Apache Spark for Time Series Forecasting
6. Implementation of Disease Prediction System
7. Usage of Image Segmentation
8. Design a Face recognition System
9. Use Natural Language Processing for short text Summarization

**TOTAL: 60 PERIODS**

#### OUTCOMES:

- Install analytical tools and configure distributed file system.
- Have skills in developing and executing analytical procedures in various distributed frameworks and databases.
- Develop, implement and deploy simple applications on very large datasets.
- Implement simple to complex data modeling in NoSQL databases.
- Implement real world applications by using suitable analytical framework and tools.

#### REFERENCES:

1. [www.kaggle.com](http://www.kaggle.com)
2. <https://amankharwal.medium.com/130-machine-learning-projects-solved-and-explained-605d188fb392>
3. Jake VanderPlas, "Python Data Science Handbook", O'Reilly, 2016.
4. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", Green Tea Press, 2014.
5. Data Science From Scratch: First Principles with Python, Second Edition by Joel Grus, 2019

**AD8601**

**ARTIFICIAL INTELLIGENCE II**

**L T P C**  
**3 0 0 3**

#### OBJECTIVES:

- To know the underlying structure behind intelligence mathematically.
- To know the logical implications in probabilistic Reasoning.
- To know the automated learning techniques.
- To explore the techniques in Reinforcement Learning.
- To explore artificial intelligence techniques for Robotics.

#### UNIT I      **PROBABILISTIC REASONING I**

**9**

Acting under uncertainty - Bayesian inference - naïve bayes models

Probabilistic reasoning - Bayesian networks - exact inference in BN - approximate inference in BN – causal networks

|  |  |          |
|--|--|----------|
| <b>UNIT II</b>   | <b>PROBABILISTIC REASONING II</b>          | <b>9</b> |
| Probabilistic reasoning over time - time and uncertainty - inference in temporal models - Hidden Markov Models - Kalman filters - Dynamic Bayesian networks<br>Probabilistic programming   |  |          |
| <b>UNIT III</b>  | <b>DECISIONS UNDER UNCERTAINTY</b>         | <b>9</b> |
| Basis of utility theory - utility functions - Multiattribute utility functions - decision networks - value of information - unknown preferences<br>Sequential decision problems - MDPs - Bandit problems - partially observable MDPs<br>Multiagent environments - non-cooperative game theory - cooperative game theory - making collective decisions  |  |          |
| <b>UNIT IV</b>   | <b>LEARNING PROBABILISTIC MODELS</b>       | <b>9</b> |
| Statistical learning theory - maximum-likelihood parameter learning - naïve bayes models - generative and descriptive models - continuous models - Bayesian parameter learning - Bayesian linear regression - learning Bayesian net structures - density estimation<br>EM Algorithm - unsupervised clustering - Gaussian mixture models - learning Bayes net parameters - learning HMM - learning Bayes net structures with hidden variables |  |          |
| <b>UNIT V</b>  | <b>REINFORCEMENT LEARNING AND ROBOTICS</b> | <b>9</b> |
| Learning from rewards - passive reinforcement learning - active reinforcement learning - generalization in reinforcement learning - policy search - inverse reinforcement learning - applications<br>Robots - robotic perception - planning movements - reinforcement learning in robotics - robotic frameworks -- applications of robotics<br>Philosophy, ethics, and safety of AI - the future of AI                                       |  |          |

**TOTAL:45 PERIODS**

**OUTCOMES:**

**On completion of the course, the students will be able to:**

- Explain the probabilistic reasoning using Bayesian inference
- Apply appropriate Probabilistic reasoning techniques for solving uncertainty problems
- Explain use of game theory for decision making.
- Explain and apply probabilistic models for various use cases
- Apply AI techniques for robotics

**TEXT BOOK**

1. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020.

**REFERENCES**

1. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007
2. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008
3. Patrick H. Winston, "Artificial Intelligence", Third edition, Pearson Edition, 2006
4. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013 (<http://nptel.ac.in/>)





## OUTCOMES:

- Understand the fundamentals of security and the significance of number theory in computer security
- Learn the public key cryptographic standards and authentication scheme
- Able to apply the security frameworks for real time applications
- Understand the security threats and attacks in IoT, Cloud.
- Able to develop appropriate security algorithms understanding the possible threats

**TOTAL:45 PERIODS**

## TEXT BOOKS:

1. William Stallings, "Cryptography and Network Security Principles and Practice", Fifth Edition, 2011, Pearson Education International
2. William Stallings and Lawrie Brown, "Computer Security Principles and Practice", Third Edition, 2015, Pearson Education International

## REFERENCES:

1. Tim Mather, Subra Kumaraswamy and Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", 2009, Oreilly
2. Mikhail Gloukhovtsev, "IoT Security: Challenges, Solutions & Future Prospects", 2018, Knowledge Sharing Article, Dell Inc.
3. Pradip KumarDas, Hrudaya Kumar Tripathy, Shafiz Affendi Mohd yusuf, Privacy and Security Issues in Big Data, An Analytical View on Business Intelligence. Springer 2021.

**IT8501**

**WEB TECHNOLOGY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

## OBJECTIVES:

- To understand about client-server communication and protocols used during communication.
- To design interactive web pages using Scripting languages.
- To learn server side programming using servlets and JSP.
- To develop web pages using XML/XSLT.

## UNIT I WEB SITE BASICS AND HTML

**9**

Web Essentials: Clients, Servers, and Communication. The Internet-Basic Internet Protocols -The World Wide Web-HTTP request message-response message-Web Clients Web Servers. Markup Languages: XHTML. An Introduction to HTML History-Versions-Basic XHTML Syntax and Semantics-Some Fundamental HTML Elements-Relative URLs-Lists-tables-Frames-Forms-HTML 5.0.

## UNIT II CSS AND CLIENT SIDE SCRIPTING

**9**

Style Sheets: CSS-Introduction to Cascading Style Sheets-Features-Core Syntax-Style Sheets and HTML- Style Rule Cascading and Inheritance-Text Properties-Box Model Normal Flow Box Layout-Beyond the Normal Flow-CSS3.0. Client-Side Programming: The JavaScript Language-History and Versions Introduction JavaScript in Perspective-Syntax-Variables and Data Types-Statements-Operators-Literals-Functions-Objects-Arrays-Built-in Objects-JavaScript Debuggers.

## UNIT III SERVER SIDE SCRIPTING

**9**

Host Objects: Browsers and the DOM-Introduction to the Document Object Model DOM History and Levels-Intrinsic Event Handling-Modifying Element Style-The Document Tree-DOM Event Handling-

Accommodating Noncompliant Browsers Properties of window. Server-Side Programming: Java Servlets- Architecture -Overview-A Servlet-Generating Dynamic Content-Life Cycle- Parameter Data-Sessions-Cookies-URL Rewriting-Other Capabilities-Data Storage Servlets and Concurrency-Databases and Java Servlets.

**UNIT IV JSP AND XML 9**

Separating Programming and Presentation: JSP Technology Introduction-JSP and Servlets-Running JSP Applications Basic JSP-JavaBeans Classes and JSP-Tag Libraries and Files-Support for the Model-View-Controller Paradigm- Databases and JSP. Representing Web Data: XML-Documents and Vocabularies-Versions and Declaration-Namespaces- DOM based XML processing Event-oriented Parsing: SAX-Transforming XML Documents-Selecting XML Data: XPATH-Template based Transformations: XSLT-Displaying XML Documents in Browsers.

**UNIT V AJAX AND WEB SERVICES 9**

AJAX: Ajax Client Server Architecture-XML Http Request Object-Call Back Methods. Web Services: JAX-RPC-Concepts-Writing a Java Web Service-Writing a Java Web Service Client-Describing Web Services: WSDL- Representing Data Types: XML Schema-Communicating Object Data: SOAP Related Technologies-Software Installation-Storing Java Objects as Files.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Design simple web pages using markup languages like HTML and XHTML.
- Create dynamic web pages using DHTML and java script that is easy to navigate and use.
- Program server side web pages that have to process request from client side web pages.
- Represent web data using XML and develop web pages using JSP.
- Understand various web services and how these web services interact.

**TEXT BOOK:**

1. Jeffrey C. Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006.

**REFERENCES**

1. Robert. W. Sebesta, "Programming the World Wide Web", Fourth Edition, Pearson Education, 2007 .
2. Deitel, Deitel, Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006.
3. Marty Hall and Larry Brown, "Core Web Programming" Second Edition, Volume I and II, Pearson Education, 2001.
4. Bates, "Developing Web Applications", Wiley, 2006

**IT8511**

**WEB TECHNOLOGY LABORATORY**

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**OBJECTIVES:**

- To design interactive web pages using Scripting languages.
- To learn server side programming using servlets and JSP.
- To develop web pages using XML/XSLT.

## LIST OF EXPERIMENTS:

1. Create a web page with the following using HTML.
  - i) To embed an image map in a web page.
  - ii) To fix the hot spots.
  - iii) Show all the related information when the hot spots are clicked
2. Create a web page with all types of Cascading style sheets.
3. Client Side Scripts for Validating Web Form Controls using DHTML.
4. Installation of Apache Tomcat web server.
5. Write programs in Java using Servlets:  
To invoke servlets from HTML forms.  
Session Tracking.
6. Write programs in Java to create three-tier applications using JSP and Databases
  - For conducting on-line examination.
  - For displaying student mark list. Assume that student information is available in a database which has been stored in a database server.
7. Programs using XML - Schema - XSLT/XSL.
8. Programs using DOM and SAX parsers.
9. Programs using AJAX.
10. Consider a case where we have two web Services- an airline service and a travel agent and the travel agent is searching for an airline. Implement this scenario using Web Services and Data base.

**TOTAL: 60 PERIODS**

## OUTCOMES:

### Upon Completion of the course, the students will be able to:

- Design simple web pages using markup languages like HTML and XHTML.
- Create dynamic web pages using DHTML and java script that is easy to navigate and use.
- Program server side web pages that have to process request from client side web pages.
- Represent web data using XML and develop web pages using JSP.
- Understand various web services and how these web services interact.

## SOFTWARE REQUIRED:

- Dream Weaver or Equivalent, MySQL or Equivalent, Apache Server, WAMP/XAMPP

AD8611

ARTIFICIAL INTELLIGENCE – II LABORATORY

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## OBJECTIVES:

- To impart knowledge about Artificial Intelligence.
- To understand the main abstractions and reasoning for intelligent systems.
- To understand the use of Artificial Intelligence in various applications

## LIST OF EXPERIMENTS:

1. To implement Bayesian Belief networks
2. Approximate inferences in Bayesian network
3. To implement decision problems for various real-world applications
4. To learn various Bayesian parameters
5. Implementation of Hidden Markov Models
6. Implement EM algorithm for HMM

7. Implement the Reinforcement learning for various reward based applications
8. Mini-Project

**OUTCOMES:**

**TOTAL PERIODS:60**

- Solve basic AI based problems.
- Implement the concept of Bayesian Network.
- Apply AI techniques to real-world problems to develop intelligent systems
- Implement HMM for real-world application.
- Use Reinforcement Learning to implement various intelligent systems.

**SOFTWARE:**

- **Python/Java with Machine Learning packages.**

**REFERENCES:**

1. aimacode · GitHub (<https://github.com/aimacode>)
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007
3. Kevin Night, Elaine Rich, and Nair B., "Artificial Intelligence", McGraw Hill, 2008
4. Patrick H. Winston, "Artificial Intelligence", Third edition, Pearson Edition, 2006
5. Deepak Khemani, "Artificial Intelligence", Tata McGraw Hill Education, 2013 (<http://nptel.ac.in/>)

**HS8581**

**PROFESSIONAL COMMUNICATION**

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**OBJECTIVES:**

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

**UNIT I**

Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills--Grooming as a professional with values--Time Management--General awareness of Current Affairs

**UNIT II**

Self-Introduction-organizing the material - Introducing oneself to the audience - introducing the topic - answering questions - individual presentation practice-- presenting the visuals effectively - 5 minute presentations

**UNIT III**

Introduction to Group Discussion-- Participating in group discussions - understanding group dynamics - brainstorming the topic -- questioning and clarifying -GD strategies- activities to improve GD skills

**UNIT IV**

Interview etiquette - dress code - body language - attending job interviews- telephone/skype interview -one to one interview &panel interview - FAQs related to job interviews

## UNIT V

Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes

**TOTAL:30 PERIODS**

### OUTCOMES:

**At the end of the course Learners will be able to:**

- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

### RECOMMENDED SOFTWARE

1. Open Source Software
2. Win English

### REFERENCES:

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. E. Suresh Kumar et al. Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
3. Interact English Lab Manual for Undergraduate Students,. OrientBalckSwan: Hyderabad, 2016.
4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
5. S. Hariharanetal. Soft Skills. MJP Publishers: Chennai, 2010.

**AD8612**

**SOCIALLY RELEVANT PROJECT**

**L T P C**  
**0 0 4 2**

### OBJECTIVES:

- The students are expected to develop solution for socially existing problems with the concepts and tools they are familiar with.
- A few broad areas related to the course are presented below.
- The list below is only a guideline for the students and the students are motivated to build the projects to portray their own creativity.

### PRACTICAL EXERCISES:

1. Solve social problems using Statistical and Mathematical Concepts
2. Solving Big Data related Concepts
3. Solving Business Intelligence related Concepts
4. Solving problems with Machine Learning Algorithms.
5. Solving problems with Deep Learning Algorithms
6. Solving any Security Related Problems.
7. Solving health Related Problems.
9. problems related to Data wrangling

**TOTAL: 60 PERIODS**

### OUTCOMES:

- The students are expected to use different platforms and tools like SAS, Python, R, Scala.
- Big Data: Hadoop Ecosystem (Hive, Pig, Sqoop, Flume), Big Data Lakes,No SQL, Apache

Spark, Spark MLlib, HPC, Storm.

- Business Intelligence : SQL, Microsoft Power BI, SAP BI, Tableau, Oracle Fusion,
- Machine Learning and Deep Learning : TensorFlow, Keras, Artificial Neural Networks, Deep Neural Networks, Convolution Neural Networks, Auto encoders.

#### REFERENCES:

1. <https://www.jeremyjordan.me/ml-projects-guide/>
2. Problems listed in Smart India Hackathon : [www.sih.gov.in](http://www.sih.gov.in)

AD8701

### DEEP LEARNING

L T P C  
3 0 0 3

#### OBJECTIVES:

- 1: To understand the basics of deep neural networks
- 2: To understand CNN architectures of deep neural networks
- 3: To understand the concepts of Artificial Neural Networks
- 4: To learn the basics of Data science in Deep learning
- 5: To learn about applications of deep learning in AI and Data Science

#### UNIT I DEEP NETWORKS BASICS

9

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 -- Challenges motivating deep learning; Deep Networks: Deep feedforward networks; Regularization -- Optimization.

#### UNIT II CONVOLUTIONAL NEURAL NETWORKS

9

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 III DEEP LEARNING ALGORITHMS FOR AI

9

Artificial Neural Networks -- Linear Associative Networks -- Perceptrons -- The Backpropagation Algorithm -- Hopfield Nets -- Boltzmann Machines -- Deep RBMs -- Variational Autoencoders -- Deep Backprop Networks -- Autoencoders

#### UNIT IV DATA SCIENCE AND DEEP LEARNING

9

Data science fundamentals and responsibilities of a data scientist - life cycle of data science -- Data science tools - Data modeling, and featurization - How to work with data variables and data science tools - How to visualize the data - How to work with machine learning algorithms and Artificial Neural Networks

#### UNIT V APPLICATIONS OF DEEP LEARNING

9

Detection in chest X-ray images - object detection and classification - RGB and depth image fusion - NLP tasks - dimensionality estimation - time series forecasting - building electric power grid for controllable energy resources - guiding charities in maximizing donations and robotic control in industrial environments.

**TOTAL:45 PERIODS**

## OUTCOMES:

- CO1: Explain the basics in deep neural networks (K2)
- CO2: Apply Convolution Neural Network for image processing (K3)
- CO3: Explain the basics of Artificial Intelligence using deep learning (K2)
- CO4: Apply deep learning algorithms for data science
- CO5: Apply deep learning algorithms for variety applications

## TEXT BOOKS:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, ``Deep Learning'', MIT Press, 2016
2. Stone, James. (2019). Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning, Sebtel Press, United States, 2019
3. Vance, William , Data Science: A Comprehensive Beginners Guide to Learn the Realms of Data Science (Hardcover - 2020), Joiningthedotstv Limited
4. Wani, M.A., Raj, B., Luo, F., Dou, D. (Eds.), Deep Learning Applications, Volume 3, Springer Publications 2022
5. Charu C. Aggarwal, ``Neural Networks and Deep Learning: A Textbook'', Springer International Punlishing, 2018.

AD8702

TEXT ANALYTICS

L T P C  
3 0 0 3

## 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

### UNIT I TEXT EXTRACTION

9

Introduction- Rapid automatic keyword extraction: candidate keywords, keyword scores, adjoining keywords, extracted keywords-Benchmark evaluation: precision and recall, efficiency, stoplist generation, Evaluation on new articles.

### UNIT II DOCUMENT CLUSTERING

9

Multilingual document clustering: Multilingual LSA, Tucker1 method, PARAFAC2 method, LSA with term alignments, LMSA, LMSA with term alignments; Constrained clustering with k-means type algorithms.

### UNIT III CONTENT BASED CLASSIFICATION

8

Classification algorithms for Document Classification, Content-based spam email classification, Utilizing nonnegative matrix factorization for email classification problems.

### UNIT IV ANOMALY AND TREND DETECTION

9

Text visualization techniques: Visualization in text analysis, Tag clouds, tag clouds, authorship and change tracking, Data Exploration and the search for noval patterns, sentiment tracking, visual analytics and FutureLens, scenario discovery.

adaptive threshold setting for novelty mining: Introduction, adaptive threshold for anomaly detection, Experimental study.



**UNIT V TEXT STREAMS****10**

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:45 PERIODS****OUTCOMES:****After the completion of this course, students will be able to:**

- CO1: Design text extraction techniques
- CO2: Devise clustering techniques for text mining
- CO3: Design classification techniques for text mining
- CO4: Apply visualization techniques and perform anomaly & trend detection
- CO5: Perform Event operations in Text streams

**REFERENCES**

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.

**AD8703****BASICS OF COMPUTER VISION**

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**OBJECTIVES:**

- 1: To review image processing techniques for computer vision.
- 2: To understand various features and recognition techniques
- 3: To learn about histogram and binary vision
- 4: Apply three-dimensional image analysis techniques
- 5: Study real world applications of computer vision algorithms

**UNIT I INTRODUCTION****9**

Image Processing, Computer Vision ,What is Computer Vision - Low-level, Mid-level, High-level ; Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective, Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.

**UNIT II FEATURE EXTRACTION AND FEATURE SEGMENTATION****9**

Feature Extraction -Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space

Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT.  
Image Segmentation -Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation.

**UNIT III IMAGES, HISTOGRAMS, BINARY VISION 9**

Simple pinhole camera model - Sampling - Quantisation - Colour images - Noise - Smoothing - 1D and 3D histograms - Histogram/Image Equalisation - Histogram Comparison - Back-projection - k-means Clustering - Thresholding - Threshold Detection Methods - Variations on Thresholding - Mathematical Morphology - Connectivity.

**UNIT IV 3D VISION AND MOTION 9**

Methods for 3D vision - projection schemes - shape from shading - photometric stereo - shape from texture - shape from focus - active range finding - surface representations - point-based representation - volumetric representations - 3D object recognition - 3D reconstruction - introduction to motion - triangulation - bundle adjustment - translational alignment - parametric motion-spline-based motion- optical flow - layered motion.

**UNIT V APPLICATIONS 9**

Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing , Virtual Reality and Augmented Reality.

**OUTCOMES:**

- Explain low level processing of image and transformation techniques applied to images.
- Explain the feature extraction, segmentation and object recognition methods.
- Apply Histogram transform for detection of geometric shapes like line, ellipse and objects.
- Illustrate 3D vision process and motion estimation techniques.
- Apply vision techniques to real time applications.

**TOTAL:45 PERIODS**

**TEXT BOOKS:**

1. D. A. Forsyth, J. Ponce, "Computer Vision: A Modern Approach", Pearson Education, 2003.
2. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Verlag London Limited,2011.

**REFERENCES:**

1. B. K. P. Horn -Robot Vision, McGraw-Hill.
2. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012.
3. Mark Nixon and Alberto S. Aquado, Feature Extraction & Image Processing for Computer Vision, Third Edition, Academic Press, 2012.
4. E. R. Davies, (2012), "Computer & Machine Vision", Fourth Edition, Academic Press.
5. Concise Computer Vision: An Introduction into Theory and Algorithms, by Reinhard Klette, 2014

**OBJECTIVES:**

1. To understand about big data.
2. To learn and use NoSQL big data management.
3. To learn mapreduce analytics using Hadoop and related tools.
4. To work with map reduce applications
5. To understand the usage of Hadoop related tools for Big Data Analytics

**UNIT I UNDERSTANDING BIG DATA 9**

What is big data – why big data – convergence of key trends – unstructured data – industry examples of big data - web analytics - big data and marketing - fraud and big data - risk and big data - credit risk management - big data and algorithmic trading - big data and healthcare - big data in medicine - advertising and big data - big data technologies - introduction to Hadoop - open source technologies - cloud and big data - mobile business intelligence - Crowd sourcing analytics - inter and trans firewall analytics.

**UNIT II NOSQL DATA MANAGEMENT 9**

Introduction to NoSQL - aggregate data models - aggregates - key-value and document data models – relationships – graph databases – schemaless databases – materialized views – distribution models - sharding - master-slave replication - peer-peer replication - sharding and replication - consistency - relaxing consistency - version stamps - map-reduce - partitioning and combining - composing map-reduce calculations.

**UNIT III BASICS OF HADOOP 9**

Data format - analyzing data with Hadoop - scaling out - Hadoop streaming - Hadoop pipes - design of Hadoop distributed file system (HDFS) - HDFS concepts - Java interface - data flow - Hadoop I/O - data integrity - compression - serialization - Avro - file-based data structures.

**UNIT IV MAPREDUCE APPLICATIONS 9**

MapReduce workflows - unit tests with MRUnit - test data and local tests - anatomy of MapReduce job run - classic Map-reduce - YARN - failures in classic Map-reduce and YARN - job scheduling - shuffle and sort - task execution - MapReduce types - input formats - output formats.

**UNIT V HADOOP RELATED TOOLS 9**

Hbase - data model and implementations - Hbase clients - Hbase examples - praxis.Cassandra - cassandra data model - cassandra examples - cassandra clients - Hadoop integration. Pig - Grunt - pig data model - Pig Latin - developing and testing Pig Latin scripts. Hive - data types and file formats - HiveQL data definition - HiveQL data manipulation - HiveQL queries.

**TOTAL:45 PERIODS****OUTCOMES:**

After the completion of this course, students will be able to:

- Describe big data and use cases from selected business domains.
- Explain NoSQL big data management.
- Install, configure, and run Hadoop and HDFS.
- Perform map-reduce analytics using Hadoop.
- Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

**LIST OF EXPERIMENTS:  
PERIODS**

**PRACTICALS:15**

1. Downloading and installing Hadoop; Understanding different Hadoop modes. Startup scripts, Configuration files.
2. Hadoop Implementation of file management tasks, such as Adding files and directories, retrieving files and Deleting files
3. Implement of Matrix Multiplication with Hadoop Map Reduce
4. Run a basic Word Count Map Reduce program to understand Map Reduce Paradigm.
5. Installation of Hive along with practice examples.
7. Installation of HBase, Installing thrift along with Practice examples
8. Patrice importing and exporting data from various data bases.

**Software Requirements:**

Hadoop, Java, Hive and HBase.

**TOTAL:75 PERIODS**

**TEXT BOOKS:**

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.

**REFERENCES:**

1. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
2. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
3. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.
4. Alan Gates, "Programming Pig", O'Reilley, 2011.

**AD8705**

**AI AND ROBOTICS**

**L T P C  
3 0 2 4**

**OBJECTIVES:**

1. To study the Robot Locomotion and types of robots.
2. To explore the kinematic models and constraints
3. To Learn sensors of robots and image processing for robotics.
4. To understand the methods for mobile robot Localization
5. To study the Path planning and Navigation of Robots.

**UNIT I ROBOT LOCOMOTION**

**9**

Introduction to AI and Robotics - robot locomotion - legged mobile robots - wheeled mobile robots - aerial mobile robots.

**UNIT II MOBILE ROBOT KINEMATICS**

**9**

Kinematic models and constraints - mobile robot maneuverability - mobile robot workspace - advanced kinematics - motion control.

**UNIT III ROBOT PERCEPTION**

**9**

Sensors for mobile robots - computer vision for robots - image processing for robotics - place recognition - range data.

**UNIT IV MOBILE ROBOT LOCALIZATION 9**

Introduction to localization – noise and aliasing – localization-based navigation – belief representation - map representation - probabilistic map-based localization - autonomous map building.

**UNIT V ROBOT PLANNING AND NAVIGATION 9**

Planning and navigation - planning and reacting - path planning - obstacle avoidance - navigation architectures.

**TOTAL:45 PERIODS**

**OUTCOMES:**

**After the completion of this course, students will be able to:**

- CO1: Explain the types of Robots
- CO2: Narrate the kinematics of Robots
- CO3: Implement image processing algorithms
- CO4: Devise Localization algorithms
- CO5: Devise Path planning methods for navigation

**LIST OF EXPERIMENTS:  
PERIODS**

**PRACTICALS:15**

1. Line tracing bot
2. Gesture controlled bot
3. 4(Four) DOF Robotic Arm
4. Home Security System using NodeMCU
5. RF Controlled or WiFi controlled Navigation bot
6. Pick and place bot with Object Detetction
7. Wall Following bot
8. Maze solving Robot
9. Forward and reverse kinematics based experiment using open source platforms
10. Computer Visio based robotic tasks execution

**Software Requirements:**

Open Source Software

**TOTAL:75 PERIODS**

**TEXT BOOKS:**

1. R. Siegwart, I. R. Nourbaksh, and D. Scarramuzza, "Introduction to Autonomous Mobile Robots", Second Edition, MIT Press, 2011.
2. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020.

**AD8711**

**DEEP LEARNING LABORATORY**

**L T P C  
0 0 4 2**

**OBJECTIVES:**

- 1: To learn deep neural networks and apply for simple problems
- 2: To Learn and apply Convolution Neural Network for image processing
- 3: To Learn and apply Recurrent Neural Network and its variants for text analysis
- 4: To augment data using generative models

5: To explore real world applications with deep neural networks

**LIST OF EXPERIMENTS:**

1. Solving XOR problem using Multilayer perceptron
2. Implement character and Digit Recognition using ANN.
3. Implement the analysis of X-ray image using autoencoders
4. Implement Speech Recognition using NLP
5. Develop a code to design object detection and classification for traffic analysis using CNN
6. Implement online fraud detection of share market data using any one of the data analytics tools.
7. Implement image augmentation using deep RBM.
8. Implement Sentiment Analysis using LSTM.
9. Mini Project: Number plate recognition of traffic video analysis.

**Hardware/Software Requirements**

**Software:**

- Understanding on Working of Colab and Transfer Learning Networks
- High end GPU Systems ( Huge Computation)

**OUTCOMES:**

- CO1: Apply deep neural network for simple problems
- CO2: Apply Convolution Neural Network for image processing
- CO3: Apply Recurrent Neural Network and its variants for text analysis
- CO4: Apply generative models for data augmentation
- CO5: Develop a real world application using suitable deep neural networks

**TOTAL:60 PERIODS**

**REFERENCES**

1. Wani, M.A., Raj, B., Luo, F., Dou, D. (Eds.), "Deep Learning Applications", Volume 3, Springer Publications 2022.
2. Stone, James. (2019), " Artificial Intelligence Engines: A Tutorial Introduction to the Mathematics of Deep Learning", Sebtel Press, United States, 2019

**EC8691**

**MICROPROCESSORS AND MICROCONTROLLERS**

**L T P C**

**3 0 0 3**

**OBJECTIVES:**

- To understand the Architecture of 8086 microprocessor.
- To learn the design aspects of I/O and Memory Interfacing circuits.
- To interface microprocessors with supporting chips.
- To study the Architecture of 8051 microcontroller.
- To design a microcontroller based system

**UNIT I THE 8086 MICROPROCESSOR**

**9**

Introduction to 8086 - Microprocessor architecture - Addressing modes - Instruction set and assembler directives - Assembly language programming - Modular Programming - Linking and Relocation - Stacks - Procedures - Macros - Interrupts and interrupt service routines - Byte and String Manipulation.



**OBJECTIVES:**

- 1: To acquire knowledge on software process management
- 2: To acquire managerial skills for software project development.
- 3: To understand software economics
- 4: To acquire knowledge about real time software development scenarios.

**UNIT I SOFTWARE PROCESS 9**

Software Process Maturity Software maturity Framework, Principles of Software Process Change, Software Process Assessment, The Initial Process, The Repeatable Process, The Defined Process, The Managed Process, The Optimizing Process. Process Reference Models Capability Maturity Model (CMM), CMMI, PCMM, PSP, TSP).

**UNIT II SOFTWARE ECONOMICS AND LIFECYCLE 9**

Software Project Management Renaissance Conventional Software Management, Evolution of Software Economics, Improving Software Economics, The old way and the new way. Life-Cycle Phases and Process artifacts Engineering and Production stages, inception phase, elaboration phase, construction phase, transition phase, artifact sets, management artifacts, engineering artifacts and pragmatic artifacts, model-based software architectures.

**UNIT III SOFTWARE PROCESSES PLANNING 9**

Workflows and Checkpoints of process Software process workflows, Iteration workflows, Major milestones, minor milestones, periodic status assessments. Process Planning Work breakdown structures, Planning guidelines, cost and schedule estimating process, iteration planning process, Pragmatic planning.

**UNIT IV PROJECT MANAGEMENT AND METRICS 9**

Project Organizations Line-of- business organizations, project organizations, evolution of organizations, process automation. Project Control and process instrumentation The seven-core metrics, management indicators, quality indicators, life-cycle expectations, Pragmatic software metrics, metrics automation.

**UNIT V UNIT TITLE 9**

CCPDS-R Case Study and Future Software Project Management Practices Modern Project Profiles, Next-Generation software Economics, Modern Process Transitions.

**OUTCOMES:**

- CO1: Understand the software process phases in the cycle of software development.
- CO2: Gain knowledge of software economics, project organization, project control and process instrumentation
- CO3: Analyze the major and minor milestones, artifacts and metrics from management and technical perspective.
- CO4: Design and develop software product using conventional and modern principles of software project management
- CO5: Analyze the real time software development processes.

**TOTAL:45 PERIODS****TEXT BOOKS:**

1. Managing the Software Process, Watts S. Humphrey, Pearson Education
2. Software Project Management, Walker Royce, Pearson Education



## REFERENCES:

1. An Introduction to the Team Software Process, Watts S. Humphrey, Pearson Education, 2000 Process Improvement essentials, James R. Persse, O'Reilly, 2006
2. Software Project Management, Bob Hughes & Mike Cotterell, fourth edition, TMH, 2006
3. Applied Software Project Management, Andrew Stellman & Jennifer Greene, O'Reilly, 2006.
4. Head First PMP, Jennifer Greene & Andrew Stellman, O'Reilly, 2007
5. Software Engineering Project Management, Richard H. Thayer & Edward Yourdon, 2 nd edition, Wiley India, 2004.
6. Agile Project Management, Jim Highsmith, Pearson education, 2004.

AD8002

## HEALTH CARE ANALYSIS

L T P C  
3 0 0 3

### OBJECTIVES:

- 1: Understand the health data formats, health care policy and standards
- 2: Learn the significance and need of data analysis and data visualization
- 3: Understand the health data management frameworks
- 4: Learn the use of machine learning and deep learning algorithms in healthcare
- 5: Apply healthcare analytics for critical care applications

### UNIT I INTRODUCTION TO HEALTHCARE ANALYSIS 9

Overview - History of Healthcare Analysis Parameters on medical care systems- Health care policy- Standardized code sets – Data Formats – Machine Learning Foundations: Tree Like reasoning , Probabilistic reasoning and Bayes Theorem, Weighted sum approach.

### UNIT II ANALYTICS ON MACHINE LEARNING 9

Machine Learning Pipeline - Pre-processing -Visualization - Feature Selection - Training model parameter - Evaluation model : Sensitivity , Specificity , PPV ,NPV, FPR ,Accuracy , ROC , Precision Recall Curves , Valued target variables -Python: Variables and types, Data Structures and containers , Pandas Data Frame :Operations - Scikit -Learn : Pre-processing , Feature Selection.

### UNIT III HEALTH CARE MANAGEMENT 9

IOT- Smart Sensors - Migration of Healthcare Relational database to NoSQL Cloud Database - Decision Support System - Matrix block Cipher System - Semantic Framework Analysis - Histogram bin Shifting and Rc6 Encryption - Clinical Prediction Models - Visual Analytics for Healthcare.

### UNIT IV HEALTHCARE AND DEEP LEARNING 9

Introduction on Deep Learning - DFF network CNN- RNN for Sequences - Biomedical Image and Signal Analysis - Natural Language Processing and Data Mining for Clinical Data - Mobile Imaging and Analytics - Clinical Decision Support System.

### UNIT V CASE STUDIES 9

Predicting Mortality for cardiology Practice -Smart Ambulance System using IOT -Hospital Acquired Conditions (HAC) program- Healthcare and Emerging Technologies – ECG Data Analysis.

**OUTCOMES:**

- CO1: Use machine learning and deep learning algorithms for health data analysis
- CO2: Apply the data management techniques for healthcare data
- CO3: Evaluate the need of healthcare data analysis in e-healthcare, telemedicine and other critical care applications
- CO4: Design health data analytics for real time applications
- CO5: Design emergency care system using health data analysis

**TOTAL:45 PERIODS****REFERENCES:**

1. Chandan K.Reddy, Charu C. Aggarwal, "Health Care data Analysis", First edition, CRC, 2015.
2. Vikas Kumar, "Health Care Analysis Made Simple", Packt Publishing, 2018.
3. Nilanjan Dey, Amira Ashour , Simon James Fong, Chintan Bhatl, "Health Care Data Analysis and Management, First Edition, Academic Press, 2018.
4. Hui Jang, Eva K.Lee, "HealthCare Analysis : From Data to Knowledge to Healthcare Improvement", First Edition, Wiley, 2016.
5. Kulkarni , Siarry, Singh ,Abraham, Zhang, Zomaya , Baki, "Big Data Analytics in HealthCare", Springer, 2020.

**AD8003****MOBILE APPLICATIONS DEVELOPMENT****L T P C  
3 0 0 3****OBJECTIVES:**

1. Understand system requirements for mobile applications
2. Generate suitable design using specific mobile development frameworks
3. Generate mobile application design
4. Implement the design using specific mobile development frameworks
5. Deploy the mobile applications in marketplace for distribution

**UNIT I INTRODUCTION TO MOBILE APPLICATIONS****9**

Web Vs mobile App - Cost of Development - Myths - Mobile Applications - Marketing - Mobile User Interface Design - Effective Use of Screen - Mobile Users - Mobile Information Design - Mobile Platforms - Tools of Mobile Interface Design

**UNIT II ANDROID USER INTERFACE DESIGN****9**

Android Architecture - Android SDK Tools - Application Components - Intents - Content providers - Broadcast receivers - Services - User Interface Design - Views - View Groups - Layouts - Event Handling - Listeners - Adapters - Menus - Action Bars - Notifications - Android Localization

**UNIT III ANDROID DATA STORAGE****9**

Content Providers - Uri - CRUD access -Browser - CallLog - Contacts - Media Store - Data Access and Storage - Shared Preferences - Storage External - Network Connection - SQLite Databases

**UNIT IV ANDROID NATIVE CAPABILITIES****9**

Camera - Audio - Sensors and Bluetooth - Playing audio/video - Media recording - Sensors - Listening to sensor readings - Bluetooth - Android Communications - GPS - Working with

Location Manager, Working with Google Maps extensions - Maps via intent - Map Activity - Location based Services - Location Updates - Location Providers - Selecting a Location Provider - Finding Location

**UNIT V IOS DESIGN 9**

iPhone Craze - iOS Features - iOS Tools - iOS Project - Objective C Basics - Building iOS App - Actions and Outlets - Delegates - User Interface Elements - Accelerometer - Location Handling - SQLite Database

**OUTCOMES:**

- CO1:** Describe the requirements for mobile applications
- CO2:** Design user interface for mobile applications
- CO3:** Store mobile data of android applications
- CO4:** Evaluate native capabilities of android applications
- CO5:** Design iOS applications with tools

**TOTAL:45 PERIODS**

**REFERENCES:**

1. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012.
2. Reto Meier, "Professional Android 4 Development", John Wiley and Sons, 2012.
3. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS 6 Development: Exploring the iOS SDK", Apress, 2013.

**AD8004**

**PARALLEL COMPUTING**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- 1:** To understand different parallelism techniques.
- 2:** To know parallel architecture.
- 3:** To learn about parallel algorithm design
- 4:** Understand parallel programming
- 5:** Learn about the interpretation of parallel programming

**UNIT I INTRODUCTION 9**

Historical progression leading to current state - types of parallelism including temporal, data and functional. Instructional level parallelism - pipelined processors - super scalar processors - VLIW processors - multithreaded processors - proposed future processors including trace, multiscalar and super flow - case studies

**UNIT II PARALLEL ARCHITECTURES 9**

Classification - inter connection networks - vector computers - shared memory parallel computers - cache coherence - distributed shared memory parallel computers - message passing parallel computers - cluster of workstations.

**UNIT III PARALLEL ALGORITHMS PLATFORM 9**

Preliminaries - decomposition techniques - characteristics of tasks and interactions - mapping techniques for load balancing - methods for containing interaction overheads - parallel algorithm models.

**UNIT IV PARALLEL PROGRAMMING DESGN 9**

Trends in microprocessor architectures - limitations of memory system performance - parallel computing platforms - communication costs in parallel machines - routing mechanisms for interconnection networks.

**UNIT V COMPILER TRANSFORMATIONS AND PERFORMANCE EVALUATION 9**

Dependence analysis loop transformations - transformations for parallel computers including data layouts, computational and communication optimization. Performance Metrics -performance lows - scalability - performance measurement books.

**OUTCOMES:**

- CO1:** Understand different parallel computing technique
- CO2:** Learn parallel computing architecture
- CO3:** Learn to design parallel algorithms
- CO4:** Understand how to develop parallel program
- CO5:** Know compiler interpretation of parallel programming

**TOTAL:45 PERIODS**

**TEXT BOOKS:**

1. V. Rajaraman and C. Siva Ram Murthy, "Parallel Computers – Architecture and Programming", Prentice-Hall of India, 2003.
2. Ananth Grama, Anshul gupta, George Karypis and Vipin Kumar, "Introduction to Parallel Computing", Pearson Education, Second edition, 2004.

**REFERENCES:**

1. Selim G.Akl - The design and analysis of parallel algorithms - Prentice Hall International Inc, 1989.
2. Hwang K. Briggs F.A. - Computer Architecture and parallel processing - MCGraw Hill - 1985
3. Shameem Akhter and Jason Roberts, "Multi-core Programming", Intel Press, 2006.

**AD 8005 EMBEDDED SYSTEMS AND PROGRAMMING L T P C  
3 0 0 3**

**OBJECTIVES:**

- To understand the architecture of embedded processors, microcontrollers and peripheral devices
- To learn programming the embedded processor in assembly
- To understand the challenges in developing operating systems for embedded systems
- To learn programming the embedded systems in high level language such as C
- To understand the Real time operating systems

**UNIT I INTRODUCTION TO EMBEDDED SYSTEM 9**

Components of Embedded System – Classification - Characteristic of embedded system- Microprocessors & Micro controllers- Introduction to embedded processors - Embedded software architectures: Simple control loop - Interrupt controlled system - Cooperative multitasking - Preemptive multitasking or multi-threading - Micro kernels and kernels - Monolithic kernels - Exotic custom operating systems.

|  |                                       |          |
|--|---------------------------------------|----------|
| <b>UNIT II</b>   | <b>EMBEDDED HARDWARE ARCHITECTURE</b> | <b>9</b> |
| ARM 2 TDMI core based 32 Bitmicrocontrollers and family of processors, Register, Memory and Data transfer, Arithmetic and Logic instructions, Assembly Language, I/O operations interrupt structure, ARM cache. ARMBus, Embedded systems with ARM.   |                                       |          |
| <b>UNIT III</b>  | <b>REAL TIME OPERATING SYSTEMS</b>    | <b>9</b> |
| Tasking Models, Task States, Services and Transitions - Real- Time Scheduling Algorithms: Round-Robin, FIFO, Priority-Based Preemptive Scheduling - Rate-Monotonic Scheduling - Priority Inversion and Priority Ceiling - Deadlocks - Process Synchronization - IPC - Shared Memory, Memory Locking, Memory Allocation - Signals - Semaphore Flag or mutex as Resource key - Message Queues - Mailboxes - Pipes - Virtual Sockets. |                                       |          |
| <b>UNIT IV</b>   | <b>SOFTWARE DEVELOPMENT</b>           | <b>9</b> |
| Embedded Programming in C and C++ - Source Code Engineering Toolsfor Embedded C/C++ - Program Modeling Concepts in Single and Multiprocessor Systems - Software Development Process - Software Engineering Practices in the Embedded Software Development - Hardware / Software Co-design in an Embedded System  |                                       |          |
| <b>UNIT V</b>  | <b>STUDY OF MICRO C/OS-II</b>         | <b>9</b> |
| RTOS System Level Functions - Task Service Functions Time Delay Functions - Memory Allocation Related Functions - Semaphore Related Functions Mailbox Related Functions - Queue Related Functions – Case Studies of Programming withRTOS.  |                                       |          |

**OUTCOMES:**

- CO1:** Understand the embedded systems
- CO2:** Learn the embedded systems Architecture
- CO3:** Understand the embedded systems programming
- CO4:** Learn about the real time operating systems
- CO5:** Understand the concept on micro C

**TOTAL:45 PERIODS**

**TEXT BOOKS:**

1. Rajkamal, "Embedded System: Architecture, Programming and Design" Tata McGraw- Hill, 2003.
2. Wayne Wolf, "Computers as Components - Principles of Embedded Computing System Design", Harcourt India Pvt. Ltd., Morgan Kaufmann Publishers, First Indian Reprint, 2001.

**REFERENCES:**

1. Steve Heath, "Embedded Systems Design", Newnes, Second edition, 2003.
2. Noergaard, "Embedded System Architecture", Elsevier India Private Limited, 2005
3. Sriram Iyer and Pankaj Gupta, "Embedded Real Time Systems Programming", Tata McGraw-Hill, 2004.

**CW8591**

**SOFTWARE ARCHITECTURE**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- Understand the fundamentals of software architecture.
- Study the various software development methodologies.
- Learn the importance of architectural documentation and evaluation.
- Learn the various software architecture design components.
- Relate software architecture and software quality.

|  |   |          |
|--|---|----------|
| <b>UNIT I</b>  | <b>INTRODUCTION</b>   | <b>9</b> |
| Basic concepts of software architecture - Context of Software Architecture - ABC cycle - What software architecture is and what it isn't - Architectural patterns - Good Architecture- Reference models - Architectural structures and views-Introduction to styles - Decentralized Architectures  |   |          |
| <b>UNIT II</b>   | <b>DESIGN METHODOLOGIES</b>                                   | <b>9</b> |
| Structured design- Design practices-Stepwise refinement - Incremental design- Structured system analysis and design -Jackson structured programming - Jackson system Development.  |   |          |
| <b>UNIT III</b>  | <b>ARCHITECTURAL DESCRIPTION DOCUMENTATION AND EVALUATION</b> | <b>9</b> |
| Early architecture description languages-Domain and style specific ADL's- Extensible ADL's - Documenting software architecture - Uses and Audiences for Architecture Documentation - Views - Choosing Views - Combining Views -Architecture evaluation - Evaluation Factors - Architecture Tradeoff Analysis Method - Lightweight Architecture Evaluation - ATAM.  |   |          |
| <b>UNIT IV</b>   | <b>ARCHITECTURE DESIGN</b>                                    | <b>9</b> |
| Typical architectural design-Dataflow-Independent components-Call and return - Using styles in design - Architectural design space-Design space of architectural elements - Design space of architectural styles.  |   |          |
| <b>UNIT V</b>  | <b>IMPLEMENTATION AND CONFORMANCE TO ARCHITECTURE</b>         | <b>9</b> |
| Understanding quality attributes- Implementation of Quality attributes in Architecture - Architecture and requirements conformance -Functionality- Quality attribute considerations - System quality attributes-Introduction to tactics - Achieving Quality Attributes through Tactics - Tactics types -Architectural patterns and styles - Architecture and Quality Attributes - Quality attribute scenarios in practice. |   |          |

**OUTCOMES:**

**Upon Completion of the course, the students should be able to:**

- Develop Software applications starting from software architecture and design.
- Learn and evaluate existing software architectures.
- Realize importance of architectural documentation and document them.
- Employ various software architecture design components.
- Design methods for improving software quality from the perspective of software architecture.

**TOTAL:45 PERIODS**

**TEXT BOOKS:**

1. Len Bass, Paul Clements, Rick Kazman, "Software Architecture in Practice", Third Edition, Addison,Wesley, 2012.
2. David Budgen, "Software Design", Second Edition, Pearson Education, 2004.

**REFERENCES:**

1. Richard N.Taylor, NenadMedvidovic and Eric M.Dashofy, "Software Architecture, Foundations,Theory and Practice", Wiley 2010.
2. Hong Zhu, "Software Design Methodology from Principles to Architectural Styles", Elsevier, 2005.

3. Mary Shaw and David Garlan, "Software Architecture -Perspectives on an emerging Discipline", Pearson Education, 2008.

|               |  |          |          |          |          |
|---------------|--|----------|----------|----------|----------|
| <b>AD8006</b> | <b>ENGINEERING PREDICTIVE ANALYSIS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To explain terminology, technology and applications of predictive analysis
- To apply data preparation techniques and generate appropriate association rules.
- To discuss various descriptive models, their merits, demerits and application.
- To describe various predictive modelling methods.
- To introduce the text mining tools, technologies and case study which is used in day-to-day analytics cycle

**UNIT I INTRODUCTION TO PREDICTIVE ANALYTICS 9**

Overview of Predictive Analytics- Setting Up the Problem - Data Understanding- Single Variable- Data Visualization in One Dimension- Data Visualization, Two or Higher Dimensions- The Value of Statistical Significance- Pulling It All Together into a Data Audit.

**UNIT II DATA PREPARATION AND ASSOCIATION RULES 9**

Data Preparation- Variable Cleaning- Feature Creation- Item sets and Association Rules- Terminology- Parameter Settings- How the Data Is Organized- Measures of Interesting Rules- Deploying Association Rules- Problems with Association Rules- Building Classification Rules from Association Rules.

**UNIT III MODELLING 9**

Descriptive Modeling- Data Preparation Issues with Descriptive Modeling- Principal Component Analysis- Clustering Algorithms- Interpreting Descriptive Models- Standard Cluster Model Interpretation

**UNIT IV PREDICTIVE MODELLING 9**

Decision Trees- Logistic Regression -Neural Network Model - K-Nearest Neighbours - Naive Bayes - Regression Models - Linear Regression - Other Regression Algorithms.

**UNIT V TEXT MINING 9**

Motivation for Text Mining- A Predictive Modeling Approach to Text Mining- Structured vs. Unstructured Data- Why Text Mining Is Hard- Data Preparation Steps- Text Mining Features- Modeling with Text Mining Features- Regular Expressions- Case Studies:- Survey Analysis.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of this course, the students will be able to:**

- CO1: Explain terminology, technology and applications of predictive analysis  
 CO2: Apply data preparation techniques to effectively interpret big data  
 CO3: Discuss various descriptive models, their merits, demerits and application.  
 CO4: Describe principles of predictive analytics and apply them to achieve real, pragmatic

solutions.

CO5: Illustrate the features and applications of text mining.

#### REFERENCES:

1. Dean Abbott, "Applied Predictive Analytics-Principles and Techniques for the Professional Data Analyst", Wiley, 2014
2. Jiawei Han and Micheline Kamber, Data Mining Concepts and Techniques, Third Edition, Elsevier, 2012.
3. Conrad Carlberg, "Predictive Analytics: Microsoft Excel", 1st Edition, Que Publishing, 2012.
4. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani. An Introduction to Statistical Learning with Applications in R Springer 2013
5. Alberto Cordoba, "Understanding the Predictive Analytics Lifecycle", Wiley, 2014
6. Anasse Bari, Mohammad Chaouchi, Tommy Jung, Predictive Analytics for Dummies, 2nd Edition, 2017.

CS8603

### DISTRIBUTED SYSTEMS

L T P C  
3 0 0 3

#### OBJECTIVES:

- To understand the foundations of distributed systems.
- To learn issues related to clock Synchronization and the need for global state in distributed systems.
- To learn distributed mutual exclusion and deadlock detection algorithms.
- To understand the significance of agreement, fault tolerance and recovery protocols in Distributed Systems.
- To learn the characteristics of peer-to-peer and distributed shared memory systems.

#### UNIT I Introduction 9

**Introduction:** Definition -Relation to computer system components -Motivation -Relation to parallel systems - Message-passing systems versus shared memory systems -Primitives for distributed communication -Synchronous versus asynchronous executions -Design issues and challenges. **A model of distributed computations:** A distributed program -A model of distributed executions -Models of communication networks -Global state - Cuts -Past and future cones of an event -Models of process communications. **Logical Time:** A framework for a system of logical clocks -Scalar time -Vector time - Physical clock synchronization: NTP.

#### UNIT II MESSAGE ORDERING & SNAPSHOTS 9

**Message ordering and group communication:** Message ordering paradigms -Asynchronous execution with synchronous communication -Synchronous program order on an asynchronous system -Group communication - Causal order (CO) - Total order. **Global state and snapshot recording algorithms:** Introduction -System model and definitions -Snapshot algorithms for FIFO channels

#### UNIT III DISTRIBUTED MUTEX & DEADLOCK 9

**Distributed mutual exclusion algorithms:** Introduction - Preliminaries - Lamport's algorithm -



Ricart-Agrawala algorithm - Maekawa's algorithm - Suzuki-Kasami's broadcast algorithm.  
**Deadlock detection in distributed systems:** Introduction - System model - Preliminaries - Models of deadlocks - Knapp's classification - Algorithms for the single resource model, the AND model and the OR model.

**UNIT IV RECOVERY & CONSENSUS 9**

**Checkpointing and rollback recovery:** Introduction - Background and definitions - Issues in failure recovery - Checkpoint-based recovery - Log-based rollback recovery - Coordinated checkpointing algorithm - Algorithm for asynchronous checkpointing and recovery. **Consensus and agreement algorithms:** Problem definition - Overview of results - Agreement in a failure-free system - Agreement in synchronous systems with failures.

**UNIT V P2P & DISTRIBUTED SHARED MEMORY 9**

**Peer-to-peer computing and overlay graphs:** Introduction - Data indexing and overlays - Chord - Content addressable networks - Tapestry. **Distributed shared memory:** Abstraction and advantages - Memory consistency models - Shared memory Mutual Exclusion.

**OUTCOMES:**

**At the end of this course, the students will be able to:**

- Elucidate the foundations and issues of distributed systems
- Understand the various synchronization issues and global state for distributed systems.
- Understand the Mutual Exclusion and Deadlock detection algorithms in distributed systems
- Describe the agreement protocols and fault tolerance mechanisms in distributed systems.
- Describe the features of peer-to-peer and distributed shared memory systems

**TOTAL:45 PERIODS**

**TEXT BOOKS:**

1. Kshemkalyani, Ajay D., and Mukesh Singhal. Distributed computing: principles, algorithms, and systems. Cambridge University Press, 2011.
2. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", Fifth Edition, Pearson Education, 2012.

**REFERENCES:**

1. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", Prentice Hall of India, 2007.
2. Mukesh Singhal and Niranjan G. Shivaratri. Advanced concepts in operating systems. McGraw-Hill, Inc., 1994.
3. Tanenbaum A.S., Van Steen M., "Distributed Systems: Principles and Paradigms", Pearson Education, 2007.
4. Liu M.L., "Distributed Computing, Principles and Applications", Pearson Education, 2004.
5. Nancy A Lynch, "Distributed Algorithms", Morgan Kaufman Publishers, USA, 2003.



- Develop techniques and tools for improving team collaboration and software quality.
- Perform Software process improvement as an ongoing task for development teams.
- Show how agile approaches can be scaled up to the enterprise level.

#### **TEXT BOOKS:**

1. David J. Anderson and Eli Schragenheim, “Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results”, Prentice Hall, 2003.
2. Hazza and Dubinsky, “Agile Software Engineering, Series: Undergraduate Topics in Computer Science”, Springer, 2009.

#### **REFERENCES:**

1. Craig Larman, “Agile and Iterative Development: A Manager’s Guide”, Addison-Wesley, 2004.
2. Kevin C. Desouza, “Agile Information Systems: Conceptualization, Construction, and Management”, Butterworth-Heinemann, 2007.

**CS8081**

**INTERNET OF THINGS**

**L T P C  
3 0 0 3**

#### **OBJECTIVES:**

- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

#### **UNIT I FUNDAMENTALS OF IoT**

**9**

Evolution of Internet of Things - Enabling Technologies - IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models - Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

#### **UNIT II IoT PROTOCOLS**

**9**

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition - Application Layer Protocols: CoAP and MQTT

#### **UNIT III DESIGN AND DEVELOPMENT**

**9**

Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.

#### **UNIT IV DATA ANALYTICS AND SUPPORTING SERVICES**

**9**

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest - Role of Machine Learning - No SQL Databases - Hadoop Ecosystem - Apache Kafka, Apache Spark - Edge Streaming Analytics and Network Analytics - Xively Cloud for IoT, Python Web Application Framework - Django - AWS for IoT - System Management with NETCONF-YANG

**UNIT V CASE STUDIES/INDUSTRIAL APPLICATIONS****9**

Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – GridBlocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control

**TOTAL : 45 PERIODS****OUTCOMES:****Upon completion of the course, the student should be able to:**

- Explain the concept of IoT.
- Analyze various protocols for IoT.
- Design a PoC of an IoT system using Rasperry Pi/Arduino
- Apply data analytics and use cloud offerings related to IoT.
- Analyze applications of IoT in real time scenario

**TEXTBOOK:**

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017

**REFERENCES:**

1. Arshdeep Bahga, Vijay Madiseti, "Internet of Things – A hands-on approach", Universities Press, 2015
2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things - Key applications and Protocols", Wiley, 2012 (for Unit 2).
3. Jan Ho" ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
5. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2<sup>nd</sup> Edition, O'Reilly Media, 2011.

<https://www.arduino.cc/>

[https://www.ibm.com/smarterplanet/us/en/?ca=v\\_smarterplanet](https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet)

|               |   |          |          |          |          |
|---------------|---|----------|----------|----------|----------|
| <b>AD8007</b> | <b>SOFTWARE TESTING AND QUALITY ASSURANCE</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To understand the basics of testing, planning, designing and managing test cases.
- To study the various types of test in the life cycle of the software product.
- To build design concepts for system testing and execution.
- To learn the software quality assurance ,metrics, defect prevention techniques
- To learn the techniques for quality assurance and applying for applications.

**UNIT I SOFTWARE TESTING - CONCEPTS, ISSUES, AND TECHNIQUES 9**

Quality Revolution, Verification and Validation, Failure, Error, Fault, and Defect, Objectives of Testing, Testing Activities, Test Case Selection White-Box and Black, test Planning and design, Test Tools and Automation, Power of Test. Test Team Organization and Management-Test Groups, Software Quality Assurance Group, System Test Team Hierarchy, Team Building

**UNIT II SYSTEM TESTING 9**

System Testing - System Integration Techniques-Incremental, Top Down Bottom Up Sandwich and Big Bang, Software and Hardware Integration, Hardware Design Verification Tests, Hardware and Software Compatibility Matrix Test Plan for System Integration. Built- in Testing. Functional testing - Testing a Function in Context. Boundary Value Analysis, Decision Tables. acceptance testing - Selection of Acceptance Criteria, Acceptance Test Plan, Test Execution Test. software reliability - Fault and Failure, Factors Influencing Software, Reliability Models

**UNIT III SYSTEM TEST CATEGORIES 10**

System test categories Taxonomy of System Tests, Interface Tests Functionality Tests. GUI Tests, Security Tests Feature Tests, Robustness Tests, Boundary Value Tests Power Cycling Tests Interoperability Tests, Scalability Tests, Stress Tests, Load and Stability Tests, Reliability Tests, Regression Tests, Regulatory Tests. Test Generation from FSM models- State-Oriented Model. Finite-State Machine Transition Tour Method, Testing with State Verification. Test Architectures-Local, distributed, Coordinated, Remote system test design- Test Design Factors Requirement Identification, modeling a Test Design Process Test Design Preparedness, Metrics, Test Case Design Effectiveness. System test execution- Modeling Defects, Metrics for Monitoring Test Execution .Defect Reports, Defect Causal Analysis, Beta testing, measuring Test Effectiveness.

**UNIT IV SOFTWARE QUALITY 8**

Software quality - People's Quality Expectations, Frameworks and ISO-9126, McCall's Quality Factors and Criteria – Relationship. Quality Metrics. Quality Characteristics ISO 9000:2000 Software Quality Standard. Maturity models- Test Process Improvement, Testing Maturity Model.

**UNIT V SOFTWARE QUALITY ASSURANCE 9**

Quality Assurance - Root Cause Analysis, modeling, technologies, standards and methodologies for defect prevention. Fault Tolerance and Failure Containment - Safety Assurance and Damage Control, Hazard analysis using fault-trees and event-trees. Comparing Quality Assurance Techniques and Activities. QA Monitoring and Measurement, Risk Identification for Quantifiable Quality Improvement. Case Study: FSM-Based Testing of Web-Based Applications.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**AT THE END OF THE COURSE, LEARNERS WILL BE ABLE TO:**

- Perform functional and non-functional tests in the life cycle of the software product.
- Understand system testing and test execution process.
- Identify defect prevention techniques and software quality assurance metrics.
- Apply techniques of quality assurance for typical applications.

**TEXT BOOKS:**

1. Software Testing And Quality Assurance-Theory and Practice, Kshirasagar Naik, Priyadarshi Tripathy, John Wiley & Sons Inc,2008

2. Software Quality Assurance - From Theory to Implementation, Daniel Galin, Pearson Education Ltd UK, 2004

**REFERENCES:**

1. Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement, Jeff Tian, John Wiley & Sons, Inc., Hoboken, New Jersey. 2005.
2. Software Quality Assurance, Milind Limaye, TMH ,New Delhi, 2011
3. Aditya P. Mathur, “Foundations of Software Testing \_ Fundamental Algorithms and Techniques”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

**CS8791**

**CLOUD COMPUTING**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To understand the concept of cloud computing.
- To appreciate the evolution of cloud from the existing technologies.
- To have knowledge on the various issues in cloud computing.
- To be familiar with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.

**UNIT I INTRODUCTION 9**

Introduction to Cloud Computing - Definition of Cloud - Evolution of Cloud Computing - Underlying Principles of Parallel and Distributed Computing - Cloud Characteristics - Elasticity in Cloud - On-demand Provisioning

**UNIT II CLOUD ENABLING TECHNOLOGIES 9**

Service Oriented Architecture - REST and Systems of Systems - Web Services - Publish-Subscribe Model - Basics of Virtualization - Types of Virtualization - Implementation Levels of Virtualization - Virtualization Structures - Tools and Mechanisms - Virtualization of CPU - Memory - I/O Devices -Virtualization Support and Disaster Recovery.

**UNIT III CLOUD ARCHITECTURE, SERVICES AND STORAGE 9**

Layered Cloud Architecture Design - NIST Cloud Computing Reference Architecture - Public, Private and Hybrid Clouds - IaaS - PaaS - SaaS - Architectural Design Challenges - Cloud Storage - Storage-as-a-Service - Advantages of Cloud Storage - Cloud Storage Providers - S3.

**UNIT IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9**

Inter Cloud Resource Management - Resource Provisioning and Resource Provisioning Methods - Global Exchange of Cloud Resources - Security Overview - Cloud Security Challenges - Software-as-a-Service Security - Security Governance - Virtual Machine Security - IAM - Security Standards.

**UNIT V CLOUD TECHNOLOGIES AND ADVANCEMENTS 9**

Hadoop - MapReduce - Virtual Box -- Google App Engine - Programming Environment for Google App Engine – Open Stack - Federation in the Cloud - Four Levels of Federation - Federated Services and Applications - Future of Federation.

## OUTCOMES:

On Completion of the course, the students should be able to:

- Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
- Learn the key and enabling technologies that help in the development of cloud.
- Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
- Explain the core issues of cloud computing such as resource management and security.
- Be able to install and use current cloud technologies.
- Evaluate and choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

**TOTAL:45 PERIODS**

## TEXT BOOKS:

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. Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, Management and Security", CRC Press, 2017.

## REFERENCES:

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach", Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)", O'Reilly, 2009.

**CS8085**

**SOCIAL NETWORK ANALYTICS**

**L T P C**  
**3 0 0 3**

## OBJECTIVES:

- To understand the concept of semantic web and related applications.
- To learn knowledge representation using ontology.
- To understand human behaviour in social web and related communities.
- To learn visualization of social networks.

## UNIT I INTRODUCTION

**9**

Introduction to Semantic Web: Limitations of current Web - Development of Semantic Web - Emergence of the Social Web - Social Network analysis: Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities - Web-based networks - Applications of Social Network Analysis.

## UNIT II MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION

**9**

Ontology and their role in the Semantic Web: Ontology-based knowledge Representation - Ontology languages for the Semantic Web: Resource Description Framework - Web Ontology Language - Modelling and aggregating social network data: State-of-the-art in network data representation - Ontological representation of social individuals - Ontological representation of





**OBJECTIVES:**

1. To understand the types of web services, resources, APIs and their architectures
2. To analyze the web service / API design patterns
3. To understand the design principles and best practices
4. To develop, deploy RESTful web service APIs in JAVA
5. To understand the security concerns.

9

**INTRODUCTION****UNIT I**

Web Services - Building Blocks, Types; Service Oriented architectures - resource oriented architectures, API architectures, Micro services and architectures, HATEOAS, REST, URI, Code on Demand.

**UNIT II RESOURCES AND DESIGN PATTERNS**

9

Resources - Identification, Resource Relations, Representations, Parameters, types, methods, Requirements for APIs, Architectural Patterns. Basic and Advanced RESTful API patterns.

**UNIT III RESTFUL API DESIGN PRINCIPLES**

9

API front End Design, API back end Design, Identifier Design, Interaction Design with HTTP, Metadata Design, Representation Design, URI design, REST constraints, Best Practices.

**UNIT IV DEVELOPMENT AND DEPLOYMENT**

9

Frameworks, Standard Languages, API Description Languages, Handover points, Development and Deployment of RESTful web service applications in Java, microservice API, Best Practices.

**UNIT V PERFORMANCE AND SECURITY**

9

Performance and availability - caching - Traffic shaping - Evolution and versioning, Security concerns - Mechanisms, Authentication, Validation, Access Control, Token Based Authentication, Authorization.

**OUTCOMES:**

At the end of the course, the student should be able to:

- Use a suitable architecture for a given design problem
- Analyze the types of resources and suitable design patterns for development and deployment
- Create and Analyze front-end and Back end designs
- Deploy RESTful API web services using JAVA
- Implement security best practices for preventing security attacks

**TOTAL:45 PERIODS****TEXT BOOK:**

1. Matthias Biehl, "RESTful API Design, API University Series, 1st Edition, CreateSpace Independent Publishing Platform, 2016.
2. Mark Masse, "REST API Design Rulebook: Designing Consistent RESTful Web Service Interfaces", 1st Edition, O' Reilly, 2011.
3. Harihara Subramanian, Pethuru Raj, "Hands-On RESTful API Design Patterns and Best Practices: Design, develop, and deploy highly adaptable, scalable, and secure "RESTful web APIs", Packt Publishing, 2019.

**REFERENCES:**

1. JJ Geewax, "API Design Patterns", 1st Edition, Manning Publications, 2021.
2. Bogunuva Mohanram Balachandar, "Restful Java Web Services: A pragmatic guide to designing and building RESTful APIs using Java, 3rd Edition, Ingram Short Title, 2017.

|               |   |          |          |          |          |
|---------------|---|----------|----------|----------|----------|
| <b>AD8009</b> | <b>OPERATIONS AND SUPPLY CHAIN MANAGEMENT</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To provide an insight on the operations, quality management and sampling tools and fundamentals of supply chain networks, tools and techniques

|               |   |          |
|---------------|---|----------|
| <b>UNIT I</b> | <b>INTRODUCTION TO OPERATIONS AND SUPPLY CHAIN MANAGEMENT</b> | <b>9</b> |
|---------------|---|----------|

Scope and Importance- Evolution of Supply Chain - Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles - The Operations Function - The Evolution of Operations and Supply Chain Management - Globalization - Productivity and Competitiveness - Strategy and Operations-Operational Decision-Making Tools: Decision Analysis-Decision Analysis with and without Probabilities

|                |                           |          |
|----------------|---------------------------|----------|
| <b>UNIT II</b> | <b>QUALITY MANAGEMENT</b> | <b>9</b> |
|----------------|---------------------------|----------|

Quality and Value in Athletic Shoes -What Is Quality-Quality Management System-Quality Tools-Quality in Services-Six Sigma-Quality Costs and Productivity-Quality Awards-ISO 9000-Statistical Process Control-Operational Decision-Making Tools: Acceptance Samp

|                 |  |          |
|-----------------|--|----------|
| <b>UNIT III</b> | <b>NETWORK DESIGN AND TRANSPORTATION</b> | <b>9</b> |
|-----------------|--|----------|

Factors influencing Distribution network design - Design options for Distribution Network-- factors affecting transportations decision – Design option for transportation network – Tailored transportation - Routing and scheduling in transportation

|                |                                  |          |
|----------------|----------------------------------|----------|
| <b>UNIT IV</b> | <b>SOURCING AND COORDINATION</b> | <b>9</b> |
|----------------|----------------------------------|----------|

Role of sourcing supply chain - supplier selection assessment and contracts- Design collaboration - sourcing planning and analysis - supply chain co-ordination - Bull whip effect - Effect of lack of co-ordination in supply chain and obstacles - Building strategic partnerships and trust within a supply chain.

|               |  |          |
|---------------|--|----------|
| <b>UNIT V</b> | <b>SUPPLY CHAIN AND INFORMATION TECHNOLOGY</b> | <b>9</b> |
|---------------|--|----------|

The role IT in supply chain- The supply chain IT frame work - Customer Relationship Management - Internal supply chain management - supplier relationship management - future of IT in supply chain – E-Business in supply chain.

**TOTAL:45 PERIODS****OUTCOMES:**

- To know about the operations and fundamentals of supply chain
- To understand the quality management tools and sampling process
- To understand the design factors and various design options of distribution networks in industries and the role of transportation and warehousing
- To understand the various sourcing decisions in supply chain





**UNIT II SECURITY IN OPERATING SYSTEM & NETWORKS 9**

Security in Operating Systems - Security in the Design of Operating Systems -Rootkit - Network security attack- Threats to Network Communications - Wireless Network Security - Denial of Service - Distributed Denial-of-Service.

**UNIT III DEFENCES: SECURITY COUNTER MEASURES 9**

Cryptography in Network Security - Firewalls - Intrusion Detection and Prevention Systems - Network Management - Databases - Security Requirements of Databases - Reliability and Integrity - Database Disclosure - Data Mining and Big Data.

**UNIT IV PRIVACY IN CYBERSPACE 9**

Privacy Concepts -Privacy Principles and Policies -Authentication and Privacy - Data Mining - Privacy on the Web - Email Security - Privacy Impacts of Emerging Technologies.

**UNIT V MANAGEMENT AND INCIDENTS 9**

Security Planning - Business Continuity Planning - Handling Incidents - Risk Analysis - Dealing with Disaster - Emerging Technologies - The Internet of Things - Economics - Electronic Voting - Cyber Warfare- Cyberspace and the Law - International Laws - Cyber crime - Cyber Warfare and Home Land Security.

**OUTCOMES:**

**After the completion of this course, students will be able to:**

- CO1: Explain the basic concepts of computer security
- CO2: Devise methods for Security in operating system & networks
- CO3: Differentiate the various security counter measures.
- CO4: Devise Privacy principles and policies
- CO5: Manage the Cyber space.

**TOTAL:45 PERIODS**

**TEXT BOOKS:**

1. Jan L.Harrington,"Network Security - A Practical Approach", Morgan Kaufmann Publishers -An Imprint of Elsevier, 2005,
2. William Stallings, "Cryptography and Network Security – Principles and Practice", Pearson Education Asia, Fourth Edition, 2005

**REFERENCES:**

1. Edward Amoroso, "Cyber Security", Silicon Press, 2006
2. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, Security in Computing, 5th Edition , Pearson Education , 2015
3. George K.Kostopoulous, Cyber Space and Cyber Security, CRC Press, 2013.
4. MarttiLehto, PekkaNeittaanmäki, Cyber Security: Analytics, Technology and Automation edited, Springer International Publishing Switzerland 2015
5. Nelson Phillips and EnfingerSteuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2009.

AD8012

**NONLINEAR OPTIMIZATION**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

1. To understand the role of optimization techniques and its importance in engineering
2. To introduce the concept of nonlinear optimization methods.
3. To realize the application of non-traditional optimization algorithms
4. To choose appropriate optimization method and solve real world problems.

**UNIT I CLASSICAL OPTIMIZATION TECHNIQUES 9**

Single variable optimization, Constrained and unconstrained multi-variable optimization, Direct substitution method, Lagrange's method of multipliers, Karush-Kuhn-Tucker conditions

**UNIT II NON-LINEAR PROGRAMMING: ONE-DIMENSIONAL MINIMIZATION METHOD 9**

Unimodal function, Unrestricted search, Exhaustive search, Dichotomous search, Interval halving method, Fibonacci method, Golden section method, Direct root methods

**UNIT III NON-LINEAR PROGRAMMING: UNCONSTRAINED OPTIMIZATION TECHNIQUES 9**

Direct Search Methods: Random search methods, Grid search method, Univariate method, Hookes and Jeeves' method, Powell's method Indirect Search Methods: Steepest descent method, Fletcher-Reeves method, Newton's method

**UNIT IV NON-LINEAR PROGRAMMING: CONSTRAINED OPTIMIZATION TECHNIQUES 9**

Direct Methods: Random search method, Sequential linear programming, Indirect methods: Transformation techniques, Exterior penalty function method, Interior penalty function method

**UNIT V ADVANCED NON-LINEAR OPTIMIZATION 9**

Genetic Algorithms -Working principle-Genetic operators-Numerical problem-Simulated Annealing – Numerical problem - Neural network based optimization-Optimization of fuzzy systems-fuzzy set theory-computational procedure

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of this course, the students will be able to:**

- Comprehend the need and applications of the optimization methods
- understand basic theoretical principles for formulation of optimization models and its solution.
- learn the unified and exact mathematical basis as well as the general principles of various soft computing techniques
- apply detailed theoretical and practical aspects of intelligent modelling, optimization and control of non-linear systems.

**REFERENCES:**

1. Engineering Optimization Theory and Practice, S.S.Rao, New Age International (P), 5<sup>th</sup> edition, 2019
2. C. B Gupta, Optimization Techniques in Operation Research, I.K. International House

Pvt.Ltd 2007.

3. Godfrey C. Onwubolu, B. V. Babu, New Optimization Techniques in Engineering, 2004
4. Cesar Lopez, MATLAB Optimization Techniques, 2014

**AD8013**

**ETHICS OF ARTIFICIAL INTELLIGENCE**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- 1: To understand the need for ensuring ethics in AI
- 2: To understand ethical issues with the development of AI agents
- 3: To apply the ethical considerations in different AI applications
- 4: To evaluate the relation of ethics with nature
- 5: To overcome the risk for Human rights and other fundamental values.

**UNIT I INTRODUCTION TO ETHICS OF AI 9**

Role of Artificial Intelligence in Human Life, Understanding Ethics, Why Ethics in AI? Ethical Considerations of AI, Current Initiatives in AI and Ethics, Ethical Issues with our relationship with artificial Entities

**UNIT II FRAMEWORK AND MODELS 9**

AI Governance by Human-right centered design, Normative models, Role of professional norms, Teaching Machines to be Moral

**UNIT III CONCEPTS AND ISSUES 9**

Accountability in Computer Systems, Transparency, Responsibility and AI. Race and Gender, AI as a moral right-holder

**UNIT IV PERSPECTIVES AND APPROACHES 9**

Perspectives on Ethics of AI, Integrating ethical values and economic value, Automating origination, AI a Binary approach, Machine learning values, Artificial Moral Agents

**UNIT V CASES AND APPLICATION 9**

Ethics of Artificial Intelligence in Transport, Ethical AI in Military, Biomedical research, Patient Care, Public Health, Robot Teaching, Pedagogy, Policy, Smart City Ethics

**OUTCOMES:**

- CO1: Understand the ethical issues in the development of AI agents  
CO2: Learn the ethical considerations of AI with perspectives on ethical values  
CO3: Apply the ethical policies in AI based applications and Robot development  
CO4: To implement the AI concepts to societal problems by adapting the legal concepts by securing fundamental rights.  
CO5: This study will help to overcome the evil genesis in the concepts of AI.

**TOTAL:45 PERIODS**

**REFERENCES**

1. Paula Boddington, "Towards a Code of Ethics for Artificial Intelligence", Springer, 2017
2. Markus D. Dubber, Frank Pasquale, Sunit Das, "The Oxford Handbook of Ethics of AI", Oxford University Press Edited book, 2020
3. S. Matthew Liao, "Ethics of Artificial Intelligence", Oxford University Press Edited





CO5: Understand the different Production and Marketing techniques used in the industries.

**TOTAL:45 PERIODS**

**TEXT BOOKS**

1. O.P. Khanna, 'Industrial Engineering and Management', Dhanpat Rai and Sons,201
2. R. Pannerselvam, 'Engineering Economics', Prentice Hall of India Pvt. Ltd,2014

**REFERENCES**

1. S.K. Jain, "Applied Economics for Engineers and Managers", Vikas Publications House, New Delhi, 1997.
2. Mote Paul, Gupta, "Managerial Economics" Tata Mc Graw Hill, 1987.
3. Joseph L. Massie, "Essentials of Management", Prentice-Hall of India, Third edition, 1979.

|               |  |          |          |          |          |
|---------------|--|----------|----------|----------|----------|
| <b>AD8081</b> | <b>COGNITIVE SCIENCE AND ANALYTICS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To explain cognitive computing and design principles.
- To distinguish between NLP and cognitive computing.
- To apply advanced analytics to cognitive computing.
- To discuss application of cognitive computing in business.
- To illustrate various applications of cognitive computing.

**UNIT I FOUNDATION & DESIGN PRINCIPLES 9**

Foundation of Cognitive Computing: cognitive computing as a new generation, the uses of cognitive systems, system cognitive, gaining insights from data, Artificial Intelligence as the foundation of cognitive computing, understanding cognition.

Design Principles for Cognitive Systems: Components of a cognitive system, building the corpus, bringing data into cognitive system, machine learning, hypotheses generation and scoring, presentation and visualization services.

**UNIT II NLP IN COGNITIVE SYSTEM 9**

Natural Language Processing in support of a Cognitive System: Role of NLP in a cognitive system, semantic web, Applying Natural language technologies to Business problems.

Representing knowledge in Taxonomies and Ontologies: Representing knowledge, Defining Taxonomies and Ontologies, knowledge representation, models for knowledge representation, implementation considerations.

**UNIT III BIG DATA Vs COGNITIVE COMPUTING 9**

Relationship between Big Data and Cognitive Computing: Dealing with human-generated data, defining big data, architectural foundation, analytical data warehouses, Hadoop, data in motion and streaming data, integration of big data with traditional data.

Applying Advanced Analytics to cognitive computing: Advanced analytics is on a path to cognitive computing, Key capabilities in advanced analytics, Using advanced analytics to create value, Impact of open source tools on advanced analytics.

**UNIT IV COGNITIVE COMPUTING IN BUSINESS 9**

The Business Implications of Cognitive Computing: Preparing for change, advantages of new disruptive models, knowledge meaning to business, difference with a cognitive systems approach, meshing data together differently, using business knowledge to plan for the future, answering business questions in new ways, building business specific solutions, making cognitive computing a reality, cognitive application changing the market- IBM Watson as a cognitive systems.

**UNIT V APPLICATIONS 9**

The process of building a cognitive application: Emerging cognitive platform, defining the objective, defining the domain, understanding the intended users and their attributes, questions and exploring insights, training and testing- Building a cognitive health care application- Smarter cities-Cognitive Computing in Government.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of this course, the students will be able to:**

- CO1: Explain cognitive computing and design principles.
- CO2: Distinguish between NLP and cognitive computing.
- CO3: Apply advanced analytics to cognitive computing.
- CO4: Discuss application of cognitive computing in business.
- CO5: Illustrate various applications of cognitive computing.

**REFERENCES:**

1. Judith H Hurwitz, Marcia Kaufman, Adrian Bowles, "Cognitive computing and Big Data Analytics", Wiley, 2015.
2. Vijay Raghvan, Venu Govindaraju, C.R. Rao, Cognitive Computing: Theory and Applications", by Elsevier publications, North Holland Publication, 1<sup>st</sup> Edition, 2016.
3. Bernadette Sharp (Author), Florence Sedes (Author), Wieslaw Lubaszewski (Author), Cognitive Approach to Natural Language Processing Hardcover, First Edition May 2017.
4. Arun Kumar Sangaiah, Arunkumar Thangavelu, et al., Cognitive Computing for Big Data Systems Over IoT: Frameworks, Tools and Applications: Lecture Notes on Data Engineering and Communications Technologies 1st edition 2018
5. Min Chen and Kai Hwang, Big-Data Analytics for Cloud, IoT and Cognitive Computing Wiley Publication, 1<sup>st</sup> Edition, 2017.
6. Mallick, Pradeep Kumar, Borah, Samarjeet," Emerging Trends and Applications in Cognitive Computing", IGI Global Publishers, 2019.

**MG8591**

**PRINCIPLES OF MANAGEMENT**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization.

|  |   |          |
|--|---|----------|
| <b>UNIT I</b>  | <b>INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS</b> | <b>9</b> |
| Definition of Management - Science or Art - Manager Vs Entrepreneur - types of managers - managerial roles and skills - Evolution of Management - Scientific, human relations , system and contingency approaches - Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment - Current trends and issues in Management. |   |          |
| <b>UNIT II</b>   | <b>PLANNING</b>                                     | <b>9</b> |
| Nature and purpose of planning - planning process - types of planning - objectives - setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques - Decision making steps and process.   |   |          |
| <b>UNIT III</b>  | <b>ORGANISING</b>                                   | <b>9</b> |
| Nature and purpose - Formal and informal organization - organization chart - organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization - Job Design - Human Resource Management - HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management                         |   |          |
| <b>UNIT IV</b>   | <b>DIRECTING</b>                                    | <b>9</b> |
| Foundations of individual and group behaviour - motivation - motivation theories - motivational techniques - job satisfaction - job enrichment - leadership - types and theories of leadership - communication - process of communication - barrier in communication - effective communication -communication and IT.  |   |          |
| <b>UNIT V</b>  | <b>CONTROLLING</b>                                  | <b>9</b> |
| System and process of controlling - budgetary and non-budgetary control techniques - use of computers and IT in Management control - Productivity problems and management - control and performance - direct and preventive control – reporting.   |   |          |

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

**TEXTBOOKS:**

1. Stephen P. Robbins & Mary Coulter, “Management”, Prentice Hall (India) Pvt. Ltd., 10<sup>th</sup> Edition, 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, Pearson Education, 6th Edition, 2004.

**REFERENCES:**

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management” Pearson Education, 7th Edition, 2011.
2. Robert Kreitner & Mamata Mohapatra, “ Management”, Biztantra, 2008.
3. Harold Koontz & Heinz Weihrich “Essentials of management” Tata McGraw Hill, 1998.
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata McGraw Hill, 1999

**OBJECTIVES:**

- To understand fundamental topics in bio-inspired optimization techniques
- To Learn the collective systems such as ACO, PSO, and BCO
- To develop skills in biologically inspired algorithm design with an emphasis on solving real world problems
- To understand the most appropriate types of algorithms for different data analysis problems and to introduce some of the most appropriate implementation strategies.
- To implement the Bio-inspired technique with other traditional algorithms.

**UNIT I INTRODUCTION****9**

Optimization Techniques: Introduction to Optimization Problems - Single and Multi- objective Optimization - Classical Techniques - Overview of various Optimization methods - Evolutionary Computing: Genetic Algorithm and Genetic Programming: Basic concept - encoding - representation - fitness function - Reproduction - differences between GA and Traditional optimization methods - Applications - Bio- inspired Computing (BIC): Motivation - Overview of BIC - usage of BIC - merits and demerits of BIC.

**UNIT II SWARM INTELLIGENCE****9**

Introduction - Biological foundations of Swarm Intelligence - Swarm Intelligence in Optimization - Ant Colonies: Ant Foraging Behavior - Towards ArtificialAnts - Ant Colony Optimization (ACO) - S-ACO - Ant Colony Optimization Metaheuristic: Combinatorial Optimization - ACO Metaheuristic - Problem solving usingACO - Other Metaheuristics - Simulated annealing - Tabu Search - Local search methods - Scope of ACO algorithms.

**UNIT III NATURAL TO ARTIFICIAL SYSTEMS****9**

Biological Nervous Systems - artificial neural networks - architecture - Learning Paradigms - unsupervised learning - supervised learning - reinforcement learning - evolution of neural networks - hybrid neural systems - Biological Inspirations in problem solving - Behavior of Social Insects: Foraging -Division of Labor - Task Allocation - Cemetery Organization and Brood Sorting - Nest Building - Cooperative transport.

**UNIT IV SWARM ROBOTICS****9**

Foraging for food - Clustering of objects - Collective Prey retrieval -Scope of Swarm Robotics - Social Adaptation of Knowledge: Particle Swarm - ParticleSwarm Optimization (PSO) - Particle Swarms for Dynamic Optimization Problems - Artificial Bee Colony (ABC) Optimization biologically inspired algorithms in engineering.

**UNIT V CASE STUDIES****9**

Other Swarm Intelligence algorithms: Fish Swarm - Bacteria foraging - Intelligent Water Drop Algorithms - Applications of biologically inspired algorithms in engineering. Case Studies: ACO and PSO for NP-hard problems - Routing problems - Assignment problems - Scheduling problems - Subset problems - Machine Learning Problems -Travelling Salesman problem.

**OUTCOMES:**

- CO1:** Familiarity with the basics of several biologically inspired optimization techniques.  
**CO2:** Familiarity with the basics of several biologically inspired computing paradigms.  
**CO3:** Ability to select an appropriate bio-inspired computing method and implement for any application and data set.

**CO4:** Theoretical understanding of the differences between the major bio-inspired computing methods.

**CO5:** Learn Other Swarm Intelligence algorithms and implement the Bio-inspired technique with other traditional algorithms.

**TOTAL PERIODS:45**

### TEXT BOOK

1. A. E. Elben and J. E. Smith, "Introduction to Evolutionary Computing", Springer, 2010.
2. Floreano D. and Mattiussi C., "Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies", MIT Press, Cambridge, MA, 2008.
3. Leandro Nunes de Castro, " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007

### REFERENCES

1. Eric Bonabeau, Marco Dorigo, Guy Theraulaz, "Swarm Intelligence: From Natural to Artificial Systems", Oxford University press, 2000.
2. Christian Blum, Daniel Merkle (Eds.), "Swarm Intelligence: Introduction and Applications", Springer Verlag, 2008.
3. Leandro N De Castro, Fernando J Von Zuben, "Recent Developments in Biologically Inspired Computing", Idea Group Inc., 2005.
4. Albert Y.Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006.
5. C. Ebelhart et al., "Swarm Intelligence", Morgan Kaufmann, 2001.

**AD8016**

**INFORMATION EXTRACTION AND RETRIEVAL**

**L T P C**

**3 0 0 3**

### OBJECTIVES:

- 1: To understand the different ways for extraction of multimedia data
- 2: To learn and analyze the information retrieval techniques
- 3: To apply the information retrieval algorithms for real time applications
- 4: To understand and evaluate the applications of information retrieval techniques
- 5: To understand the role of information retrieval systems in web applications

### UNIT I INTRODUCTION TO INFORMATION EXTRACTION

**9**

Introduction - Origins - Text, Audio ,Image, Video Extraction - Visual object Feature Localization - Entropy based Image Analysis - 3D shape Extraction Techniques - Semantic Multimedia Extraction using Audio & Video - Multimedia Web Documents.

### UNIT II TEXT EXTRACTION

**9**

Pre-processing Techniques - Clustering - Probabilistic Models - Browsing and Query Refinement on presentation Layer- Link Analysis - Visualization Approaches and its Operations.

### UNIT III INFORMATION RETRIEVAL SYSTEMS

**9**

Text formats -Retrieval and Ranking -Evaluation strategies - Tokens -Query processing -Static Inverted Indices - Dynamic Inverted Indices - Index compression -Categorization and Filtering Classifiers -Probabilistic, Linear ,Similarity based, Generalized Linear, Information Theoretic models- XML Retrieval.

#### UNIT IV ALGORITHMS ON INFORMATION RETRIEVAL

9

Introduction - Strategies - Utilities - Crossing the language barrier- Cross Language strategies with Utilities - Efficiency Multidimensional data model- Parallel Information Retrieval - Distributed Information Retrieval.

#### UNIT V APPLICATIONS

9

Sound Authoring Data with Audio MME-CBR Systems-Implementation of Message Recognition Systems - Paralinguistic Information Retrieval in Broadcast - Text mining Applications- Pre-processing Applications using Probabilistic and Hybrid Approaches - Web Search.

#### OUTCOMES:

- Able to apply the information extraction techniques for real time applications
- Design systems based on the concepts of information retrieval
- Apply data specific information extraction and retrieval
- Create web applications by understanding the information extraction and retrieval techniques
- Use the concepts of information classification and clustering in wide range of other applications

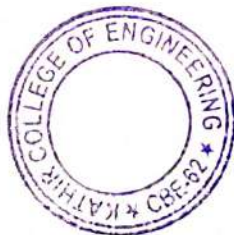
TOTAL PERIODS:45


#### TEXT BOOKS:

1. Mark T. Maybury, "Multimedia Information Extraction", Wiley (IEEE), John Wiley & Sons, 2012.
2. Ronen Feldman, James Sanger, "Text Mining Handbook", Cambridge University press, 2006.

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1. David A. Grossman, Ophir Frieder, "Information Retrieval: Algorithms and Heuristics", Second Edition, Springer, 2004.
2. Stefan Buttcher LA Clarke Gox v.Cormack, "Information Retrieval: Implementing and Evaluating Search Engines", MIT Press, 2016.
3. Big Data Security and Privacy Handbook:100 Best Practices in Big Data security and Privacy", 2016.



  
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**AFFILIATED INSTITUTIONS**

**REGULATIONS 2017**

**CHOICE BASED CREDIT SYSTEM**

**COMMON TO ALL POST GRADUATE PROGRAMMES**

The following Regulations is applicable to the students admitted to M.E / M.Tech., M.C.A and M.B.A. Programmes at all Engineering Colleges affiliated to Anna University, Chennai (other than Autonomous Colleges) and to all the University Colleges of Engineering of Anna University, Chennai from the academic year 2017-2018.

**1 PRELIMINARY DEFINITIONS AND NOMENCLATURE**

In these Regulations, unless the context otherwise requires:

- i. **"Programme"** means Post graduate Degree Programme e.g. M.E., M.Tech. Degree Programme.
- ii. **"Branch"** means specialization or discipline of M.E. / M.Tech. Degree Programme like "Structural Engineering", "Engineering Design", etc.
- iii. **"Course"** means Theory or Practical subject that is normally studied in a semester, like Applied Mathematics, Advanced Thermodynamics, etc.
- iv. **"Director, Academic Courses"** means the authority of the University who is responsible for all academic activities of the University for implementation of relevant Rules and Regulations.
- v. **"Chairman"** means the Head of the Faculty.
- vi. **"Head of the Department"** means Head of the Department concerned.
- vii. **"Head of the Institution"** means the Principal of a College / Institution who is responsible for all academic activities of that College / Institution and for implementation of relevant Rules and Regulations.
- viii. **"Controller of Examinations"** means the Authority of the University who is responsible for all activities of the University Examinations.
- ix. **"University"** means ANNA UNIVERSITY, CHENNAI.



  
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## **2 PROGRAMMES OFFERED, MODES OF STUDY AND ADMISSION REQUIREMENTS**

### **2.1 P.G. PROGRAMMES OFFERED:**

1. M.E
2. M.Tech.
3. M.B.A.
4. M.C.A.

### **2.2 MODES OF STUDY:**

#### **2.2.1 Full-Time:**

Candidates admitted under 'Full-Time' should be available in the College / Institution during the entire duration of working hours (From Morning to Evening on Full-Time basis) for the curricular, co-curricular and extra-curricular activities assigned to them.

The Full-Time candidates should not attend any other Full-Time programme(s) / course(s) or take up any Full-Time job / Part-Time job in any Institution or Company during the period of the Full-Time programme. Violation of the above rules will result in cancellation of admission to the PG programme.

#### **2.2.2 Part-Time Mode:**

In this mode of study, the students are required to attend classes conducted in the evenings and complete the course in three years.

2.2.3 Conversion from one mode of study to the other is not permitted.

### **2.3 ADMISSION REQUIREMENTS:**

2.3.1 Candidates for admission to the first semester of the Post-Graduate Degree Programme shall be required to have passed an appropriate Under-Graduate Degree **Examination of Anna University** or equivalent as specified under qualification for admission as per the Tamil Nadu Common Admission (TANCA) criteria.

**Note:** TANCA releases the updated criteria during the admissions every academic year. Admission shall be offered only to the candidates who possess the qualification prescribed against each programme.

Any other relevant qualification which is not prescribed against each programme shall be considered for equivalence by the committee constituted for the purpose. Admission to such degrees shall be offered only after obtaining equivalence to such degrees.

2.3.2 However, the Syndicate of the University may decide to restrict admission in any particular year to candidates having a subset of qualifications prescribed at the time of admission.

2.3.3 Notwithstanding the qualifying examination the candidate might have passed, he/she shall have a minimum level of proficiency in the appropriate programme / courses as prescribed by the Syndicate of the University from time to time.

2.3.4 Eligibility conditions for admission such as the class obtained, the number of attempts in qualifying examination and physical fitness will be as prescribed by the Syndicate of the University from time to time.

2.3.5 All Part-Time candidates should satisfy other conditions regarding Experience, Sponsorship etc. that may be prescribed by the Syndicate from time to time.



### 3 STRUCTURE OF THE PROGRAMMES

#### 3.1 Categorization of Courses

Every Post Graduate Degree Programme will have a curriculum with syllabi consisting of theory and practical courses that shall be categorized as follows:

- i. **Foundation Courses (FC)** may include Mathematics or other basic courses
- ii. **Professional Core (PC)** courses include the core courses relevant to the chosen specialization/branch.
- iii. **Professional Elective (PE)** courses include the elective courses relevant to the chosen specialization/ branch.
- iv. **Employability Enhancement Courses (EEC)** include Project Work and/or Internship, Seminar, Professional Practices, Summer Project, Case Study and Industrial / Practical Training.

Instead of two electives in the curriculum, the student may be permitted to choose a maximum of 2 courses from other PG programmes with the approval of the Head of the Department offering such courses.

#### 3.2 Courses per Semester

Curriculum of a semester shall normally have a blend of lecture courses and practical courses including Employability Enhancement Courses. Each course may have credits assigned as per clause 3.3.

#### 3.3 Credit Assignment

Each course is assigned certain number of credits based on the following:

| Contact period per week  | CREDITS |
|--|---------|
| 1 Lecture Period   | 1       |
| 2 Tutorial Periods   | 1       |
| 2 Practical Periods<br>(Laboratory / Seminar /<br>Project Work etc.) | 1       |

The Contact Periods per week for Tutorials and Practical can only be in multiples of 2.

#### 3.4 Project Work

3.4.1 The project work for M.E. / M.Tech. Programmes consist of Phase-I and Phase-II. The Phase-I is to be undertaken during III semester and Phase-II, which is a continuation of Phase-I is to be undertaken during IV semester.

3.4.2 In case of candidates of M.E. / M.Tech. Programmes not completing Phase-I of project work successfully, the candidates can undertake Phase-I again in the subsequent semester. In such cases the candidates can enroll for Phase-II, only after successful completion of Phase-I.

3.4.3 Project work shall be carried out under the supervision of a “qualified teacher” in the Department concerned. In this context “qualified teacher” means the faculty member possessing (i) PG degree with a minimum of 3 years experience in teaching or (ii) Ph.D. degree.

3.4.4 A candidate may, however, in certain cases, be permitted to work on projects in an Industrial/Research Organization, on the recommendations of the Head of the Department Concerned. In such cases, the Project work shall be jointly supervised by a supervisor of the department and an expert, as a joint supervisor from the organization and the student shall be instructed to meet the supervisor periodically and to attend the review committee meetings for evaluating the progress.

3.4.5 The Project work (Phase II in the case of M.E/M.Tech.) shall be pursued for a minimum of 16 weeks during the final semester.

3.6 The deadline for submission of final Project Report is 60 calendar days from the last working day of the semester in which project / thesis / dissertation is done. However, the Phase-I of the Project work in the case M.E. / M.Tech. Programmes shall be submitted within a maximum period of 30 calendar days from the last working day of the semester as per the academic calendar published by the University.

### 3.7 Industrial Training / Internship

The students may undergo Industrial training for a period as specified in the curriculum during summer / winter vacation. In this case the training has to be undergone continuously for the entire period.

The students may undergo Internship at Research organization / University (after due approval from the Department Consultative Committee) for the period prescribed in the curriculum during summer / winter vacation, in lieu of Industrial training.

### 3.8 Value Added Courses

**The Students may optionally undergo Value Added Courses and** the credits earned through the Value Added Courses shall be over and above the total credit requirement prescribed in the curriculum for the award of the degree. One / Two credit courses shall be offered by a Department **of an institution with the prior approval from the Head of the Institution.** The details of the syllabus, time table and faculty may be sent to the Centre for Academic Courses and the Controller of Examinations after approval from the **Head of the Institution** concerned atleast one month before the course is offered. **Students can take a maximum of two one credit courses / one two credit course** during the entire duration of the Programme.

### 3.9 Online Courses

3.9.1 Students may be permitted to credit only one online course of 3 credits with the approval of **Head of the Institution** and Centre for Academic Courses.

3.9.2 Students may be permitted to credit one online course (which are provided with certificate) subject to a maximum of three credits. The approved list of online courses will be provided by the Centre for Academic courses from time to time. The student needs to obtain certification or credit to become eligible for writing the End Semester Examination to be conducted by Controller of Examinations, Anna University. The details regarding online courses taken up by students should be sent to the Controller of Examinations, Anna University and Centre for Academic Courses one month before the commencement of end Semester Examination.

### 3.10 Medium of Instruction

The medium of instruction is English for all courses, examinations, seminar presentations and project / thesis / dissertation reports.

#### 4 DURATION AND STRUCTURE OF THE PROGRAMMES:

4.1 The minimum and maximum period for completion of the P.G. Programmes are given below:

| Programme                  | Min. No. of Semesters | Max. No. of Semesters |
|----------------------------|-----------------------|-----------------------|
| M.E. / M.Tech. (Full-Time) | 4                     | 8                     |
| M.E. / M.Tech. (Part Time) | 6                     | 12                    |
| M.C.A. (Full Time)         | 6                     | 12                    |
| M.B.A. (Full Time)         | 4                     | 8                     |
| M.B.A. (Part Time)         | 6                     | 12                    |

4.2 The Curriculum and Syllabi of all the P.G. Programmes shall be approved by the Academic Council of Anna University. The number of Credits to be earned for the successful completion of the programme shall be as specified in the Curriculum of the respective specialization of the P.G. Programme

4.3 Each semester shall normally consist of 75 working days or 540 periods of each 50 minutes duration, for full-time mode of study or 250 periods for part-time mode of study. The Head of the Institution shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus and that the teacher teaches the full content of the specified syllabus for the course being taught. For the purpose of calculation of attendance requirement for writing the end semester examinations (as per clause 9) by students, following method shall be used.

$$\text{Percentage of Attendance} = \frac{\text{Total no. of periods attended in all the courses per semester}}{(\text{No. of periods / week as prescribed in the curriculum}) \times 15 \text{ taken together for all courses of the semester}} \times 100$$

End Semester Examinations conducted by the University will be scheduled after the last working day of the semester.

4.4 The minimum prescribed credits required for the award of the degree shall be within the limits specified below:

| Programme      | Prescribed Credit Range |
|----------------|-------------------------|
| M.E. / M.Tech. | 70 to 75                |

| Programme | Prescribed Credit Range |
|-----------|-------------------------|
| M.C.A.    | 115 - 120               |
| M.B.A.    | 86 - 90                 |

#### 5. COURSE REGISTRATION

5.1 The Institution is responsible for registering the courses that each student is proposing to undergo in the ensuing semester. Each student has to register for all courses to be undergone in the curriculum of a particular semester (with the facility to drop courses to a maximum of 6 credits (vide clause 5.2)). The student can also register for courses for which the student has failed in the earlier semesters.

The registration details of the candidates may be approved by the Head of the Institution and forwarded to the Controller of Examinations. This registration is for undergoing the course as well as for writing the End Semester Examinations.

**The courses that a student registers in a particular semester may include**

- i. Courses of the current semester.
- ii. The core (Theory/Lab /EEC) courses that the student has not cleared in the previous semesters.
- iii. Elective courses which the student failed (either the same elective or a different elective instead).

**5.2 Flexibility to Drop courses**

- 5.2.1 A student has to earn the total number of credits specified in the curriculum of the respective Programme of study in order to be eligible to obtain the degree.
- 5.2.2 From the II to Final semesters, the student has the option of dropping existing courses in a semester during registration. Total number of credits of such courses cannot exceed 6 for PG (Full Time) programmes and cannot exceed 3 for PG (Part Time) programmes.

**6 EVALUATION OF PROJECT WORK**

The evaluation of Project Work for Phase-I & Phase-II in the case of M.E. / M.Tech. and project work of M.B.A and M.C.A shall be done independently in the respective semesters and marks shall be allotted as per the weightages given in Clause 6.1.

- 6.1 There shall be three assessments (each 100 marks) during the Semester by a review committee. The Student shall make presentation on the progress made before the Committee. The Head of the Institution shall constitute the review committee for each branch of study. The total marks obtained in the three assessments shall be reduced to 20 marks and rounded to the nearest integer (as per the Table given below). There will be a vice-voce Examination during End Semester Examinations conducted by a Committee consisting of the supervisor, one internal examiner and one external examiner. The internal examiner and the external examiner shall be appointed by the Controller of Examination. The distribution of marks for the internal assessment and End semester examination is given below:

| Internal Assessment (20 Marks) |             |              | End Semester Examination (80 Marks) |                                   |                   |                     |
|--------------------------------|-------------|--------------|-------------------------------------|-----------------------------------|-------------------|---------------------|
| Review - I                     | Review - II | Review - III | Thesis Submission (30 Marks)        | Viva – Voce (Rounded to 50 Marks) |                   |                     |
|                                |             |              | External Examiner                   | Internal Examiner                 | External Examiner | Supervisor Examiner |
| 5                              | 7.5         | 7.5          | 30                                  | 15                                | 20                | 15                  |

- 6.2 The Project Report prepared according to approved guidelines as given by Director, Academic Courses and duly signed by the supervisor(s) and the Head of the Department concerned shall be submitted to the Head of the Institution.

- 6.3 If the candidate fails to obtain 50% of the internal assessment marks in the Phase–I and Phase–II / final project, he/she will not be permitted to submit the report for that particular semester and has to re-enroll for the same in the subsequent semester.

If a candidate fails to submit the project report on or before the specified deadline, he/she is deemed to have failed in the Project Work and shall re-enroll for the same in a subsequent semester. This applies to both Phase–I and Phase–II in the case of M.E. / M.Tech. Project Work and the Final Project work of M.B.A. / M.C.A.

If a candidate fails in the end semester examinations of Phase–I, he/she has to resubmit the Project Report within 30 days from the date of declaration of the results. If he / she fails in the End semester examination of Phase–II of Project work of M.E. / M.Tech. or the Final Project work of M.B.A. / M.C.A, he/she shall resubmit the Project Report within 60 days from the date of declaration of the results. The resubmission of a project report and subsequent viva-voce examination will be considered as reappearance with payment of exam fee. For this purpose the same Internal and External examiners shall evaluate the resubmitted report.

- 6.3.1 A copy of the approved Project Report after the successful completion of viva-voce examinations shall be kept in the library of the college / institution.
- 6.3.2 Practical / Industrial Training, Summer Project if specified in the Curriculum shall not exceed the maximum duration of 4 weeks and should be organized by the Head of the Department for every student.
- 6.3.3 At the end of Practical / Industrial Training, Summer Project the candidate shall submit a certificate from the organization where he/she has undergone training and also a brief report. The evaluation for 100 marks will be carried out internally based on this report and a Viva-Voce Examination will be conducted by a Departmental Committee constituted by the Head of the Institution. Certificates submitted by the students shall be attached to the mark list sent by the Head of the Institution to the Controller of Examination.

## **7 CLASS ADVISER**

There shall be a class advisor for each class. The class advisor will be one among the (course-instructors) of the class. He / She will be appointed by the Head of the department concerned. The class advisor is the ex-officio member and the Convener of the class committee. The responsibilities for the class advisor shall be:

- To act as the channel of communication between the HoD and the students of the respective class.
- To collect and maintain various statistical details of students.
- To help the chairperson of the class committee in planning and conduct of the class committee meetings.
- To monitor the academic performance of the students including attendance and to inform the class committee.
- To attend to the students' welfare activities like awards, medals, scholarships and industrial visits.

## **8 CLASS COMMITTEE**

- 8.1 A Class Committee consists of teachers of the concerned class, student representatives and a chairperson who is not teaching the class. It is like the 'Quality Circle' (more commonly used in industries) with the overall goal of improving the teaching-learning process. The functions of the class committee include:

- Solving problems experienced by students in the class room and in the laboratories.
- Clarifying the regulations of the programme and the details of rules therein.
- Informing the student representatives, the “academic schedule” including the dates of assessments and the syllabus coverage for each assessment period.
- Informing the student representatives, the details of regulations regarding the weightage used for each assessment. In the case of practical courses (laboratory / project work / seminar etc.) the breakup of marks for each experiment/ exercise/ module of work, should be clearly discussed in the class committee meeting and informed to the students.
- Analyzing the performance of the students of the class after each test and finding the ways and means of improving the Students Performance
- Identifying the weak students, if any, in any specific subject and requesting the teachers concerned to provide some additional help or guidance or coaching to such weak students as frequently as possible.

8.2 The class committee for a class under a particular programme is normally constituted by the Head of the Department. However, if the students of different programmes are mixed in a class, the class committee is to be constituted by the Head of the Institution.

8.3 The class committee shall be constituted on the first working day of any semester or earlier.

8.4 At least 2 student representatives (usually 1 boy and 1 girl) shall be included in the class committee.

8.5 The chairperson of the class committee shall invite the Class adviser(s) and the Head of the Department to the meeting of the class committee.

8.6 The Head of the Institution may participate in any class committee of the institution.

8.7 The Chairperson of the Class Committee is required to prepare the minutes of every meeting, submit the same to the Head of the Institution within two days of the meeting and arrange to circulate among the concerned students and teachers. If there are some points in the minutes requiring action by the management, the same shall be brought to the notice of the management by the Head of the Institution.

8.8 The first meeting of the class committee shall be held within one week from the date of commencement of the semester in order to inform the students about the nature and weightage of assessments within the framework of the Regulations. Two or three subsequent meetings may be held at suitable intervals. During these meetings the student members, representing the entire class, shall meaningfully interact and express the opinions and suggestions of the class students to improve the effectiveness of the teaching-learning process.

## **9 COURSE COMMITTEE FOR COMMON COURSES**

Each common course offered to more than one group of students shall have a “Course Committee” comprising all the teachers teaching the common course with one of them nominated as Course Coordinator. The nomination of the course Coordinator shall be made by the Head of the Department / Head of the Institution depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The ‘Course committee’ shall meet as often as possible and ensure uniform evaluation of the tests and arrive at a common scheme of evaluation for the tests. Wherever it is feasible, the course committee may also prepare a common question paper for the Assessment Test(s).

## 10 ATTENDANCE REQUIREMENTS FOR COMPLETION OF A SEMESTER

- 10.1 A candidate who has fulfilled the following conditions shall be deemed to have satisfied the attendance requirements for completion of a semester.

Ideally every student is expected to attend all classes and earn 100% attendance. However in order to allow provision for certain unavoidable reasons such as prolonged hospitalization / accident / specific illness the student is expected to earn a minimum of 75% attendance to become eligible to write the End-Semester Examinations.

Therefore, every student shall secure not less than 75% of overall attendance in that semester as per clause 4.3.

- 10.2 However, a candidate who secures overall attendance between 65% and 74% in that current semester due to medical reasons (prolonged hospitalization / accident / specific illness / participation in sports events) may be permitted to appear for the current semester examinations subject to the condition that the candidate shall submit the medical certificate / sports participation certificate to the Head of the Institution. The same shall be forwarded to the Controller of Examinations for record purposes.
- 10.3 Candidates who could secure less than 65% overall attendance and **Candidates who do not satisfy the clauses 10.1 & 10.2** will not be permitted to write the end-semester examination of that current semester and are not permitted to go to next semester. They are required to repeat the incomplete semester in the next academic year.

## 11 PROCEDURES FOR AWARDING MARKS FOR INTERNAL ASSESSMENT(IA)

The maximum marks assigned to different courses shall be as given below:

Each of the theory and practical courses (including project work) shall carry a maximum of 100 marks of which 20 marks will be through internal assessment and the End Semester Examination (ESE) will carry 80 marks.

- 11.1 The marks for the continuous assessment shall be awarded as per the procedure given below:

### (i) Theory Courses:

Three tests each carrying 100 marks shall be conducted during the semester by the Department / College concerned. The total marks obtained in all tests put together out of 300, shall be proportionately reduced for 20 marks and rounded to the nearest integer (This also implies equal weightage to all the three tests).

### (ii) Practical Courses:

The maximum marks for Internal Assessment shall be 20 in case of practical courses. Every practical exercise / experiment shall be evaluated based on conduct of experiment / exercise and records maintained. There shall be at least one test. The criteria for arriving at the Internal Assessment marks of 20 is as follows: 75 marks shall be awarded for successful completion of all the prescribed experiments done in the Laboratory and 25 marks for the test. The total mark shall be reduced to 20 and rounded to the nearest integer.

### (iii) Theory Courses with Laboratory component:

The maximum marks for Internal Assessment shall be 20 in case of theory courses with Laboratory component. For a theory course with Laboratory component, there shall be three assessments: the first two assessments (each with a maximum of 100 marks) will be from theory portions and the third assessment (maximum marks 100) will be for laboratory component. The sum of marks of all three assessments shall be reduced to 20 marks and rounded to the nearest integer.

#### (iv) Other Employability Enhancement Courses

- (a) The seminar / Case study is to be considered as purely INTERNAL (with 100% internal marks only). Every student is expected to present a minimum of 2 seminars per semester before the evaluation committee and for each seminar marks can be equally apportioned. The three member committee appointed by Head of the Institution will evaluate the seminar and at the end of the semester the marks can be consolidated and taken as the final mark. The evaluation shall be based on the seminar paper (40%), presentation (40%) and response to the questions asked during presentation (20%).
- (b) The Industrial / Practical Training shall carry 100 marks and shall be evaluated through internal assessment only. At the end of Industrial / Practical training / internship / Summer Project, the candidate shall submit a certificate from the organization where he / she has undergone training and a brief report. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a three member Departmental Committee constituted by the Head of the Institution. Certificates submitted by the candidate shall be attached to the mark list sent by the Head of the Department.

#### 11.2 Assessment for Value Added Course

The one / two credit course shall carry 100 marks and shall be evaluated through **continuous assessments only**. Two Assessments shall be conducted during the semester by the Department concerned. The total marks obtained in the tests shall be reduced to 100 marks and rounded to the nearest integer. A committee consisting of the Head of the Department, staff handling the course and a senior Faculty member nominated by the Head of the Institution shall monitor the evaluation process. The list of students along with the marks and the grades earned may be forwarded to the Controller of Examinations for appropriate action at least one month before the commencement of End Semester Examinations

#### 11.3 Assessment for Online Courses

Students may be permitted to credit one online course (which are provided with certificate) subject to a maximum of three credits. The approved list of online courses will be provided by the Centre for Academic courses from time to time. **This online course of 3 credits can be considered instead of one elective course**. The student needs to obtain certification or credit to become eligible for writing the End Semester Examination to be conducted by Anna University. **The course shall be evaluated through the End Semester Examination only conducted by Controller of Examinations, Anna University.**

- 11.4 Internal marks approved by the Head of the Institution shall be displayed by the respective HODs within 5 days from the last working day.
- 11.5 Every teacher is required to maintain an 'ATTENDANCE AND ASSESSMENT RECORD' which consists of attendance marked in each lecture or practical or project work class, the test marks and the record of class work (topics covered), separately for each course. This should be submitted to the Head of the Department periodically (at least three times in a semester) for checking the syllabus coverage and the records of test marks and attendance. The Head of the department will put his signature and date after due verification. At the end the semester, the record should be verified by the Head of the institution who will keep this document in safe custody (for five years). The university or any inspection team appointed by the University may inspect the records of attendance and assessments of both current and previous semesters.



## 12 REQUIREMENTS FOR APPEARING FOR SEMESTER EXAMINATION

- 12.1 A candidate shall normally be permitted to appear for the University examinations of the current semester if he/she has satisfied the semester completion requirements as per clause 10.1 & 10.2 and has registered for examination in all courses of the current semester.
- 12.2 Further, registration is mandatory for all the courses in the current semester as well as for arrear(s) course(s) for the university examinations failing which, the candidate will not be permitted to move to the higher semester.
- 12.3 A student who has passed all the courses prescribed in the curriculum for the award of the degree shall not be permitted to re-enroll to improve his/her marks in a course or the aggregate marks / CGPA.

## 13 UNIVERSITY EXAMINATIONS

- 13.1 There shall be an End- Semester Examination of 3 hours duration in each lecture based course.

The examinations shall ordinarily be conducted between October and December during the odd semesters and between April and June in the even semesters.

For the practical examinations (including project work), both internal and external examiners shall be appointed by the University.

### 13.2 WEIGHTAGE

The following will be the weightage for different courses.

- i) Lecture or Lecture cum Tutorial based course:

|                          |   |     |
|--------------------------|---|-----|
| Internal Assessment      | - | 20% |
| End Semester Examination | - | 80% |

- ii) Laboratory based courses

|                          |   |     |
|--------------------------|---|-----|
| Internal Assessment      | - | 20% |
| End Semester Examination | - | 80% |

- iii) Project work

|                     |   |     |
|---------------------|---|-----|
| Internal Assessment | - | 20% |
|---------------------|---|-----|

|  |   |     |
|--|---|-----|
| Evaluation of Project Report<br>by external examiner | - | 30% |
| Viva-Voce Examination                                | - | 50% |

- iv) Practical training / summer project / seminar

|                     |   |      |
|---------------------|---|------|
| Internal Assessment | - | 100% |
|---------------------|---|------|

## 14 PASSING REQUIREMENTS

- 14.1 A candidate who secures not less than 50% of total marks prescribed for the course with a minimum of 50% of the marks prescribed for each of the course of the End-Semester University Examination in both theory and practical courses shall be declared to have passed in the course and acquired the relevant number of credits.

14.2 If a student fails to secure a pass in theory courses in the current semester examination, he/she is allowed to write arrear examinations for the next three consecutive semesters and their internal marks shall be carried over for the above mentioned period of three consecutive semesters.

In case, if he/she has not successfully completed all the courses of semester I at the end of semester IV, he/she shall redo the semester I courses along with regular students. For the subsequent semesters of II, III and IV, the same procedure shall be followed, subject to the maximum permissible period for this programme.

For MCA programme, to register for courses in V and VI semesters, the student should have successfully completed all the courses of I and II semesters respectively. In case, if he/she has not successfully completed all the courses of semester III at the end of semester VI, he/she shall redo the semester III courses along with regular students. For the subsequent semesters of IV, V and VI, the same procedure shall be followed, subject to the maximum permissible period for this programme.

14.3 If a student fails to secure a pass in a laboratory course, **the student shall register** for the course again, when offered next.

14.4 If a student fails to secure a pass in project work even after availing clause (6.3), **the student shall register** for the course again, when offered next.

14.5 The passing requirement for the courses which are assessed only through purely internal assessment (EEC courses except project work), is 50% of the internal assessment marks only.

14.6 A student can apply for revaluation of the student's semester examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee along with prescribed application to the COE through the Head of the Institution. The COE will arrange for the revaluation and the results will be intimated to the student concerned through the Head of the Institution. Revaluation is not permitted for laboratory course and project work.

## 15 AWARD OF LETTER GRADES

15.1 All assessments of a course will be evaluated on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each subject as detailed below:

| Letter Grade                | Grade Points | Marks Range |
|-----------------------------|--------------|-------------|
| O (Outstanding)             | 10           | 91 - 100    |
| A + (Excellent)             | 9            | 81 - 90     |
| A (Very Good)               | 8            | 71 - 80     |
| B + (Good)                  | 7            | 61 - 70     |
| B (Average)                 | 6            | 50 - 60     |
| RA                          | 0            | <50         |
| SA (Shortage of Attendance) | 0            |             |
| W                           | 0            |             |

A student is deemed to have passed and acquired the corresponding credits in a particular course if he/she obtains any one of the following grades: "O", "A+", "A", "B+", "B".

'SA' denotes shortage of attendance (as per clause 10.3) and hence prevention from writing the end semester examinations. 'SA' will appear only in the result sheet.

"RA" denotes that the student has failed to pass in that course. "W" denotes **withdrawal** from the exam for the particular course. The grades RA and W will figure both in Marks Sheet as well as in Result Sheet). In both cases the student has to earn Continuous Assessment marks and appear for the End Semester Examinations.

If the grade W is given to course, the attendance requirement need not be satisfied.

If the grade RA is given to a core **theory course**, the attendance requirement need not be satisfied, but if the grade RA is given to a **Laboratory Course/ Project work / Seminar and any other EEC course**, the attendance requirements (vide clause 10) should be satisfied.

**15.2** The grades O, A+, A, B+, B obtained for the one credit course shall figure in the Mark sheet under the title '**Value Added Courses**'. The Courses for which the grades are RA, SA **will not figure in the mark sheet.**

**15.3 GRADE SHEET**

After results are declared, Grade Sheets will be issued to each student which will contain the following details:

- The college in which the candidate has studied.
- The list of courses enrolled during the semester and the grades scored.
- The Grade Point Average (GPA) for the semester and
- The Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

GPA for a semester is the ratio of the sum of the products of the number of credits for courses acquired and the corresponding points to the sum of the number of credits for the courses acquired in the semester. CGPA will be calculated in a similar manner, considering all the courses registered from first semester. RA grades will be excluded for calculating GPA and CGPA.

$$\text{GPA / CGPA} = \frac{\sum_{i=1}^n C_i GP_i}{\sum_{i=1}^n C_i}$$

where

**C<sub>i</sub>** is the number of credits assigned to the course

**GP<sub>i</sub>** is the Grade point corresponding to the grade obtained for each Course

**n** is number of all Courses successfully cleared during the particular semester in the case of GPA and during all the semesters in the case of **CGPA**.

## 16 ELIGIBILITY FOR THE AWARD OF THE DEGREE

- 16.1 A student shall be declared to be eligible for the award of the PG Degree (M.E./ M.Tech., M.C.A., M.B.A.) provided the student has
- i. Successfully gained the required number of total credits as specified in the curriculum corresponding to the student's programme within the stipulated time.
  - ii. **a. M.E./ M.Tech., M.B.A.(Full Time)**  
Successfully completed the course requirements, appeared for the End-Semester examinations and passed all the subjects prescribed in all the 4 semesters within a maximum period of 4 years reckoned from the commencement of the first semester to which the candidate was admitted.
  - b. M.E./ M.Tech., M.B.A.(Part Time) and M.C.A.(Full Time)**  
Successfully completed the course requirements, appeared for the End-Semester examinations and passed all the subjects prescribed in all the 6 semesters within a maximum period of 6 years reckoned from the commencement of the first semester to which the candidate was admitted.
  - iii. Successfully passed any additional courses prescribed by the Director, Academic Courses whenever readmitted under regulations other than R-2017 (vide clause **19.3**)
  - iv. No disciplinary action pending against the student.
  - v. The award of Degree must have been approved by the Syndicate of the University.

## 17 CLASSIFICATION OF THE DEGREE AWARDED

### 17.1 FIRST CLASS WITH DISTINCTION:

A Student who satisfies the following conditions shall be declared to have passed the examination in **First class with Distinction**:

#### **M.E. / M.Tech. M.B.A.(Full Time)**

- Should have passed the examination in all the courses of all the four semesters in the student's First Appearance within **three** years, which includes authorised break of study of one year (if availed). Withdrawal from examination (vide Clause 18) will not be considered as an appearance.
- Should have secured a CGPA of not less than **8.50**.
- Should NOT have been prevented from writing end Semester examination due to lack of attendance in any of the courses.

#### **M.E. / M.Tech. M.B.A.(Part Time) and M.C.A (Full Time)**

- Should have passed the examination in all the courses of all the six semesters in the student's First Appearance within **four** years, which includes authorised break of study of one year (if availed). Withdrawal from examination (vide Clause 18) will not be considered as an appearance.
- Should have secured a CGPA of not less than **8.50**.
- Should NOT have been prevented from writing end Semester examination due to lack of attendance in any of the courses.

## 17.2 FIRST CLASS:

A student who satisfies the following conditions shall be declared to have passed the examination in **First class**:

### **M.E. / M.Tech. M.B.A.(Full Time)**

- Should have passed the examination in all the courses of all four semesters **within three years** , which includes one year of authorized break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable).
- Should have secured a CGPA of not less than **7.00**.

### **M.E. / M.Tech. M.B.A. (Part Time) and M.C.A (Full Time)**

- Should have passed the examination in all the courses of all six semesters **within four years** , which includes one year of authorized break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable).
- Should have secured a CGPA of not less than **7.00**.

## 17.3 SECOND CLASS:

All other students (not covered in clauses 17.1 and 17.2) who qualify for the award of the degree (vide Clause 16.1) shall be declared to have passed the examination in **Second Class**.

- 17.4 A student who is absent in End Semester Examination in a course / project work after having registered for the same shall be considered to have appeared in that examination (except approved withdrawal from end semester examinations as per clause 18) for the purpose of classification.

## 17.5 Photocopy / Revaluation

A candidate can apply for photocopy of his/her semester examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Head of Institutions. The answer script is to be valued and justified by a faculty member, who handled the subject and recommend for revaluation with breakup of marks for each question. Based on the recommendation, the candidate can register for the revaluation through proper application to the Controller of Examinations. The Controller of Examinations will arrange for the revaluation and the results will be intimated to the candidate concerned through the Head of the Institutions. Revaluation is not permitted for practical courses and for project work.

A candidate can apply for revaluation of answer scripts for not exceeding 5 subjects at a time.

## 17.6 Review

Candidates not satisfied with Revaluation can apply for Review of his/ her examination answer paper in a theory course, within the prescribed date on payment of a prescribed fee through proper application to Controller of Examination through the Head of the Institution.

Candidates applying for Revaluation only are eligible to apply for Review.

## 18 PROVISION FOR WITHDRAWAL FROM EXAMINATION:

- 18.1 A student may, for valid reasons, (medically unfit / unexpected family situations / sports approved by Chairman, sports board and HOD) be granted permission to withdraw from appearing for the end semester examination in any course or courses in **ANY ONE** of the semester examinations during the entire duration of the degree programme. The application shall be sent to Director, Student Affairs through the Head of the Institutions with required documents.

- 18.2 Withdrawal application is valid if the student is otherwise eligible to write the examination (Clause 10) and if it is made within TEN days prior to the commencement of the examination in that course or courses and recommended by the Head of the Institution and approved by the Controller of Examinations.
- 18.2.1 Notwithstanding the requirement of mandatory 10 days notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.
- 18.3 In case of withdrawal from a course / courses (Clause 12) the course will figure both in Marks Sheet as well as in Result Sheet. **Withdrawal essentially requires the student to register for the course/courses** The student has to register for the course, fulfill the attendance requirements (vide clause 10), earn continuous assessment marks and attend the end semester examination. However, withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction.
- 18.4 Withdrawal is permitted for the end semester examinations in the final semester only if the period of study the student concerned does not exceed 3 years as per clause 17.1.

## **19 AUTHORIZED BREAK OF STUDY FROM A PROGRAMME**

- 19.1 A student is permitted to go on break of study for a maximum period of one year as a single spell.
- 19.2 Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily discontinue the programme in the middle of the semester for valid reasons, and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he / she applies to the Director, Student Affairs in advance, but not later than the last date for registering for the end semester examination of the semester in question, through the Head of the Institution stating the reasons therefore and the probable date of rejoining the programme.
- 19.3 The candidates permitted to rejoin the programme after break of study / prevention due to lack of attendance, shall be governed by the Curriculum and Regulations in force at the time of rejoining. The students rejoining in new Regulations shall apply to the Director, Academic Courses in the prescribed format through Head of the Institution at the beginning of the readmitted semester itself for prescribing additional courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.
- 19.4 The authorized break of study would not be counted towards the duration specified for passing all the courses for the purpose of classification (vide Clause 17.1).
- 19.5 The total period for completion of the Programme reckoned from, the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 4.1 irrespective of the period of break of study in order that he/she may be eligible for the award of the degree.
- 19.6 If any student is prevented for want of required attendance, the period of prevention shall not be considered as authorized 'Break of Study' (Clause 19.1)

## **20 DISCIPLINE**

- 20.1 Every student is required to observe disciplined and decorous behavior both inside and outside the college and not to indulge in any activity which will tend to bring down the prestige of the University / College. The Head of Institution shall constitute a disciplinary committee consisting of Head of Institution, Two Heads of Department of which one should be from the faculty of the student, to enquire into acts of indiscipline and notify the University about the disciplinary action

recommended for approval. In case of any serious disciplinary action which leads to suspension or dismissal, then a committee shall be constituted including one representative from Anna University, Chennai. In this regard, the member will be nominated by the University on getting information from the Head of the Institution.

20.2 If a student indulges in malpractice in any of the University / internal examination he / she shall be liable for punitive action as prescribed by the University from time to time.

## 21 REVISION OF REGULATIONS, CURRICULUM AND SYLLABI

The University may from time to time revise, amend or change the Regulations, Curriculum, Syllabus and scheme of examinations through the Academic Council with the approval of Syndicate.

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**ANNA UNIVERSITY, CHENNAI  
AFFILIATED INSTITUTIONS  
M.E.APPLIED ELECTRONICS  
REGULATIONS – 2017  
CHOICE BASED CREDIT SYSTEM**

**PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

1. To enable graduates to develop solutions to real world problems in the frontier areas of Applied Electronics.
2. To enable the graduates to adapt to the latest trends in technology through self-learning and to pursue research to meet out the demands in industries and Academia.
3. To enable the graduates to exhibit leadership skills and enhance their abilities through lifelong learning.


**PROGRAM OUTCOMES (POs)**

**Engineering Graduates will be able to:**

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.



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10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### **PROGRAMME SPECIFIC OUTCOMES (PSOs)**

**PSO1:** To critically evaluate the design and provide optimal solutions to problem areas in advanced signal processing, digital system design, embedded systems and VLSI design.

**PSO2:** To enhance and develop electronic systems using modern engineering hardware and software tools.

**PSO3:** To work professionally and ethically in applied electronics and related areas.

### **Mapping of Programme Educational Objectives (PEOs) and the Program Outcomes (Pos):**

| PEOs | PROGRAM OUTCOMES (POS) |     |     |     |     |     |     |     |     |      |      |      |
|------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
|      | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| PEO1 | 3                      | 3   | 3   | 2   | 2   | 1   | 1   | -   | 2   | 3    | 2    | 2    |
| PEO2 | 3                      | 2   | 2   | 2   | 2   | -   | -   | 2   | 3   | 3    | 3    | 3    |
| PEO3 | 3                      | 2   | 2   | 2   | 2   | 1   | 1   | 3   | 2   | 3    | 2    | 3    |

### **Mapping of Programme Specific Outcomes (PSOs) and the Program Outcomes (Pos):**

| PSOs | PROGRAM OUTCOMES (POS) |     |     |     |     |     |     |     |     |      |      |      |
|------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
|      | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| PSO1 | 3                      | 3   | 3   | 2   | 2   | 1   | 1   | 1   | 2   | 3    | 2    | 2    |
| PSO2 | 3                      | 2   | 3   | 2   | 3   | -   | -   | 2   | 3   | 3    | 2    | 2    |
| PSO3 | 3                      | 2   | 2   | 2   | -   | 3   | 1   | 3   | 2   | 3    | 2    | 3    |

**M.E. APPLIED ELECTRONICS  
SEMESTER COURSE WISE PO MAPPING**

|                       |                                | SUBJECTS                                       | PROGRAMME OUTCOMES |     |     |     |     |     |     |     |     |      |      |      |
|-----------------------|--------------------------------|--|--------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
|                       |                                |  | PO1                | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| I<br>Y<br>E<br>A<br>R | SEMESTER I                     | Applied Mathematics for Electronics Engineers  | 3                  | 3   | 2   | 1   |     |     |     | 3   | 2   | 3    |      | 2    |
|                       |                                | Advanced Digital System Design                 | 3                  | 2   | 2   | 2   | 1   |     |     | 3   | 2   | 3    |      | 2    |
|                       |                                | Advanced Digital Signal Processing             | 3                  | 2   | 2   | 2   | 1   |     |     | 3   | 2   | 3    |      | 2    |
|                       |                                | Embedded System Design                         | 3                  | 2   | 2   | 2   | 2   |     |     | 3   | 2   | 3    |      | 2    |
|                       |                                | Sensors, Actuators and Interface Electronics   | 3                  | 2   | 2   | 1   |     |     |     | 3   | 2   | 3    |      | 2    |
|                       |                                | <b>Professional Elective I</b>                 |                    |     |     |     |     |     |     |     |     |      |      |      |
|                       |                                | Digital Control Engineering                    | 3                  | 2   | 2   | 1   |     |     |     | 3   | 2   | 3    |      | 2    |
|                       |                                | Computer Architecture and Parallel Processing  | 3                  | 2   | 2   | 1   |     |     |     | 3   | 2   | 3    |      | 2    |
|                       |                                | CAD for VLSI                                   | 3                  | 2   | 2   | 2   | 1   |     |     | 3   | 2   | 3    |      | 2    |
|                       |                                | Electromagnetic Interference and Compatibility | 3                  | 2   | 2   | 1   |     |     |     | 3   | 2   | 3    |      | 2    |
|                       | Electronic System Design Lab I | 3  | 2                  | 2   | 2   | 2   |     |     | 3   | 3   | 3   |      | 2    |      |
|                       | SEMESTER II                    | Soft Computing and Optimization Techniques     | 3                  | 2   | 2   | 2   | 1   |     |     | 3   | 2   | 3    |      | 2    |
|                       |                                | ASIC and FPGA Design                           | 3                  | 2   | 2   | 2   |     |     |     | 3   | 2   | 3    |      | 2    |
|                       |                                | Hardware – Software Co-design                  | 3                  | 2   | 2   | 2   |     |     |     | 3   | 2   | 3    |      | 2    |
|                       |                                | Digital Image Processing                       | 3                  | 2   | 2   | 2   | 1   |     |     | 3   | 2   | 3    |      | 2    |
|                       |                                | <b>Professional Elective - II</b>              |                    |     |     |     |     |     |     |     |     |      |      |      |
|                       | VLSI Design Techniques         | 3  | 2                  | 2   | 2   | 1   |     |     |     | 3   | 2   | 3    |      | 2    |

|                        |                          |   |   |   |   |   |   |   |   |   |   |   |   |   |
|------------------------|--------------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|
|                        |                          | Nano Electronics  | 3 | 2 | 1 |   |   |   |   | 3 | 2 | 3 |   | 2 |
|                        |                          | Wireless Adhoc and Sensor Networks                          | 3 | 2 | 1 |   |   |   |   | 3 | 2 | 3 |   | 2 |
|                        |                          | High Performance Networks                                   | 3 | 2 | 1 |   |   |   |   | 3 | 2 | 3 |   | 2 |
|                        |                          | <b>Professional Elective - III</b>                          |   |   |   |   |   |   |   |   |   |   |   |   |
|                        |                          | DSP Architectures and Programming                           | 3 | 2 | 2 | 2 | 2 |   |   | 3 | 2 | 3 |   | 2 |
|                        |                          | RF System Design  | 3 | 2 | 2 | 1 |   |   |   | 3 | 2 | 3 |   | 2 |
|                        |                          | Speech and Audio Signal Processing                          | 3 | 2 | 2 | 1 | 1 |   |   | 3 | 2 | 3 |   | 2 |
|                        |                          | Solid State Device Modeling and Simulation                  | 3 | 2 | 2 | 1 |   |   |   | 3 | 2 | 3 |   | 2 |
|                        |                          | Electronic System Design Lab II                             | 3 | 2 | 2 | 2 | 2 |   |   | 3 | 3 | 3 |   | 2 |
|                        |                          | Term Paper Writing and Seminar                              | 3 | 2 | 2 | 1 |   |   |   | 3 | 3 | 3 |   | 3 |
| II<br>Y<br>E<br>A<br>R | SEMESTER III             | Advanced Microprocessors and Microcontrollers Architectures | 3 | 2 | 2 | 2 |   |   |   | 3 | 2 | 3 |   | 2 |
|                        |                          | <b>Professional Elective –IV</b>                            |   |   |   |   |   |   |   |   |   |   |   |   |
|                        |                          | Internet of Things  | 3 | 2 | 2 | 2 | 1 |   |   | 3 | 2 | 3 |   | 2 |
|                        |                          | System on Chip Design                                       | 3 | 2 | 2 | 1 | 1 |   |   | 3 | 2 | 3 |   | 2 |
|                        |                          | Robotics  | 3 | 2 | 2 | 2 | 1 |   |   | 3 | 2 | 3 |   | 2 |
|                        |                          | Physical Design of VLSI Circuits                            | 3 | 2 | 2 | 1 |   |   |   | 3 | 2 | 3 |   | 2 |
|                        |                          | <b>Professional Elective V</b>                              |   |   |   |   |   |   |   |   |   |   |   |   |
|                        |                          | Signal Integrity for High Speed Design                      | 3 | 2 | 1 |   |   |   |   | 3 | 2 | 3 |   | 2 |
|                        |                          | MEMS and NEMS   | 3 | 2 | 1 |   |   |   |   | 3 | 2 | 3 |   | 2 |
|                        | Secure Computing Systems | 3   | 2 | 2 | 1 |   |   |   | 3 | 2 | 3 |   | 2 |   |
|                        | Pattern Recognition      | 3   | 2 | 2 |   |   |   |   | 3 | 2 | 3 |   | 2 |   |
|                        | Project Work Phase I     | 3   | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |   |
|                        | SEM IV                   | 3   | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 | 3 |   |
|                        | Project Work Phase – II  |   |   |   |   |   |   |   |   |   |   |   |   |   |

**ANNA UNIVERSITY, CHENNAI**  
**AFFILIATED INSTITUTIONS**  
**M.E. APPLIED ELECTRONICS**  
**REGULATIONS – 2017**  
**CHOICE BASED CREDIT SYSTEM**  
**CURRICULA AND SYLLABI**

**SEMESTER I**

| SL. NO            | COURSE CODE | COURSE TITLE                                  | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |          |           |
| 1.                | MA5152      | Applied Mathematics for Electronics Engineers | FC       | 4               | 4         | 0        | 0        | 4         |
| 2.                | AP5151      | Advanced Digital System Design                | PC       | 3               | 3         | 0        | 0        | 3         |
| 3.                | AP5152      | Advanced Digital Signal Processing            | PC       | 5               | 3         | 2        | 0        | 4         |
| 4.                | AP5191      | Embedded System Design                        | PC       | 3               | 3         | 0        | 0        | 3         |
| 5.                | AP5101      | Sensors, Actuators and Interface Electronics  | PC       | 3               | 3         | 0        | 0        | 3         |
| 6.                |             | Professional Elective I                       | PC       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |          |           |
| 7.                | AP5111      | Electronic System Design Laboratory I         | PC       | 4               | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>      |             |   |          | <b>25</b>       | <b>19</b> | <b>2</b> | <b>4</b> | <b>22</b> |

**SEMESTER II**

| SL. NO            | COURSE CODE | COURSE TITLE                               | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|--|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |  |          |                 |           |          |          |           |
| 1.                | AP5251      | Soft Computing and Optimization Techniques | PC       | 3               | 3         | 0        | 0        | 3         |
| 2.                | AP5252      | ASIC and FPGA Design                       | PC       | 3               | 3         | 0        | 0        | 3         |
| 3.                | AP5291      | Hardware – Software Co-design              | PC       | 3               | 3         | 0        | 0        | 3         |
| 4.                | AP5292      | Digital Image Processing                   | PC       | 3               | 3         | 0        | 0        | 3         |
| 5.                |             | Professional Elective II                   | PE       | 3               | 3         | 0        | 0        | 3         |
| 6.                |             | Professional Elective III                  | PE       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |  |          |                 |           |          |          |           |
| 7.                | AP5211      | Electronic System Design Laboratory II     | PC       | 4               | 0         | 0        | 4        | 2         |
| 8.                | CP5281      | Term Paper Writing and Seminar             | EEC      | 2               | 0         | 0        | 2        | 1         |
| <b>TOTAL</b>      |             |  |          | <b>24</b>       | <b>18</b> | <b>0</b> | <b>6</b> | <b>21</b> |

**SEMESTER III**

| SL. NO            | COURSE CODE | COURSE TITLE  | CATEGORY | CONTACT PERIODS | L        | T        | P         | C         |
|-------------------|-------------|---|----------|-----------------|----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |          |          |           |           |
| 1.                | AP5301      | Advanced Microprocessors and Microcontrollers Architectures | PC       | 3               | 3        | 0        | 0         | 3         |
| 2.                |             | Professional Elective IV                                    | PE       | 3               | 3        | 0        | 0         | 3         |
| 3.                |             | Professional Elective V                                     | PE       | 3               | 3        | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |   |          |                 |          |          |           |           |
| 4.                | AP5311      | Project Work Phase I  | EEC      | 12              | 0        | 0        | 12        | 6         |
| <b>TOTAL</b>      |             |   |          | <b>21</b>       | <b>9</b> | <b>0</b> | <b>12</b> | <b>15</b> |

**SEMESTER IV**

| SL. NO            | COURSE CODE | COURSE TITLE          | CATEGORY | CONTACT PERIODS | L        | T         | P         | C  |
|-------------------|-------------|-----------------------|----------|-----------------|----------|-----------|-----------|----|
| <b>PRACTICALS</b> |             |                       |          |                 |          |           |           |    |
| 1.                | AP5411      | Project Work Phase II | EEC      | 24              | 0        | 0         | 24        | 12 |
| <b>TOTAL</b>      |             |                       |          | <b>0</b>        | <b>0</b> | <b>24</b> | <b>12</b> |    |

**TOTAL NO. OF CREDITS: 70**

**FOUNDATION COURSES (FC)**

| SL. NO | COURSE CODE | COURSE TITLE                                  | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|---|----------|-----------------|---|---|---|---|
| 1.     | MA5152      | Applied Mathematics for Electronics Engineers | FC       | 4               | 4 | 0 | 0 | 4 |

**PROFESSIONAL CORE (PC)**

| SL. NO | COURSE CODE | COURSE TITLE   | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|--|----------|-----------------|---|---|---|---|
| 1.     | AP5151      | Advanced Digital System Design                           | PC       | 3               | 3 | 0 | 0 | 3 |
| 2.     | AP5152      | Advanced Digital Signal Processing                       | PC       | 5               | 3 | 2 | 0 | 4 |
| 3.     | AP5191      | Embedded System Design                                   | PC       | 3               | 3 | 0 | 0 | 3 |
| 4.     | AP5101      | Sensors, Actuators and Interface Electronics             | PC       | 3               | 3 | 0 | 0 | 3 |
| 5.     | AP5111      | Electronic System Design Lab I                           | PC       | 4               | 0 | 0 | 4 | 2 |
| 6.     | AP5251      | Soft Computing and Optimization Techniques               | PC       | 3               | 3 | 0 | 0 | 3 |
| 7.     | AP5252      | ASIC and FPGA Design                                     | PC       | 3               | 3 | 0 | 0 | 3 |
| 8.     | AP5291      | Hardware – Software Co-design                            | PC       | 3               | 3 | 0 | 0 | 3 |
| 9.     | AP5292      | Digital Image Processing                                 | PC       | 3               | 3 | 0 | 0 | 3 |
| 10.    | AP5211      | Electronic System Design Lab II                          | PC       | 4               | 0 | 0 | 4 | 2 |
| 11.    | AP5301      | Advanced Microprocessor and Microcontroller Architecture | PC       | 3               | 3 | 0 | 0 | 3 |

**EMPLOYABILITY ENHANCEMENT COURSE (EEC)**

| SL. NO | COURSE CODE | COURSE TITLE                   | CATEGORY | CONTACT PERIODS | L | T | P  | C  |
|--------|-------------|--------------------------------|----------|-----------------|---|---|----|----|
| 1.     | CP5281      | Term Paper Writing and Seminar | EEC      | 2               | 0 | 0 | 2  | 1  |
| 2.     | AP5311      | Project Work Phase – I         | EEC      | 12              | 0 | 0 | 12 | 6  |
| 3.     | AP5411      | Project Work Phase – II        | EEC      | 24              | 0 | 0 | 24 | 12 |

**PROFESSIONAL ELECTIVES (PE)\*  
SEMESTER I  
ELECTIVE I**

| SL. NO | COURSE CODE | COURSE TITLE                                   | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|--|----------|-----------------|---|---|---|---|
| 1.     | AP5091      | Digital Control Engineering                    | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.     | AP5001      | Computer Architecture and Parallel Processing  | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.     | AP5002      | CAD for VLSI Circuits                          | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.     | CU5292      | Electromagnetic Interference and Compatibility | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER II  
ELECTIVE II**

| SL. NO | COURSE CODE | COURSE TITLE                       | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|------------------------------------|----------|-----------------|---|---|---|---|
| 1.     | AP5003      | VLSI Design Techniques             | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.     | AP5071      | Nano Electronics                   | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.     | CU5097      | Wireless Adhoc and Sensor Networks | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.     | AP5004      | High Performance Networks          | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER II  
ELECTIVE III**

| SL. NO | COURSE CODE | COURSE TITLE                               | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|--|----------|-----------------|---|---|---|---|
| 1.     | DS5191      | DSP Processor Architecture and Programming | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.     | AP5073      | RF System Design                           | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.     | AP5074      | Speech and Audio Signal Processing         | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.     | AP5092      | Solid State Device Modeling and Simulation | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER III  
ELECTIVE IV**

| <b>SL. NO</b> | <b>COURSE CODE</b> | <b>COURSE TITLE</b>              | <b>CATEGORY</b> | <b>CONTACT PERIODS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|---------------|--------------------|----------------------------------|-----------------|------------------------|----------|----------|----------|----------|
| 1.            | CP5292             | Internet of Things               | PE              | 3                      | 3        | 0        | 0        | 3        |
| 2.            | AP5005             | System on Chip Design            | PE              | 3                      | 3        | 0        | 0        | 3        |
| 3.            | AP5093             | Robotics                         | PE              | 3                      | 3        | 0        | 0        | 3        |
| 4.            | AP5006             | Physical Design of VLSI Circuits | PE              | 3                      | 3        | 0        | 0        | 3        |

**SEMESTER III  
ELECTIVE V**

| <b>SL. NO</b> | <b>COURSE CODE</b> | <b>COURSE TITLE</b>                    | <b>CATEGORY</b> | <b>CONTACT PERIODS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|---------------|--------------------|--|-----------------|------------------------|----------|----------|----------|----------|
| 1.            | AP5094             | Signal Integrity for High Speed Design | PE              | 3                      | 3        | 0        | 0        | 3        |
| 2.            | VL5091             | MEMS and NEMS                          | PE              | 3                      | 3        | 0        | 0        | 3        |
| 3.            | AP5007             | Secure Computing Systems               | PE              | 3                      | 3        | 0        | 0        | 3        |
| 4.            | AP5008             | Pattern Recognition                    | PE              | 3                      | 3        | 0        | 0        | 3        |



**OBJECTIVES:**

The main objective of this course is to demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving and logical thinking applicable in electronics engineering. This course also will help the students to identify, formulate, abstract, and solve problems in electrical engineering using mathematical tools from a variety of mathematical areas, including fuzzy logic, matrix theory, probability, dynamic programming and queuing theory.

**UNIT I FUZZY LOGIC****12**

Classical logic – Multivalued logics – Fuzzy propositions – Fuzzy quantifiers.

**UNIT II MATRIX THEORY****12**

Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR factorization - Least squares method - Singular value decomposition.

**UNIT III PROBABILITY AND RANDOM VARIABLES****12**

Probability – Axioms of probability – Conditional probability – Baye's theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random variable.

**UNIT IV DYNAMIC PROGRAMMING****12**

Dynamic programming – Principle of optimality – Forward and backward recursion – Applications of dynamic programming – Problem of dimensionality.

**UNIT V QUEUEING MODELS****12**

Poisson Process – Markovian queues – Single and multi server models – Little's formula - Machine interference model – Steady state analysis – Self service queue.

**TOTAL: 60 PERIODS****OUTCOMES:**

**After completing this course, students should demonstrate competency in the following skills:**

- Concepts of fuzzy sets, knowledge representation using fuzzy rules, fuzzy logic, fuzzy prepositions and fuzzy quantifiers and applications of fuzzy logic.
- Apply various methods in matrix theory to solve system of linear equations.
- Computation of probability and moments, standard distributions of discrete and continuous random variables and functions of a random variable.
- Conceptualize the principle of optimality and sub-optimization, formulation and computational procedure of dynamic programming
- Exposing the basic characteristic features of a queuing system and acquire skills in analyzing queuing models.
- Using discrete time Markov chains to model computer systems.

**REFERENCES:**

1. Bronson, R., "Matrix Operations", Schaum's Outline Series, McGraw Hill, 2011.
2. George, J. Klir. and Yuan, B., "Fuzzy sets and Fuzzy logic, Theory and Applications", Prentice Hall of India Pvt. Ltd., 1997.
3. Gross, D., Shortle J. F., Thompson, J.M., and Harris, C. M., "Fundamentals of Queueing Theory", 4<sup>th</sup> Edition, John Wiley, 2014.
4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8<sup>th</sup> Edition, 2015.
5. Taha, H.A., "Operations Research: An Introduction", 9<sup>th</sup> Edition, Pearson Education, Asia, New Delhi, 2016.

**OBJECTIVES:**

- To introduce methods to analyze and design synchronous and asynchronous sequential circuits.
- To introduce the architectures of programmable devices.
- To introduce design and implementation of digital circuits using programming tools.

**UNIT I SEQUENTIAL CIRCUIT DESIGN****9**

Analysis of clocked synchronous sequential circuits and modeling- State diagram, state table, state table assignment and reduction-Design of synchronous sequential circuits design of iterative circuits-ASM chart and realization using ASM

**UNIT II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN****9**

Analysis of asynchronous sequential circuit – flow table reduction-races-state assignment-transition table and problems in transition table- design of asynchronous sequential circuit-Static, dynamic and essential hazards – data synchronizers – mixed operating mode asynchronous circuits – designing vending machine controller

**UNIT III FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS****9**

Fault table method-path sensitization method – Boolean difference method-D algorithm - Tolerance techniques – The compact algorithm – Fault in PLA – Test generation-DFT schemes – Built in self test

**UNIT IV SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES****9**

Programming logic device families – Designing a synchronous sequential circuit using PLA/PAL – Realization of finite state machine using PLD – FPGA – Xilinx FPGA-Xilinx 4000

**UNIT V SYSTEM DESIGN USING VERILOG****9**

Hardware Modelling with Verilog HDL – Logic System, Data Types and Operators For Modelling in Verilog HDL - Behavioural Descriptions in Verilog HDL – HDL Based Synthesis – Synthesis of Finite State Machines– structural modeling – compilation and simulation of Verilog code –Test bench - Realization of combinational and sequential circuits using Verilog – Registers – counters – sequential machine – serial adder – Multiplier- Divider – Design of simple microprocessor.

**TOTAL : 45 PERIODS****OUTCOMES:**

**At the end of the course, the student should be able to:**

- Analyze and design sequential digital circuits
- Identify the requirements and specifications of the system required for a given application
- Design and use programming tools for implementing digital circuits of industry standards

**REFERENCES:**

1. Charles H.Roth Jr “Fundamentals of Logic Design” Thomson Learning 2004
2. M.D.Ciletti , Modeling, Synthesis and Rapid Prototyping with the Verilog HDL, Prentice Hall, 1999.
3. M.G.Arnold, Verilog Digital – Computer Design, Prentice Hall (PTR), 1999.
4. Nripendra N Biswas “Logic Design Theory” Prentice Hall of India,2001
5. Parag K.Lala “Digital system Design using PLD” B S Publications,2003
6. Parag K.Lala “Fault Tolerant and Fault Testable Hardware Design” B S Publications,2002
7. S. Palnitkar , Verilog HDL – A Guide to Digital Design and Synthesis, Pearson , 2003.

**OBJECTIVES:**

- The student comprehends mathematical description and modelling of discrete time random signals.
- The student is conversant with important theorems and random signal processing algorithms.
- The student learns relevant figures of merit such as power, energy, bias and consistency.
- The student is familiar with estimation, prediction, filtering, multirate concepts and techniques.

**UNIT I DISCRETE RANDOM SIGNAL PROCESSING 9+6**

Discrete random processes – Ensemble averages – Wide sense stationary process – Properties - Ergodic process – Sample mean & variance - Auto-correlation and Auto-correlation matrices- Properties – White noise process – Weiner Khitchine relation - Power spectral density – Filtering random process – Spectral Factorization Theorem – Special types of Random Processes – AR,MA, ARMA Processes – Yule-Walker equations.

**UNIT II SPECTRUM ESTIMATION 9+6**

Bias and Consistency of estimators - Non-Parametric methods – Periodogram – Modified Periodogram – Barlett's method – Welch's method – Blackman-Tukey method – Parametric methods – AR, MA and ARMA spectrum estimation - Performance analysis of estimators.

**UNIT III SIGNAL MODELING AND OPTIMUM FILTERS 9+6**

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 -- Mean square error – Discrete Kalman filter.

**UNIT IV ADAPTIVE FILTERS 9+6**

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.

**UNIT V MULTIRATE SIGNAL PROCESSING 9+6**

Decimation - Interpolation – Sampling Rate conversion by a rational factor I/D – Multistage implementation of sampling rate conversion – Polyphase filter structures – Applications of multirate signal processing.

**TOTAL45+30: 75 PERIODS****OUTCOMES:**

- Formulate time domain and frequency domain description of Wide Sense Stationary process in terms of matrix algebra and relate to linear algebra concepts.
- State W-K theorem, spectral factorization theorem, spectrum estimation, bias and consistency of estimators.
- Wiener filtering, LMS algorithms, Levinson recursion algorithm, applications of adaptive filters
- Decimation, interpolation, Sampling rate conversion, Applications of multirate signal processing



**OUTCOMES:**

**At the end of this course, the students should be able to:**

- Explain different protocols
- Discuss state machine and design process models
- Outline embedded software development tools and RTOS

**REFERENCES:**

1. Bruce Powel Douglas, "Real time UML, second edition: Developing efficient objects for embedded systems", 3rd Edition 1999, Pearson Education.
2. Daniel W. Lewis, "Fundamentals of embedded software where C and assembly meet", Pearson Education, 2002.
3. Frank Vahid and Tony Gwargie, "Embedded System Design", John Wiley & sons, 2002.
4. Steve Heath, "Embedded System Design", Elsevier, Second Edition, 2004.

**AP5101**

**SENSORS, ACTUATORS AND INTERFACE ELECTRONICS**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- Understand static and dynamic characteristics of measurement systems.
- Study various types of sensors.
- Study different types of actuators and their usage.
- Study State-of-the-art digital and semiconductor sensors.

**UNIT I INTRODUCTION TO MEASUREMENT SYSTEMS**

**9**

Introduction to measurement systems: general concepts and terminology, measurement systems, sensor classification, general input-output configuration, methods of correction, performance characteristics: static characteristics of measurement systems, accuracy, precision, sensitivity, other characteristics: linearity, resolution, systematic errors, random errors, dynamic characteristics of measurement systems: zero-order, first-order, and second-order measurement systems and response.

**UNIT II RESISTIVE AND REACTIVE SENSORS**

**9**

Resistive sensors: potentiometers, strain gages, resistive temperature detectors, magneto resistors, light-dependent resistors, Signal conditioning for resistive sensors: Wheatstone bridge, sensor bridge calibration and compensation, Instrumentation amplifiers, sources of interference and interference reduction, Reactance variation and electromagnetic sensors, capacitive sensors, differential, inductive sensors, linear variable differential transformers (LVDT), magneto elastic sensors, hall effect sensors, Signal conditioning for reactance-based sensors & application to the LVDT.

**UNIT III SELF-GENERATING SENSORS**

**9**

Self-generating sensors: thermoelectric sensors, piezoelectric sensors, pyroelectric sensors, photovoltaic sensors, electrochemical sensors, Signal conditioning for self-generating sensors: chopper and low-drift amplifiers, offset and drifts amplifiers, electrometer amplifiers, charge amplifiers, noise in amplifiers.

**UNIT IV ACTUATORS DRIVE CHARACTERISTICS AND APPLICATIONS**

**9**





**TOTAL :45 PERIODS**



**OUTCOMES:****Upon Completion of the course, the students will be able to:**

- Implement machine learning through Neural networks.
- Develop a Fuzzy expert system.
- Model Neuro Fuzzy system for clustering and classification.
- Able to use the optimization techniques to solve the real world problems

**REFERENCES :**

1. David E. Goldberg, Genetic Algorithms in Search, Optimization and Machine Learning, Addison wesley, 2009.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic-Theory and Applications, Prentice Hall, 1995.
3. James A. Freeman and David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Edn., 2003.
4. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, Neuro-Fuzzy and Soft Computing, Prentice-Hall of India, 2003.
5. Mitchell Melanie, An Introduction to Genetic Algorithm, Prentice Hall, 1998.
6. Simon Haykins, Neural Networks: A Comprehensive Foundation, Prentice Hall International Inc, 1999.
7. Singiresu S. Rao, Engineering optimization Theory and practice, John Wiley & sons, inc, Fourth Edition, 2009
8. Timothy J. Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997.
9. Venkata Rao, Vimal J. Savsani, Mechanical Design Optimization Using Advanced Optimization Techniques, springer 2012

**AP5252****ASIC AND FPGA DESIGN****L T P C  
3 0 0 3****OBJECTIVES:**

- To study the design flow of different types of ASIC.
- To familiarize the different types of programming technologies and logic devices.
- To learn the architecture of different types of FPGA.
- To gain knowledge about partitioning, floor planning, placement and routing including circuit extraction of ASIC

**UNIT I OVERVIEW OF ASIC AND PLD****9**

Types of ASICs - Design flow – CAD tools used in ASIC Design – Programming Technologies: Antifuse – static RAM – EPROM and EEPROM technology, Programmable Logic Devices: ROMs and EPROMs – PLA –PAL. Gate Arrays – CPLDs and FPGAs

**UNIT II ASIC PHYSICAL DESIGN****9**

System partition -partitioning - partitioning methods – interconnect delay models and measurement of delay - floor planning - placement – Routing: global routing - detailed routing - special routing - circuit extraction - DRC

**UNIT III LOGIC SYNTHESIS, SIMULATION AND TESTING****9**

Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools -EDIF- CFI design representation. Verilog and logic synthesis -VHDL and logic synthesis - types of simulation -boundary scan test - fault simulation - automatic test pattern generation.

**UNIT IV FIELD PROGRAMMABLE GATE ARRAYS****9**

FPGA Design : FPGA Physical Design Tools -Technology mapping - Placement & routing - Register transfer (RT)/Logic Synthesis - Controller/Data path synthesis - Logic minimization.

**UNIT V SOC DESIGN****9**

System-On-Chip Design - SoC Design Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus-Based Communication Architectures. High performance algorithms for ASICs/ SoCs as case studies: Canonical Signed Digit Arithmetic, Knowledge Crunching Machine, Distributed Arithmetic, High performance digital filters for sigma-delta ADC.

**TOTAL: 45 PERIODS****OUTCOMES:**

- To analyze the synthesis, Simulation and testing of systems.
- To apply different high performance algorithms in ASICs.
- To discuss the design issues of SOC.

**REFERENCES:**

1. David A.Hodges, Analysis and Design of Digital Integrated Circuits (3/e), MGH 2004
2. H.Gerez, Algorithms for VLSI Design Automation, John Wiley, 1999
3. Jan. M. Rabaey et al, Digital Integrated Circuit Design Perspective (2/e), PHI 2003
4. M.J.S. Smith : Application Specific Integrated Circuits, Pearson, 2003
5. J. Old Field, R.Dorf, Field Programmable Gate Arrays, John Wiley& Sons, Newyork.
6. P.K.Chan& S. Mourad, Digital Design using Field Programmable Gate Array, Prentice Hall.
7. Sudeep Pasricha and NikilDutt, On-Chip Communication Architectures System on Chip Interconnect, Elsevier, 2008
8. S.Trimberger, Edr., Field Programmable Gate Array Technology, Kluwer Academic Pub.
9. S.Brown,R.Francis, J.Rose, Z.Vransic, Field Programmable GateArray, Kluwer Pub. 5. Richard FJinder , "Engineering Digital Design,"Academic press

**AP5291****HARDWARE - SOFTWARE CO-DESIGN****L T P C  
3 0 0 3****OBJECTIVES:**

- To acquire the knowledge about system specification and modelling.
- To learn the formulation of partitioning
- To study the different technical aspects about prototyping and emulation.

**UNIT I SYSTEM SPECIFICATION AND MODELLING****9**

Embedded Systems, Hardware/Software Co-Design, Co-Design for System Specification and Modeling , Co-Design for Heterogeneous Implementation - Single-Processor Architectures with one ASIC and many ASICs, Multi-Processor Architectures, Comparison of Co- Design Approaches, Models of Computation, Requirements for Embedded System Specification.

**UNIT II HARDWARE / SOFTWARE PARTITIONING****9**

The Hardware/Software Partitioning Problem, Hardware-Software Cost Estimation, Generation of the Partitioning Graph, Formulation of the HW/SW Partitioning Problem, Optimization , HW/SW Partitioning based on Heuristic Scheduling, HW/SW Partitioning based on Genetic Algorithms .

**UNIT III HARDWARE / SOFTWARE CO-SYNTHESIS****9**

The Co-Synthesis Problem, State-Transition Graph, Refinement and Controller Generation, Co-Synthesis Algorithm for Distributed System- Case Studies with any one application.



**UNIT III      SEGMENTATION OF GRAY LEVEL IMAGES      9**

Histogram of gray level images, multilevel thresholding, Optimal thresholding using Bayesian classification, Watershed and Dam Construction algorithms for segmenting gray level image. Detection of edges and lines: First order and second order edge operators, multi-scale edge detection, Canny's edge detection algorithm, Hough transform for detecting lines and curves, edge linking.

**UNIT IV      IMAGE ENHANCEMENT AND COLOR IMAGE PROCESSING      9**

Point processing, Spatial Filtering, Frequency domain filtering, multi-spectral image enhancement, image restoration. Color Representation, Laws of color matching, chromaticity diagram, color enhancement, color image segmentation, color edge detection, color demosaicing.

**UNIT V      IMAGE COMPRESSION      9**

Lossy and lossless compression schemes, prediction based compression schemes, vector quantization, sub-band encoding schemes, JPEG compression standard, Fractal compression scheme, Wavelet compression scheme.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**At the end of this course, the students should be able to:**

- Discuss image enhancement techniques
- Explain color image processing
- Compare image compression schemes

**REFERENCES:**

1. A.K. Jain, "Fundamentals of Digital Image Processing", Prentice-Hall, Addison-Wesley, 1989.
2. B. Jähne, "Practical Handbook on Image Processing for Scientific Applications", CRC Press, 1997.
3. Bernd Jähne, Digital Image Processing, Springer-Verlag Berlin Heidelberg 2005.
4. Bovik (ed.), "Handbook of Image and Video Processing", Academic Press, 2000.
5. Gonzalez and Woods, Digital Image Processing, Prentice-Hall.
6. J. C. Russ. The Image Processing Handbook. CRC, Boca Raton, FL, 4th edn., 2002.
7. J. S. Lim, "Two-dimensional Signal and Image Processing" Prentice-Hall, 1990.
8. M. Petrou, P. Bosdogianni, "Image Processing, The Fundamentals", Wiley, 1999.
9. Rudra Pratap, Getting Started With MATLAB 7. Oxford University Press, 2006
10. Stephane Marchand-Maillet, Yazid M. Sharaiha, Binary Digital Image Processing, A Discrete Approach, Academic Press, 2000.
11. W. K. Pratt. Digital image processing, PIKS Inside. Wiley, New York, 3rd, edn., 2001.

**AP5211**

**ELECTRONICS SYSTEM DESIGN LABORATORY II**

**L T P C  
0 0 4 2**

**OBJECTIVES:**

- To study of 32 bit ARM7 microcontroller RTOS and its application
- To understand testing RTOS environment and system programming
- To learn wireless network design using embedded systems
- To learn System design using ASIC
- To know use of Verilog and VHDL in sequential digital system modeling

1. Study of 32 bit ARM7 microcontroller RTOS and its application
2. Testing RTOS environment and system programming
3. Designing of wireless network using embedded systems
4. Implementation of ARM with FPGA
5. Design and Implementation of ALU in FPGA using VHDL and Verilog
6. Modeling of Sequential Digital system using Verilog and VHDL
7. Flash controller programming - data flash with erase, verify and fusing
8. System design using ASIC
9. Design, simulation and analysis of signal integrity

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**At the end of this course, the students should be able to:**

- Utilize ARM with FPGA
- Demonstrate design of ALU in FPGA using VHDL and Verilog
- Assess flash controller programming - data flash with erase, verify and fusing
- Explain design, simulation and analysis of signal integrity

**CP5281**

**TERM PAPER WRITING AND SEMINAR**

**L T P C  
0 0 2 1**

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained.

Activities to be carried Out

| <b>Activity</b>                         | <b>Instructions</b>   | <b>Submission week</b> | <b>Evaluation</b>   |
|---|---|------------------------|---|
| Selection of area of interest and Topic | You are requested to select an area of interest, topic and state an objective | 2 <sup>nd</sup> week   | <b>3 %</b><br>Based on clarity of thought, current relevance and clarity in writing |
| Stating an Objective                    |   |                        |   |

|  |   |                      |   |
|--|---|----------------------|---|
| Collecting Information about your area & topic   | <ol style="list-style-type: none"> <li>1. List 1 Special Interest Groups or professional society</li> <li>2. List 2 journals</li> <li>3. List 2 conferences, symposia or workshops</li> <li>4. List 1 thesis title</li> <li>5. List 3 web presences (mailing lists, forums, news sites)</li> <li>6. List 3 authors who publish regularly in your area</li> <li>7. Attach a call for papers (CFP) from your area.</li> </ol>   | 3 <sup>rd</sup> week | <b>3%</b><br>( the selected information must be area specific and of international and national standard)                                     |
| Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter | <ul style="list-style-type: none"> <li>• You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar</li> <li>• When picking papers to read - try to: <ul style="list-style-type: none"> <li>• Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them,</li> <li>• Favour papers from well-known journals and conferences,</li> <li>• Favour “first” or “foundational” papers in the field (as indicated in other people’s survey paper),</li> <li>• Favour more recent papers,</li> <li>• Pick a recent survey of the field so you can quickly gain an overview,</li> <li>• Find relationships with respect to each other and to your topic area (classification scheme/categorization)</li> <li>• Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered.</li> </ul> </li> </ul> | 4 <sup>th</sup> week | <b>6%</b> ( the list of standard papers and reason for selection)   |
| Reading and notes for first 5 papers   | <p>Reading Paper Process</p> <ul style="list-style-type: none"> <li>• For each paper form a Table answering the following questions:</li> <li>• What is the main topic of the article?</li> <li>• What was/were the main issue(s) the author said they want to discuss?</li> <li>• Why did the author claim it was important?</li> <li>• How does the work build on other’s work, in the author’s opinion?</li> <li>• What simplifying assumptions does the author claim to be making?</li> <li>• What did the author do?</li> <li>• How did the author claim they were going to evaluate their work and</li> </ul>   | 5 <sup>th</sup> week | <b>8%</b> ( the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper) |

|                                      |  |  |   |
|--------------------------------------|--|--|---|
|                                      | <p>compare it to others?</p> <ul style="list-style-type: none"> <li>• What did the author say were the limitations of their research?</li> <li>• What did the author say were the important directions for future research?</li> </ul> <p>Conclude with limitations/issues not addressed by the paper ( from the perspective of your survey)</p> |  |   |
| Reading and notes for next 5 papers  | Repeat Reading Paper Process   | 6 <sup>th</sup> week                     | <b>8%</b> ( the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper) |
| Reading and notes for final 5 papers | Repeat Reading Paper Process   | 7 <sup>th</sup> week                     | <b>8%</b> ( the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper) |
| Draft outline 1 and Linking papers   | Prepare a draft Outline, your survey goals, along with a classification / categorization diagram   | 8 <sup>th</sup> week                     | <b>8%</b> ( this component will be evaluated based on the linking and classification among the papers)  |
| Abstract                             | Prepare a draft abstract and give a presentation   | 9 <sup>th</sup> week                     | <b>6%</b><br>(Clarity, purpose and conclusion)<br><b>6%</b> Presentation & Viva Voce  |
| Introduction Background              | Write an introduction and background sections  | 10 <sup>th</sup> week                    | <b>5%</b> ( clarity)  |
| Sections of the paper                | Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey   | 11 <sup>th</sup> week                    | <b>10%</b> (this component will be evaluated based on the linking and classification among the papers)  |
| Your conclusions                     | Write your conclusions and future work   | 12 <sup>th</sup> week                    | <b>5%</b> ( conclusions – clarity and your ideas)   |
| Final Draft                          | Complete the final draft of your paper   | 13 <sup>th</sup> week                    | <b>10%</b> (formatting, English, Clarity and linking)<br><b>4%</b> Plagiarism Check Report  |
| Seminar                              | A brief 15 slides on your paper  | 14 <sup>th</sup> & 15 <sup>th</sup> week | <b>10%</b> (based on presentation and Viva-voce)  |

**TOTAL : 30 PERIODS**





## REFERENCES:

1. Barry. B. Breg, "The Intel Microprocessors", PHI, 2008.
2. Gene .H. Miller . "Micro Computer Engineering", Pearson Education, 2003.
3. Intel Inc, "Intel 64 and IA-32 Architectures Developer's Manual", Volume-I, 2016
4. Joseph Yiu, "The Definitive Guide to the ARM @ Cortex-M3", Newnes, 2010.
5. Scott Mueller, "Upgrading and Repairing PCs", 20<sup>th</sup> edition, Que.
6. Steve Furber, "ARM System –On –Chip architecture", Addison Wesley, 2000.
7. Trevor Martin, "The Designer's Guide to the Cortex-M Processor Family", Newnes, 2013.

AP5091

DIGITAL CONTROL ENGINEERING

L T P C  
3 0 0 3

## OBJECTIVES:

- The student learns the principles of PI, PD, PID controllers.
- The student analyses time and frequency response discrete time control system.
- The student is familiar with digital control algorithms.
- The student has the knowledge to implement PID control algorithms.

### UNIT I CONTROLLERS IN FEEDBACK SYSTEMS 9

Review of frequency and time response analysis and specifications of first order and second order feedback control systems, need for controllers, continuous time compensations, continuous time PI, PD, PID controllers, digital PID controllers.

### UNIT II BASIC DIGITAL SIGNAL PROCESSING IN CONTROL SYSTEMS 9

Sampling theorem, quantization, aliasing and quantization error, hold operation, mathematical model of sample and hold, zero and first order hold, factors limiting the choice of sampling rate, reconstruction.

### UNIT III MODELING OF SAMPLED DATA CONTROL SYSTEM 9

Difference equation description, Z-transform method of description, pulse transfer function, time and frequency response of discrete time control systems, stability of digital control systems, Jury's stability test, state space description, first companion, second companion, Jordan canonical models, discrete state variable models (elementary principles only).

### UNIT IV DESIGN OF DIGITAL CONTROL ALGORITHMS 9

Review of principle of compensator design, Z-plane specifications, digital compensator design using frequency response plots, discrete integrator, discrete differentiator, development of digital PID controller, transfer function, design in the Z-plane.

### UNIT V PRACTICAL ASPECTS OF DIGITAL CONTROL ALGORITHMS 9

Algorithm development of PID control algorithms, standard programmes for microcontroller implementation, finite word length effects, choice of data acquisition systems, microcontroller based temperature control systems, microcontroller based motor speed control systems, DSP implementation of motor control system.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Describe continuous time and discrete time controllers analytically.
- Define and state basic analog to digital and digital to analog conversion principles.
- Analyze sampled data control system in time and frequency domains.
- Design simple PI, PD, PID continuous and digital controllers.
- Develop schemes for practical implementation of temperature and motor control systems.

**REFERENCES:**

1. John J. D'Azzo, "Constantive Houpios, Linear Control System Analysis and Design", Mc Graw Hill,1995.
2. Kenneth J. Ayala, "The 8051 Microcontroller- Architecture, Programming and Applications", Penram International, 2<sup>nd</sup> Edition, 1996.
3. M.Gopal, "Digital Control and Static Variable Methods", Tata McGraw Hill, New Delhi, 1997.

**AP5001****COMPUTER ARCHITECTURE AND PARALLEL PROCESSING****L T P C  
3 0 0 3****OBJECTIVES:**

- Understand the difference between pipeline and parallel processing concepts
- Study various types of processor architectures and the importance of scalable architectures
- Study Memory Architectures, Memory Technology and Optimization.

**UNIT I COMPUTER DESIGN AND PERFORMANCE MEASURES****9**

Fundamentals of Computer Design – Parallel and Scalable Architectures – Multiprocessors –Multi-vector and SIMD architectures – Multithreaded architectures – Stanford Dash multiprocessor – KSR1 - Data-flow architectures - Performance Measures

**UNIT II PARALLEL PROCESSING, PIPELINING AND ILP****9**

Instruction Level Parallelism and Its Exploitation - Concepts and Challenges - Pipelining processors - Overcoming Data Hazards with Dynamic Scheduling – Dynamic Branch Prediction - Speculation - Multiple Issue Processors - Performance and Efficiency in Advanced Multiple Issue Processors

**UNIT III MEMORY HIERARCHY DESIGN****9**

Memory Hierarchy - Memory Technology and Optimizations – Cache memory – Optimizations of Cache Performance – Memory Protection and Virtual Memory - Design of Memory Hierarchies.

**UNIT IV MULTIPROCESSORS****9**

Symmetric and distributed shared memory architectures – Cache coherence issues – Performance Issues – Synchronization issues – Models of Memory Consistency - Interconnection networks – Buses, crossbar and multi-stage switches.

**UNIT V MULTI-CORE ARCHITECTURES****9**

Software and hardware multithreading – SMT and CMP architectures – Design issues – Case-studies – Intel Multi-core architecture – SUN CMP architecture – IBM cell architecture – hp architecture.

**TOTAL : 45 PERIODS****OUTCOMES:**

- Explain design of memory hierarchies
- Assess Performance Issues and Synchronization issues
- Compare multicore architectures

## REFERENCES:

1. David E. Culler, Jaswinder Pal Singh, "Parallel Computing Architecture: A hardware/ software approach", Morgan Kaufmann / Elsevier, 1997
2. Dimitrios Soudris, Axel Jantsch, "Scalable Multi-core Architectures: Design Methodologies and Tools", Springer, 2012
3. Hwang Briggs, "Computer Architecture and parallel processing", McGraw Hill, 1984.
4. John L. Hennessy and David A. Patterson, "Computer Architecture – A quantitative approach", Morgan Kaufmann / Elsevier, 4th. edition, 2007
5. John P. Hayes, "Computer Architecture and Organization", McGraw Hill
6. John P. Shen, "Modern processor design. Fundamentals of super scalar processors", Tata McGraw Hill 2003
7. Kai Hwang, "Advanced Computer Architecture", McGraw Hill International, 2001
8. William Stallings, "Computer Organization and Architecture – Designing for Performance", Pearson Education, Seventh Edition, 2006

**AP5002**

**CAD FOR VLSI CIRCUITS**

**L T P C  
3 0 0 3**

## OBJECTIVES:

- To study various physical design methods in VLSI.
- To understand the concepts behind the VLSI design rules and routing techniques.
- To understand the concepts of various algorithms used for floor planning and routing techniques.

### **UNIT I INTRODUCTION TO VLSI DESIGN FLOW 9**

Introduction to VLSI Design methodologies, Basics of VLSI design automation tools, Algorithmic Graph Theory and Computational Complexity, Tractable and Intractable problems, General purpose methods for combinatorial optimization.

### **UNIT II LAYOUT, PLACEMENT AND PARTITIONING 9**

Layout Compaction, Design rules, Problem formulation, Algorithms for constraint graph compaction, Placement and partitioning, Circuit representation, Placement algorithms, Partitioning

### **UNIT III FLOOR PLANNING AND ROUTING 9**

Floor planning concepts, Shape functions and floorplan sizing, Types of local routing problems, Area routing, Channel routing, Global routing, Algorithms for global routing.

### **UNIT IV SIMULATION AND LOGIC SYNTHESIS 9**

Simulation, Gate-level modeling and simulation, Switch-level modeling and simulation, Combinational Logic Synthesis, Binary Decision Diagrams, Two Level Logic Synthesis.

### **UNIT V HIGH LEVEL SYNTHESIS 9**

Hardware models for high level synthesis, internal representation, allocation, assignment and scheduling, scheduling algorithms, Assignment problem, High level transformations.

**TOTAL: 45 PERIODS**

## OUTCOMES:

- To use the simulation techniques at various levels in VLSI design flow
- Discuss the concepts of floor planning and routing
- Outline high level synthesis

## REFERENCES:

1. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.
2. S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons, 2002.
3. Sadiq M. Sait, Habib Youssef, "VLSI Physical Design automation: Theory and Practice", World scientific 1999.
4. Steven M. Rubin, "Computer Aids for VLSI Design", Addison Wesley Publishing 1987.

CU5292

ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY

L T P C  
3 0 0 3

## OBJECTIVES:

The students should be made to be familiar with:

- The basics of EMI
- EMI sources.
- EMI problems.
- Solution methods in PCB.
- Measurements techniques for emission.
- Measurement techniques for immunity.

### UNIT I BASIC THEORY

9

Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case Histories, Radiation hazards to humans, Various issues of EMC, EMC Testing categories EMC Engineering Application.

### UNIT II COUPLING MECHANISM

9

Electromagnetic field sources and Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radioactive coupling, Ground loop coupling, Cable related emissions and coupling, Transient sources, Automotive transients.

### UNIT III EMI MITIGATION TECHNIQUES

9

Working principle of Shielding and Murphy's Law, LF Magnetic shielding, Apertures and shielding effectiveness, Choice of Materials for H, E, and free space fields, Gasketting and sealing, PCB Level shielding, Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems, Filter types and operation, Surge protection devices, Transient Protection.

### UNIT IV STANDARD AND REGULATION

9

Need for Standards, Generic/General Standards for Residential and Industrial environment, Basic Standards, Product Standards, National and International EMI Standardizing Organizations; IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, ACEC. Electro Magnetic Emission and susceptibility standards and specifications, MIL461E Standards.

## **UNIT V EMI TEST METHODS AND INSTRUMENTATION**

**9**

Fundamental considerations, EMI Shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber, Shielded anechoic chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Antennas, Current probes, MIL -STD test methods, Civilian STD test methods.

**TOTAL: 45 PERIODS**

### **OUTCOMES:**

**At the end of this course, the student should be able to:**

- Identify Standards
- Compare EMI test methods
- Discuss EMI mitigation techniques

### **REFERENCES:**

1. Bemhard Keiser, "Principles of Electromagnetic Compatibility", 3<sup>rd</sup> Ed, Artech house, Norwood, 1986.
2. Clayton Paul, "Introduction to Electromagnetic Compatibility", Wiley Interscience, 2006.
3. Daryl Gerke and William Kimmel, "EDN's Designer's Guide to Electromagnetic Compatibility", Elsevier Science & Technology Books, 2002
4. Dr Kenneth L Kaiser, "The Electromagnetic Compatibility Handbook", CRC Press 2005.
5. Electromagnetic Compatibility by Norman Violette, Published by Springer, 2013
6. Electromagnetic Interference and Compatibility: Electrical noise and EMI specifications Volume 1 of A Handbook Series on Electromagnetic Interference and Compatibility, Donald R. J. White Publisher-Don white consultants Original from the University of Michigan Digitized 6 Dec 2007
7. Henry W. Ott, "Electromagnetic Compatibility Engineering", John Wiley & Sons Inc, Newyork, 2009
8. V Prasad Kodali, "Engineering Electromagnetic Compatibility", IEEE Press, Newyork, 2001.
9. W Scott Bennett, "Control and Measurement of Unintentional Electromagnetic Radiation", John Wiley & Sons Inc., (Wiley Interscience Series) 1997.

**AP5003**

**VLSI DESIGN TECHNIQUES**

**L T P C  
3 0 0 3**

### **OBJECTIVES:**

- This course deals comprehensively with all aspects of transistor level design of all the digital building blocks common to all CMOS microprocessors, DSPs, network processors, digital backend of all wireless systems etc.
- The focus will be on the transistor level design and will address all important issues related to size, speed and power consumption. The units are classified according to the important building and will introduce the principles and design methodology in terms of the dominant circuit choices, constraints and performance measures.

## **UNIT I MOS TRANSISTOR PRINCIPLES AND CMOS INVERTER**

**12**

MOS(FET) Transistor Characteristic under Static and Dynamic Conditions, MOS Transistor Secondary Effects, Process Variations, Technology Scaling, Internet Parameter and electrical wise models CMOS Inverter - Static Characteristic, Dynamic Characteristic, Power, Energy, and Energy Delay parameters.

|  |  |          |
|--|--|----------|
| <b>UNIT II</b>   | <b>COMBINATIONAL LOGIC CIRCUITS</b>                        | <b>9</b> |
| Propagation Delays, Stick diagram, Layout diagrams, Examples of combinational logic design, Elmore's constant, Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation, Low Power Design principles. |  |          |
| <b>UNIT III</b>  | <b>SEQUENTIAL LOGIC CIRCUITS</b>                           | <b>9</b> |
| Static Latches and Registers, Dynamic Latches and Registers, Timing Issues, Pipelines, Pulse and sense amplifier based Registers, Nonbistable Sequential Circuits.   |  |          |
| <b>UNIT IV</b>   | <b>ARITHMETIC BUILDING BLOCKS AND MEMORY ARCHITECTURES</b> | <b>9</b> |
| Data path circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters, Speed and Area Tradeoffs, Memory Architectures, and Memory control circuits.                                     |  |          |
| <b>UNIT V</b>  | <b>INTERCONNECT AND CLOCKING STRATEGIES</b>                | <b>6</b> |
| Interconnect Parameters – Capacitance, Resistance, and Inductance, Electrical Wire Models, Timing classification of Digital Systems, Synchronous Design, Self-Timed Circuit Design.                        |  |          |

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**At the end of the course, the student should be able to:**

- Carry out transistor level design of the most important building blocks used in digital CMOS VLSI circuits.
- Discuss design methodology of arithmetic building block
- Analyze tradeoffs of the various circuit choices for each of the building block.

**REFERENCES:**

1. Jacob Baker "CMOS: Circuit Design, Layout, and Simulation, Third Edition", Wiley IEEE Press 2010.
2. Jan Rabaey, Anantha Chandrakasan, B Nikolic, "Digital Integrated Circuits: A Design Perspective". Prentice Hall of India 2<sup>nd</sup> Edition, Feb 2003,
3. M J Smith, "Application Specific Integrated Circuits", Addison Wesley, 1997
4. N.Weste, K. Eshraghian, "Principles of CMOS VLSI Design". Addison Wesley, 2<sup>nd</sup> Edition, 1993

**AP5071**

**NANOELECTRONICS**

**L T P C**  
**3 0 0 3**

**OBJECTIVES**

- To understand how transistor as Nano device
- To understand various forms of Nano Devices
- To understand the Nano Sensors

|  |                                   |          |
|--|-----------------------------------|----------|
| <b>UNIT I</b>  | <b>SEMICONDUCTOR NANO DEVICES</b> | <b>9</b> |
| Single-Electron Devices; Nano scale MOSFET – Resonant Tunneling Transistor - Single-Electron Transistors; Nanorobotics and Nanomanipulation; Mechanical Molecular Nanodevices; Nanocomputers: Optical Fibers for Nanodevices; Photochemical Molecular Devices; DNA-Based Nanodevices; Gas-Based Nanodevices. |                                   |          |

**UNIT II ELECTRONIC AND PHOTONIC MOLECULAR MATERIALS 9**

Preparation – Electroluminescent Organic materials - Laser Diodes - Quantum well lasers:- Quantum cascade lasers- Cascade surface-emitting photonic crystal laser- Quantum dot lasers - Quantum wire lasers:- White LEDs - LEDs based on nanowires - LEDs based on nanotubes - LEDs based on nanorods - High Efficiency Materials for OLEDs- High Efficiency Materials for OLEDs - Quantum well infrared photo detectors.

**UNIT III THERMAL SENSORS 9**

Thermal energy sensors -temperature sensors, heat sensors - Electromagnetic sensors - electrical resistance sensors, electrical current sensors, electrical voltage sensors, electrical power sensors, magnetism sensors - Mechanical sensors - pressure sensors, gas and liquid flow sensors, position sensors - Chemical sensors - Optical and radiation sensors.

**UNIT IV GAS SENSOR MATERIALS 9**

Criteria for the choice of materials - Experimental aspects – materials, properties, measurement of gas sensing property, sensitivity; Discussion of sensors for various gases, Gas sensors based on semiconductor devices.

**UNIT V BIOSENSORS 9**

Principles - DNA based biosensors – Protein based biosensors – materials for biosensor applications - fabrication of biosensors - future potential.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- To be able to simulate and design the nano device
- To be able to simulate and design the nano sensors

**REFERENCES:**

1. K.E. Drexler, “Nano systems”, Wiley, 1992.
2. M.C. Petty, “Introduction to Molecular Electronics”, 1995.
3. W. Ranier, “Nano Electronics and Information Technology”, Wiley, 2003.

**CU5097 WIRELESS ADHOC AND SENSOR NETWORKS L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To understand the basics of Ad-hoc & Sensor Networks.
- To learn various fundamental and emerging protocols of all layers.
- To study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and sensor networks.
- To understand the nature and applications of Ad-hoc and sensor networks.
- To understand various security practices and protocols of Ad-hoc and Sensor Networks.

**UNIT I MAC & TCP IN AD HOC NETWORKS 9**

Fundamentals of WLANs – IEEE 802.11 Architecture - Self configuration and Auto configuration-Issues in Ad-Hoc Wireless Networks – MAC Protocols for Ad-Hoc Wireless Networks – Contention Based Protocols - TCP over Ad-Hoc networks-TCP protocol overview - TCP and MANETs – Solutions for TCP over Ad-Hoc Networks.





**OBJECTIVES:**

- To develop a comprehensive understanding of multimedia networking.
- To study the types of VPN and tunneling protocols for security.
- To learn about network security in many layers and network management.

**UNIT I INTRODUCTION 9**

Review of OSI, TCP/IP; Multiplexing, Modes of Communication, Switching, Routing. SONET – DWDM – DSL – ISDN – BISDN, ATM.

**UNIT II MULTIMEDIA NETWORKING APPLICATIONS 9**

Streaming stored Audio and Video – Best effort service – protocols for real time interactive applications – Beyond best effort – scheduling and policing mechanism – integrated services – RSVP- differentiated services.

**UNIT III ADVANCED NETWORKS CONCEPTS 9**

VPN-Remote-Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN. MPLS- operation, Routing, Tunneling and use of FEC, Traffic Engineering, MPLS based VPN, overlay networks- P2P connections.

**UNIT IV TRAFFIC MODELLING 9**

Little's theorem, Need for modeling, Poisson modeling and its failure, Non- poisson models, Network performance evaluation.

**UNIT V NETWORK SECURITY AND MANAGEMENT 9**

Principles of cryptography – Authentication – integrity – key distribution and certification – Access control and: fire walls – attacks and counter measures – security in many layers. Infrastructure for network management – The internet standard management framework – SMI, MIB, SNMP, Security and administration – ASN.1

**TOTAL: 45PERIODS****OUTCOMES:**

**Upon completion of this course, the students should be able to:**

- Discuss advanced networks concepts
- Outline traffic modeling
- Evaluate network security

**REFERENCES:**

1. Aunurag Kumar, D. M Anjunath, Joy Kuri, "Communication Networking", Morgan Kaufmann Publishers, 1<sup>st</sup> edition 2004.
2. Fred Halsall and Lingana Gouda Kulkarni, "Computer Networking and the Internet", fifth edition, Pearson education 2006
3. Hersent Gurle & Petit, "IP Telephony, packet Pored Multimedia communication Systems", Pearson education 2003
4. J.F. Kurose & K.W. Ross, "Computer Networking- A top down approach featuring the internet", Pearson, 2<sup>nd</sup> edition, 2003
5. Larry I. Peterson & Bruce S. David, "Computer Networks: A System Approach"- 1996
6. LEOM-GarCIA, WIDJAJA, "Communication networks", TMH seventh reprint 2002.
7. Nader F. Mir, Computer and Communication Networks, first edition 2010
8. Walrand .J. Varatya, High performance communication network, Morgan Kauffman – Harcourt Asia Pvt. Ltd. 2<sup>nd</sup> Edition, 2000

|               |   |          |          |          |          |
|---------------|---|----------|----------|----------|----------|
| <b>DS5191</b> | <b>DSP PROCESSOR ARCHITECTURE AND PROGRAMMING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

The objective of this course is to provide in-depth knowledge on

- Digital Signal Processor basics
- Third generation DSP Architecture and programming skills
- Advanced DSP architectures and some applications.

**UNIT I                    FUNDAMENTALS OF PROGRAMMABLE DSPs                    9**

Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access in PDSPs – Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals.

**UNIT II                    TMS320C5X PROCESSOR                    9**

Architecture – Assembly language syntax - Addressing modes – Assembly language Instructions - Pipeline structure, Operation – Block Diagram of DSP starter kit – Application Programs for processing real time signals.

**UNIT III                    TMS320C6X PROCESSOR                    9**

Architecture of the C6x Processor - Instruction Set - DSP Development System: Introduction – DSP Starter Kit Support Tools- Code Composer Studio - Support Files - Programming Examples to Test the DSK Tools – Application Programs for processing real time signals.

**UNIT IV                    ADSP PROCESSORS                    9**

Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions – Application programs –Filter design, FFT calculation.

**UNIT V                    ADVANCED PROCESSORS                    9**

Architecture of TMS320C54X: Pipe line operation, Code Composer studio – Architecture of TMS320C6X - Architecture of Motorola DSP563XX – Comparison of the features of DSP family processors.

**TOTAL :                    45                    PERIODS**

**OUTCOMES:**

**Students should be able to:**

- Become Digital Signal Processor specialized engineer
- DSP based System Developer

**REFERENCES:**

1. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, cengage Learning India Private Limited, Delhi 2012
2. B.Venkataramani and M.Bhaskar, “Digital Signal Processors – Architecture, Programming and Applications” – Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.
3. RulphChassaing, Digital Signal Processing and Applications with the C6713 and C6416 DSK, A JOHN WILEY & SONS, INC., PUBLICATION, 2005
4. User guides Texas Instrumentation, Analog Devices, Motorola.

**OBJECTIVES:**

- The CMOS RF Front End (RFE) is a very crucial building block and in all of wireless and many high frequency wire-line systems. The RFE has few important building blocks within it including the Low Noise Amplifiers, Phase Locked Loop Synthesizers, Mixers, Power Amplifiers, and impedance matching circuits.
- The present course will introduce the principles of operation and design principles associated with these important blocks.
- The course will also provide and highlight the appropriate digital communication related design objectives and constraints associated with the RFEs

**UNIT I CMOS PHYSICS, TRANSCIEVER SPECIFICATIONS AND ARCHITECTURES****9**

Introduction to MOSFET Physics, Noise: Thermal, shot, flicker, popcorn noise, Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR, Phase noise - Specification distribution over a communication link, Homodyne Receiver, Heterodyne Receiver, Image reject, Low IF Receiver Architectures Direct upconversion Transmitter, Two step upconversion Transmitter.

**UNIT II IMPEDANCE MATCHING AND AMPLIFIERS****9**

S-parameters with Smith chart, Passive IC components, Impedance matching networks, Common Gate, Common Source Amplifiers, OC Time constants in bandwidth estimation and enhancement, High frequency amplifier design, Power match and Noise match, Single ended and Differential LNAs, Terminated with Resistors and Source Degeneration LNAs.

**UNIT III FEEDBACK SYSTEMS AND POWER AMPLIFIERS****9**

Stability of feedback systems: Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations, Compensation, General model – Class A, AB, B, C, D, E and F amplifiers, Power amplifier Linearisation Techniques, Efficiency boosting techniques, ACPR metric, Design considerations.

**UNIT IV MIXERS AND OSCILLATORS****9**

Mixer characteristics, Non-linear based mixers, Quadratic mixers, Multiplier based mixers, Single balanced and double balanced mixers, subsampling mixers, Oscillators describing Functions, Colpitts oscillators Resonators, Tuned Oscillators, Negative resistance oscillators, Phase noise.

**UNIT V PLL AND FREQUENCY SYNTHESIZERS****9**

Linearised Model, Noise properties, Phase detectors, Loop filters and Charge pumps, Integer-N frequency synthesizers, Direct Digital Frequency synthesizers.

**TOTAL : 45 PERIODS****OUTCOMES:**

- The student after completing this course must be able to translate the top level wireless communications system specifications into block level specifications of the RFE.
- The student should be also able to carry out transistor level design of the entire RFE.

**REFERENCES:**

1. B.Razavi, "Design of Analog CMOS Integrated Circuits", McGraw Hill, 2001
2. B.Razavi, "RF Microelectronics", Pearson Education, 1997.
3. Jan Crols, Michiel Steyaert, "CMOS Wireless Transceiver Design", Kluwer Academic Publishers, 1997.
4. Recorded lectures and notes available at . <http://www.ee.iitm.ac.in/~ani/ee6240/>
5. T.Lee, "Design of CMOS RF Integrated Circuits", Cambridge, 2004.

**OBJECTIVES:**

- To study basic concepts of processing speech and audio signals
- To study and analyse various M-band filter-banks for audio coding
- To understand audio coding based on transform coders.
- To study time and frequency domain speech processing methods

**UNIT I MECHANICS OF SPEECH AND AUDIO****9**

Introduction - Review of Signal Processing Theory-Speech production mechanism – Nature of Speech signal – Discrete time modelling of Speech production – Classification of Speech sounds – Phones – Phonemes – Phonetic and Phonemic alphabets – Articulatory features. Absolute Threshold of Hearing - Critical Bands- Simultaneous Masking, Masking-Asymmetry, and the Spread of Masking- Non-simultaneous Masking - Perceptual Entropy - Basic measuring philosophy -Subjective versus objective perceptual testing - The perceptual audio quality measure (PAQM) - Cognitive effects in judging audio quality.

**UNIT II TIME-FREQUENCY ANALYSIS: FILTER BANKS AND TRANSFORMS****9**

Introduction - Analysis-Synthesis Framework for M-band Filter Banks- Filter Banks for Audio Coding: Design Considerations - Quadrature Mirror and Conjugate Quadrature Filters - Tree-Structured QMF and CQF M-band Banks - Cosine Modulated “Pseudo QMF” M-band Banks -Cosine Modulated Perfect Reconstruction (PR) M-band Banks and the Modified Discrete Cosine Transform (MDCT) - Discrete Fourier and Discrete Cosine Transform - Pre-echo Distortion- Pre-echo Control Strategies

**UNIT III AUDIO CODING AND TRANSFORM CODERS****9**

Lossless Audio Coding – Lossy Audio Coding - ISO-MPEG-1A, 2A, 2A-Advanced, 4A Audio Coding - Optimum Coding in the Frequency Domain - Perceptual Transform Coder –Brandenburg - Johnston Hybrid Coder - CNET Coders - Adaptive Spectral Entropy Coding –Differential Perceptual Audio Coder - DFT Noise Substitution -DCT with Vector Quantization -MDCT with Vector Quantization

**UNIT IV TIME AND FREQUENCY DOMAIN METHODS FOR SPEECH PROCESSING****9**

Time domain parameters of Speech signal – Methods for extracting the parameters :Energy, Average Magnitude – Zero crossing Rate – Silence Discrimination using ZCR and energy Short Time Fourier analysis – Formant extraction – Pitch Extraction using time and frequency domain methods Homomorphic Speech Analysis: Cepstral analysis of Speech – Formant and Pitch Estimation – Homomorphic Vocoders

**UNIT V PREDICTIVE ANALYSIS OF SPEECH****9**

Formulation of Linear Prediction problem in Time Domain – Basic Principle – Auto correlation method – Covariance method – Solution of LPC equations – Cholesky method – Durbin’s Recursive algorithm – lattice formation and solutions – Comparison of different methods – Application of LPC parameters – Pitch detection using LPC parameters – Formant analysis – VELP – CELP

**TOTAL : 45 PERIODS****OUTCOMES:**

**Upon completion of this course, the students should be able to:**

- Evaluate audio coding and transform coders
- Discuss time and frequency domain methods for speech processing
- Explain predictive analysis of speech

**REFERENCES:**

1. B.Gold and N.Morgan, "Speech and Audio Signal Processing", Wiley and Sons, 2000.
2. L.R.Rabiner and R.W.Schaffer, "Digital Processing of Speech Signals", Prentice Hall, 1978.
3. Mark Kahrs, Karlheinz Brandenburg, Kluwer Applications of Digital Signal Processing to Audio And Acoustics, Academic Publishers,
4. Udo Zölzer, "Digital Audio Signal Processing", Second Edition A John Wiley& sons Ltd

**AP5092****SOLID STATE DEVICE MODELLING AND SIMULATION****L T P C  
3 0 0 3****OBJECTIVES:**

- To understand the concept of device modeling
- To learn multistep method
- To study device simulations

**UNIT I MOSFET DEVICE PHYSICS MOSFET****9**

capacitor, Basic operation, Basic modeling, Advanced MOSFET modeling, RF modeling of MOS transistors, Equivalent circuit representation of MOS transistor, High frequency behavior of MOS transistor and A.C small signal modeling, model parameter extraction, modeling parasitic BJT, Resistors, Capacitors, Inductors.

**UNIT II DEVICE MODELLING****9**

Prime importance of circuit and device simulations in VLSI; Nodal, mesh, modified nodal and hybrid analysis equations. Solution of network equations: Sparse matrix techniques, solution of nonlinear networks through Newton-Raphson technique, convergence and stability.

**UNIT III MULTISTEP METHODS****9**

Solution of stiff systems of equations, adaptation of multistep methods to the solution of electrical networks, general purpose circuit simulators.

**UNIT IV MATHEMATICAL TECHNIQUES DEVICE SIMULATIONS****9**

Poisson equation, continuity equation, drift-diffusion equation, Schrodinger equation, hydrodynamic equations, trap rate, finite difference solutions to these equations in 1D and 2D space, grid generation.

**UNIT V SIMULATION OF DEVICES****9**

Computation of characteristics of simple devices like p-n junction, MOS capacitor and MOSFET; Small-signal analysis.

**TOTAL :45PERIODS****OUTCOMES:**

**Upon completion of this course, the students should be able to:**

- Explain the importance of MOS Capacitor and Small signal modeling
- Apply and determine the drift diffusion equation and stiff system equation.
- Analyze circuits using parasitic BJT parameters and newton Raphson method.
- Model the MOS transistor using schrodinger equation and Multistep methods.

**REFERENCES:**

1. Arora, N., "MOSFET Modeling for VLSI Simulation", Cadence Design Systems, 2007
2. Chua, L.O. and Lin, P.M., "Computer-Aided Analysis of Electronic Circuits: Algorithms and Computational Techniques", Prentice-Hall., 1975
3. Fjeldly, T., Yetterdal, T. and Shur, M., "Introduction to Device Modeling and Circuit Simulation", Wiley-Interscience., 1997
4. Grasser, T., "Advanced Device Modeling and Simulation", World Scientific Publishing Company., 2003
5. Selberherr, S., "Analysis and Simulation of Semiconductor Devices", Springer-Verlag., 1984
6. Trond Ytterdal, Yuhua Cheng and Tor A. FjeldlyWayne Wolf, "Device Modeling for Analog and RF CMOS Circuit Design", John Wiley & Sons Ltd.

**CP5292**

**INTERNET OF THINGS**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To understand the fundamentals of Internet of Things
- To learn about the basics of IOT protocols
- To build a small low cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real world scenario

|               |                            |          |
|---------------|----------------------------|----------|
| <b>UNIT I</b> | <b>INTRODUCTION TO IoT</b> | <b>9</b> |
|---------------|----------------------------|----------|

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

|                |                         |          |
|----------------|-------------------------|----------|
| <b>UNIT II</b> | <b>IoT ARCHITECTURE</b> | <b>9</b> |
|----------------|-------------------------|----------|

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture

|                 |                      |          |
|-----------------|----------------------|----------|
| <b>UNIT III</b> | <b>IoT PROTOCOLS</b> | <b>9</b> |
|-----------------|----------------------|----------|

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security

|                |   |          |
|----------------|---|----------|
| <b>UNIT IV</b> | <b>BUILDING IoT WITH RASPBERRY PI &amp; ARDUINO</b> | <b>9</b> |
|----------------|---|----------|

Building IOT with RASPBERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

|               |   |          |
|---------------|---|----------|
| <b>UNIT V</b> | <b>CASE STUDIES AND REAL-WORLD APPLICATIONS</b> | <b>9</b> |
|---------------|---|----------|

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

**TOTAL :45 PERIODS**

## OUTCOMES:

Upon completion of this course, the students should be able to:

- Analyze various protocols for IoT
- Develop web services to access/control IoT devices.
- Design a portable IoT using Raspberry Pi
- Deploy an IoT application and connect to the cloud.
- Analyze applications of IoT in real time scenario

## REFERENCES:

1. Arshdeep Bahga, Vijay Madiseti, "Internet of Things – A hands-on approach", Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
3. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.
4. Jan Ho" ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012

**AP5005**

**SYSTEM ON CHIP DESIGN**

| L | T | P | C |
|---|---|---|---|
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### OBJECTIVES:

- understanding of the concepts, issues, and process of designing highly integrated SoCs following systematic hardware/software co-design & co-verification principles

#### UNIT I INTRODUCTION

9

Introduction to SoC Design, system level design, methodologies and tools, system hardware: IO, communication, processing units, memories; operating systems: prediction of execution, real time scheduling, embedded OS, middle ware; Platform based SoC design, multiprocessor SoC and Network on Chip, Low power SoC Design

#### UNIT II SYSTEM LEVEL MODELLING

9

SystemC: overview, Data types, modules, notion of time, dynamic process, basic channels, structure communication, ports and interfaces, Design with examples

#### UNIT III HARDWARE SOFTWARE CO-DESIGN

9

Analysis, partitioning, high level optimisations, real-time scheduling, hardware acceleration, voltage scaling and power management; Virtual platform models, co-simulation and FPGAs for prototyping of HW/SW systems.

#### UNIT IV SYNTHESIS

9

System synthesis: Transaction Level Modelling (TLM) based design, automaticTLM generation and mapping, platform synthesis; software synthesis: code generation, multi task synthesis, internal and external communication; Hardware synthesis: RTL architecture, Input models, estimation and optimisation, resource sharing and pipelining and scheduling

**UNIT V SOC VERIFICATION AND TESTING**

**9**

SoC and IP integration, Verification : Verification technology options, verification methodology, overview: system level verification, physical verification, hardware/software co-verification; Test requirements and methodologies, SoC design for testability - System modeling, test power dissipation, test access mechanism

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Analyse algorithms and architecture of hardware software in order to optimise the system based on requirements and implementation constraints
- Model and specify systems at high level of abstraction
- appreciate the co-design approach and virtual platform models
- Understand hardware, software and interface synthesis

**REFERENCES**

1. D. Black, J. Donovan, SystemC: From the Ground Up, Springer, 2004.
2. D. Gajski, S. Abdi, A. Gerstlauer, G. Schirner, Embedded System Design: Modeling, Synthesis, Verification, Springer, 2009
3. Erik Larson, Introduction to advanced system-on-chip test design and optimisation, Springer 2005
4. Grotker, T., Liao, S., Martin, G. & Swan, S. System design with System C, Springer, 2002.
5. Ghenassia, F. Transaction-level modeling with SystemC: TLM concepts and applications for embedded systems, Springer, 2010.
6. Hoi-junyoo, Kangmin Lee, Jun Kyoungkim, "Low power NoC for high performance SoC design", CRC press, 2008.
7. M. L. Bushnell and V.D. Agrawal, Essentials of Electronic Testing for Digital Memory and Mixed Signal VLSI Circuits, Springer, 2005
8. M. Abramovici, M. Breuer, and A. Friedman, Digital System Testing and Testable Design, IEEE Press, 1994
9. P. Marwedel, Embedded System Design, Springer, 2003. G. De Micheli, Synthesis and Optimization of Digital Circuits
10. Prakash Rashinkar, Peter Paterson and Leena Singh, System-on-a chip verification: Methodology and techniques, kluwer Academic Publishers 2002
11. T. Noergaard, Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers, Newnes.
12. Vijay K. Madisetty Chonlameth Arpikanondt, "A Platform-Centric Approach to System-on-Chip (SOC) Design", Springer, 2005.
13. Youn-Long Steve Lin, Essential Issues in SOC Design Designing Complex Systems-on-Chip, Springer, 2006

**AP5093**

**ROBOTICS**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To understand robot locomotion and mobile robot kinematics
- To understand perception in robotics
- To understand mobile robot localization
- To understand mobile robot mapping
- To understand simultaneous localization and mapping (SLAM)
- To understand robot planning and navigation



|   |                                  |          |
|---|----------------------------------|----------|
| <b>UNIT I</b>   | <b>LOCOMOTION AND KINEMATICS</b> | <b>9</b> |
| Introduction to Robotics – key issues in robot locomotion – legged robots – wheeled mobile robots – aerial mobile robots – introduction to kinematics – kinematics models and constraints – robot maneuverability   |                                  |          |
| <b>UNIT II</b>  | <b>ROBOT PERCEPTION</b>          | <b>9</b> |
| Sensors for mobile robots – vision for robotics – cameras – image formation – structure from stereo – structure from motion – optical flow – color tracking – place recognition – range data  |                                  |          |
| <b>UNIT III</b>   | <b>MOBILE ROBOT LOCALIZATION</b> | <b>9</b> |
| Introduction to localization – challenges in localization – localization and navigation – belief representation – map representation – probabilistic map-based localization – Markov localization – EKF localization – UKF localization – Grid localization – Monte Carlo localization – localization in dynamic environments |                                  |          |
| <b>UNIT IV</b>  | <b>MOBILE ROBOT MAPPING</b>      | <b>9</b> |
| Autonomous map building – occupancy grid mapping – MAP occupancy mapping – SLAM – extended Kalman Filter SLAM – graph-based SLAM – particle filter SLAM – sparse extended information filter – fastSLAM algorithm.  |                                  |          |
| <b>UNIT V</b>   | <b>PLANNING AND NAVIGATION</b>   | <b>9</b> |
| Introduction to planning and navigation – planning and reacting – path planning – obstacle avoidance techniques – navigation architectures – basic exploration algorithms   |                                  |          |

**TOTAL 45 PERIODS**

**OUTCOMES:**

**Upon Completion of the course, the students will be able to**

- Explain robot locomotion
- Apply kinematics models and constraints
- Implement vision algorithms for robotics
- Implement robot localization techniques
- Implement robot mapping techniques
- Implement SLAM algorithms
- Explain planning and navigation in robotics

**REFERENCES:**

1. Gregory Dudek and Michael Jenkin, “Computational Principles of Mobile Robotics”, Second Edition, Cambridge University Press, 2010.
2. Howie Choset et al., “Principles of Robot Motion: Theory, Algorithms, and Implementations”, A Bradford Book, 2005.
3. Maja J. Mataric, “The Robotics Primer”, MIT Press, 2007.
4. Roland Siegwart, Illah Reza Nourbakhsh, and Davide Scaramuzza, “Introduction to autonomous mobile robots”, Second Edition, MIT Press, 2011.
5. Sebastian Thrun, Wolfram Burgard, and Dieter Fox, “Probabilistic Robotics”, MIT Press, 2005.

**OBJECTIVES:**

- To introduce the physical design concepts such as routing, placement, partitioning and packaging
- To study the performance of circuits layout designs, compaction techniques.

**UNIT I INTRODUCTION TO VLSI TECHNOLOGY 9**

Layout Rules-Circuit abstraction Cell generation using programmable logic array transistor chaining, Wein Berger arrays and gate matrices-layout of standard cells gate arrays and sea of gates, field programmable gate array(FPGA)-layout methodologies Packaging-Computational Complexity - Algorithmic Paradigms.

**UNIT II PLACEMENT USING TOP-DOWN APPROACH 9**

Partitioning: Approximation of Hyper Graphs with Graphs, Kernighan-Lin Heuristic Ratio cut partition with capacity and i/o constraints. Floor planning: Rectangular dual floor planning hierarchical approach- simulated annealing- Floor plan sizing Placement: Cost function- force directed method- placement by simulated annealing partitioning placement- module placement on a resistive network – regular placement linear placement.

**UNIT III ROUTING USING TOP DOWN APPROACH 9**

Fundamentals: Maze Running- line searching- Steiner trees Global Routing: Sequential Approaches - hierarchical approaches - multi commodity flow based techniques - Randomised Routing- One Step approach - Integer Linear Programming Detailed Routing: Channel Routing - Switch box routing. Routing in FPGA: Array based FPGA- Row based FPGAs

**UNIT IV PERFORMANCE ISSUES IN CIRCUIT LAYOUT 9**

Delay Models: Gate Delay Models- Models for interconnected Delay- Delay in RC trees. Timing – Driven Placement: Zero Stack Algorithm- Weight based placement- Linear Programming Approach Timing riving Routing: Delay Minimization- Click Skew Problem- Buffered Clock Trees. Minimization: constrained via Minimization unconstrained via Minimization- Other issues in minimization

**UNIT V SINGLE LAYER ROUTING, CELL GENERATION AND COMPACTION 9**

Planar subset problem(PSP)- Single Layer Global Routing- Single Layer detailed Routing- Wire length and bend minimization technique – Over The Cell (OTC) Routing Multiple chip modules(MCM)- programmable Logic Arrays- Transistor chaining- Wein Burger Arrays- Gate matrix layout- 1D compaction- 2D compaction.

**TOTAL: 45 PERIODS****OUTCOMES:****Upon Completion of the course, the students will be able to**

- Explain different types of routing
- Discuss performance issues in circuit layout
- Outline 1D compaction- 2D compaction.

**REFERENCES:**

1. Preas M. Lorenzatti, "Physical Design and Automation of VLSI systems", The Benjamin Cummins Publishers, 1998.
2. Sarafzadeh, C.K. Wong, "An Introduction to VLSI Physical Design", McGraw Hill Int. Edition 1995

**OBJECTIVES:**

- To identify sources affecting the speed of digital circuits.
- To introduce methods to improve the signal transmission characteristics

**UNIT I SIGNAL PROPAGATION ON TRANSMISSION LINES 9**

Transmission line equations, wave solution, wave vs. circuits, initial wave, delay time, Characteristic impedance, wave propagation, reflection, and bounce diagrams Reactive terminations – L, C, static field maps of micro strip and strip line cross-sections, per unit length parameters, PCB layer stackups and layer/Cu thicknesses, cross-sectional analysis tools, Zo and Td equations for microstrip and stripline Reflection and terminations for logic gates, fan-out, logic switching, input impedance into a transmission-line section, reflection coefficient, skin-effect, dispersion

**UNIT II MULTI-CONDUCTOR TRANSMISSION LINES AND CROSS-TALK 9**

Multi-conductor transmission-lines, coupling physics, per unit length parameters, Near and far-end cross-talk, minimizing cross-talk (stripline and microstrip) Differential signalling, termination, balanced circuits, S-parameters, Lossy and Lossless models

**UNIT III NON-IDEAL EFFECTS 9**

Non-ideal signal return paths – gaps, BGA fields, via transitions, Parasitic inductance and capacitance, Transmission line losses – Rs,  $\tan\delta$ , routing parasitic, Common-mode current, differential-mode current, Connectors

**UNIT IV POWER CONSIDERATIONS AND SYSTEM DESIGN 9**

SSN/SSO, DC power bus design, layer stack up, SMT decoupling, Logic families, power consumption, and system power delivery, Logic families and speed Package types and parasitic, SPICE, IBIS models, Bit streams, PRBS and filtering functions of link-path components, Eye diagrams, jitter, inter-symbol interference Bit-error rate, Timing analysis

**UNIT V CLOCK DISTRIBUTION AND CLOCK OSCILLATORS 9**

Timing margin, Clock slew, low impedance drivers, terminations, Delay Adjustments, canceling parasitic capacitance, Clock jitter.

**TOTAL : 45 PERIODS****OUTCOMES:**

- Ability to identify sources affecting the speed of digital circuits.
- Able to improve the signal transmission characteristics.

**REFERENCES:**

1. Douglas Brooks, Signal Integrity Issues and Printed Circuit Board Design, Prentice Hall PTR, 2003
2. Eric Bogatin, Signal Integrity – Simplified, Prentice Hall PTR, 2003.
3. H. W. Johnson and M. Graham, High-Speed Digital Design: A Handbook of Black Magic, Prentice Hall, 1993.
4. S. Hall, G. Hall, and J. McCall, High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices, Wiley-Interscience, 2000.

**TOOLS REQUIRED**

1. SPICE, source - <http://www-cad.eecs.berkeley.edu/Software/software.html>
2. HSPICE from synopsis, [www.synopsys.com/products/mixedsignal/hspice/hspice.html](http://www.synopsys.com/products/mixedsignal/hspice/hspice.html)
3. SPECCTRAQUEST from Cadence, <http://www.specctraquest.com>

**OBJECTIVES:**

- To introduce the concepts of microelectromechanical devices.
- To know the fabrication process of Microsystems.
- To know the design concepts of micro sensors and micro actuators.
- To familiarize concepts of quantum mechanics and nano systems.

**UNIT I OVERVIEW****9**

New trends in Engineering and Science: Micro and Nanoscale systems, Introduction to Design of MEMS and NEMS, MEMS and NEMS – Applications, Devices and structures. Materials for MEMS: Silicon, silicon compounds, polymers, metals.

**UNIT II MEMS FABRICATION TECHNOLOGIES****9**

Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect- Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials.

**UNIT III MICRO SENSORS****9**

MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor.

**UNIT IV MICRO ACTUATORS****9**

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators.

**UNIT V NANOSYSTEMS AND QUANTUM MECHANICS****9**

Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wave function Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits.

**TOTAL: 45 PERIODS****OUTCOMES:**

**At the end of this course, the student should be able to:**

- Discuss micro sensors
- Explain micro actuators
- Outline nanosystems and Quantum mechanics

**REFERENCES:**

1. Chang Liu, "Foundations of MEMS", Pearson education India limited, 2006.
2. Marc Madou, "Fundamentals of Microfabrication", CRC press 1997
3. Stephen D. Senturia, "Micro system Design", Kluwer Academic Publishers, 2001
4. Sergey Edward Lyshovski, "MEMS and NEMS: Systems, Devices, and Structures" CRC Press, 2002.
5. Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata McGraw Hill, 2002

**OBJECTIVES:**

- To learn computer hardware, system software and data concepts from a security perspective

**UNIT I            UNIT I COMPUTER SECURITY AND MANAGEMENT            9**

Overview of Computer Security, Threats, Malware, Vulnerabilities, Authentication, Access Control, Security Management Models, Security Management Practices, Protection Mechanisms, Legal aspects of security, Ethical Hacking.

**UNIT II            HARDWARE SECURITY            9**

Need for Hardware Security, Computer Memory and storage, Bus and Interconnection, I/O and Network Interface, CPU; Side channel Analysis: Power Analysis Attack, Timing Attack, Fault attack. Countermeasures of Side Channel Attack, Secure Hardware Intellectual Properties, Physically Unclonable Functions(PUFs), Secure PUF.

**UNIT III            ASSEMBLY AND OPERATING SYSTEMS SECURITY            9**

Opcode, Operands, Addressing Modes, Stack and Buffer Overflow, FIFO and M/M/1 Problem, Kernel, Drivers and OS Security; Secure Design Principles, Trusted Operating Systems, Trusted System Functions

**UNIT IV            ADVANCED COMPUTER ARCHITECTURE            9**

Security aspects : Multiprocessors, parallel processing, Ubiquitous computing, Grid, Distributed and cloud computing, Internet computing, Virtualization

**UNIT V            NETWORK AND WEBSECURITY            9**

TCP/IP Protocol, Network switches, Routers, Gateways, Wireless Networks and Network Address Translation (NAT); Network Security Issues in TCP/IP, Threat Models, Denial of Service Attacks, Firewalls, Intrusion Detection, Browser Attacks, Web Attacks Targeting Users, Email Attacks, Secure Shell (SSH), HTTPS

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Aware of Security aspects
- Able to appreciate security in hardware, OS and its future need
- Learn security issues in various types of computing networks

**REFERENCES:**

1. Charles B. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", Fourth Edition, Pearson Education, 2007
2. Debdeep Mukhopadhyay, Rajat Subhra Chakraborty, "Hardware Security - Design Threats and Safeguards", CRC Press, 2015
3. Michael Whitman, Herbert J. Mattord, "Management of Information Security", Third Edition, Course Technology, 2010
4. Shuangbao Wang, Robert S. Ledley, Computer Architecture and Security, Wiley, 2013
5. William Stallings, "Network Security Essentials, Applications and Standards", Dorling Kindersley I P Ltd, Delhi, 2008.

**OBJECTIVES:**

- To learn about supervised and unsupervised pattern classifiers.
- To familiarize about different feature extraction techniques.
- To explore the role of Hidden Marko model and SVM in pattern recognition.
- To understand the application of Fuzzy logic and genetic algorithms for pattern classifier

**UNIT I PATTERN CLASSIFIER** 9

Overview of Pattern recognition – Discriminant functions – Supervised learning – Parametric estimation – Maximum Likelihood Estimation – Bayesian parameter Estimation – Problems with Bayes approach– Pattern classification by distance functions – Minimum distance pattern classifier.

**UNIT II CLUSTERING** 9

Clustering for unsupervised learning and classification–Clustering concept – C Means algorithm – Hierarchical clustering – Graph theoretic approach to pattern Clustering – Validity of Clusters.

**UNIT III FEATURE EXTRACTION AND STRUCTURAL PATTERN RECOGNITION** 9

Principle component analysis, Independent component analysis, Linear discriminant analysis, Feature selection through functional approximation – Elements of formal grammars, Syntactic description – Stochastic grammars – Structural Representation.

**UNIT IV HIDDEN MARKOV MODELS AND SUPPORT VECTOR MACHINE** 9

State Machines – Hidden Markov Models – Training – Classification – Support vector Machine – Feature Selection.

**UNIT V RECENT ADVANCES** 9

Fuzzy logic – Fuzzy Pattern Classifiers – Pattern Classification using Genetic Algorithms – Case Study Using Fuzzy Pattern Classifiers and Perception.

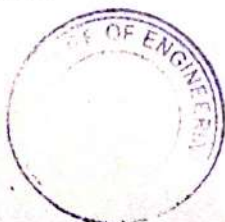
**TOTAL : 45 PERIODS****OUTCOMES:**

Upon completion of the course the student will be able to

- Differentiate between supervised and unsupervised classifiers
- Classify the data and identify the patterns.
- Extract feature set and select the features from given data set.
- Apply fuzzy logic and genetic algorithms for classification problems

**REFERENCES:**

1. Andrew Webb, "Stastical Pattern Recognition", Arnold publishers, London,1999
2. C.M.Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.
3. M. Narasimha Murthy and V. Susheela Devi, "Pattern Recognition", Springer 2011.
4. Menahem Friedman , Abraham Kandel, "Introduction to Pattern Recognition Statistical, Structural, Neural and Fuzzy Logic Approaches", World Scientific publishing Co. Ltd, 2000.
5. Robert J.Schalkoff, "Pattern Recognition Statistical, Structural and Neural Approaches", John Wiley & Sons Inc., New York, 1992.
6. R.O.Duda, P.E.Hart and D.G.Stork, "Pattern Classification", John Wiley, 2001
7. S.Theodoridis and K.Koutroumbas, "Pattern Recognition", 4<sup>th</sup> Ed., Academic Press. 2009.



**ANNA UNIVERSITY, CHENNAI**  
**AFFILIATED INSTITUTIONS**  
**M.E. COMPUTER SCIENCE AND ENGINEERING**  
**REGULATIONS – 2017**  
**CHOICE BASED CREDIT SYSTEM**

**PROGRAM EDUCATIONAL OBJECTIVES (PEOs):**

1. To enable graduates to pursue research, or have a successful career in academia or industries associated with Computer Science and Engineering, or as entrepreneurs.
2. To provide students with strong foundational concepts and also advanced techniques and tools in order to enable them to build solutions or systems of varying complexity.
3. To prepare students to critically analyze existing literature in an area of specialization and ethically develop innovative and research oriented methodologies to solve the problems identified.

**PROGRAM SPECIFIC OBJECTIVES (PSOs):**

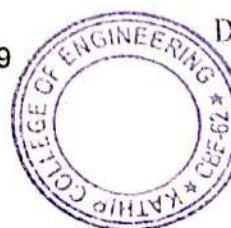
1. To analyze, design and develop computing solutions by applying foundational concepts of computer science and engineering.
2. To apply software engineering principles and practices for developing quality software for scientific and business applications.
3. To adapt to emerging information and communication technologies (ICT) to innovate ideas and solutions to existing/novel problems.

**PROGRAM OUTCOMES (POs)**

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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*Dr*  
Dr. R. UDAIYAKUMAR, ME., Ph.D.,  
Principal  
Kathir College of Engineering  
"Wisdom Tree" Avinashi Road,  
Neelambur, Coimbatore - 641 062.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES:**

A broad relation between the programme objective and the outcomes is given in the following table

| Programme Educational Objectives | Programme Outcomes |   |   |   |   |   |   |   |   |   |   |   |
|----------------------------------|--------------------|---|---|---|---|---|---|---|---|---|---|---|
|                                  | A                  | B | C | D | E | F | G | H | I | J | K | L |
| 1                                | 3                  | 3 | 3 | 3 | 3 | 1 | 3 |   | 3 | 1 | 2 | 3 |
| 2                                | 3                  | 2 | 3 | 3 | 3 |   | 3 | 1 | 2 | 3 | 3 | 2 |
| 3                                | 1                  | 3 | 2 | 3 | 2 | 3 | 3 | 3 |   |   |   | 1 |

Contribution

1: Reasonable

2: Significant

3: Strong



### MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the Program Specific Objectives and the outcomes is given in the following table

| PROGRAM SPECIFIC OBJECTIVES | PROGRAMME OUTCOMES |   |   |   |   |   |   |   |   |   |   |   |
|-----------------------------|--------------------|---|---|---|---|---|---|---|---|---|---|---|
|                             | A                  | B | C | D | E | F | G | H | I | J | K | L |
| 1                           | 3                  | 1 | 2 | 3 | 3 | 1 |   |   | 1 | 1 | 2 | 1 |
| 2                           | 3                  | 3 | 3 | 3 | 3 | 2 | 1 |   | 1 |   | 3 |   |
| 3                           | 1                  | 2 | 3 | 3 | 3 | 2 | 1 | 1 |   | 2 |   |   |

Contribution

1: Reasonable

2: Significant

3: Strong

**M.E. COMPUTER SCIENCE AND ENGINEERING  
SEMESTER COURSE WISE PO MAPPING**

|                                  | SUBJECTS           | Programme Outcomes                      |     |     |     |     |     |     |     |     |      |      |      |   |
|----------------------------------|--------------------|---|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|---|
|                                  |                    | PO1                                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |   |
| <b>I<br/>Y<br/>E<br/>A<br/>R</b> | <b>SEMESTER I</b>  | Applied Probability and Statistics      | 3   | 3   | 2   | 3   | 1   | 1   | 1   | 1   | 1    | 1    | 3    | 1 |
|                                  |                    | Advanced Data Structures and Algorithms | 3   | 3   | 3   | 3   | 1   | 1   | 1   | 1   | 1    | 1    | 1    | 3 |
|                                  |                    | Advanced Computer Architecture          | 3   | 3   | 3   | 3   | 1   | 1   | 1   | 1   | 1    | 1    | 1    | 2 |
|                                  |                    | Operating System Internals              | 3   | 3   | 3   | 3   | 3   | 1   | 1   | 1   | 1    | 2    | 1    | 1 |
|                                  |                    | Advanced Software Engineering           | 3   | 3   | 3   | 3   | 3   | 1   | 1   | 1   | 1    | 2    | 1    | 2 |
|                                  |                    | Machine Learning Techniques             | 3   | 3   | 3   | 3   | 3   | 1   | 3   | 1   | 1    | 2    | 1    | 2 |
|                                  |                    | Data Structures Laboratory              | 3   | 3   | 3   | 3   | 3   | 1   | 1   | 1   | 3    | 3    | 2    | 1 |
|                                  |                    |   |     |     |     |     |     |     |     |     |      |      |      |   |
|                                  | <b>SEMESTER II</b> | Network Design and Technologies         | 3   | 3   | 3   | 3   | 3   | 3   | 2   | 1   | 3    | 1    | 1    | 2 |
|                                  |                    | Security Practices                      | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 1    | 1    | 1    | 2 |
|                                  |                    | Internet of Things                      | 3   | 3   | 3   | 3   | 1   | 1   | 1   | 3   | 1    | 1    | 1    | 2 |
|                                  |                    | Big Data Analytics                      | 3   | 3   | 3   | 2   | 3   | 3   | 1   | 1   | 1    | 1    | 1    | 2 |
|                                  |                    | <b>Professional Elective –I</b>         |     |     |     |     |     |     |     |     |      |      |      |   |
|                                  |                    | Advanced Data bases                     | 3   | 3   | 3   | 2   | 3   | 1   | 1   | 1   | 2    | 1    | 1    | 2 |
|                                  |                    | Principles of Programming Languages     | 3   | 3   | 3   | 3   | 3   | 1   | 2   | 1   | 2    | 1    | 1    | 2 |
|                                  |                    | Image Processing and Analysis           | 3   | 3   | 3   | 3   | 3   | 1   | 2   | 2   | 2    | 1    | 1    | 2 |
|                                  |                    | Web Engineering                         | 3   | 3   | 3   | 3   | 3   | 1   | 2   | 2   | 2    | 1    | 1    | 2 |
|                                  |                    | Cloud Computing Technologies            | 3   | 3   | 3   | 3   | 3   | 1   | 2   | 2   | 2    | 1    | 1    | 2 |
|                                  |                    | <b>Professional Elective II</b>         |     |     |     |     |     |     |     |     |      |      |      |   |
| Real Time Systems                |                    | 3                                       | 3   | 3   | 3   | 3   | 1   | 1   | 1   | 2   | 1    | 1    | 2    |   |

|                        |                                |  |                                |   |   |   |   |   |   |   |   |   |   |   |   |
|------------------------|--------------------------------|--|--------------------------------|---|---|---|---|---|---|---|---|---|---|---|---|
|                        |                                | Mobile and Pervasive Computing           | 3                              | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 2 |   |
|                        |                                | Parallel Programming Paradigms           | 3                              | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 2 |   |
|                        |                                | Information Retrieval Techniques         | 3                              | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 2 |   |
|                        |                                | Software Architectures and Design        | 3                              | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 2 |   |
|                        |                                | Big Data Computing Laboratory            | 3                              | 3 | 3 | 3 | 3 | 1 | 3 | 1 | 2 | 1 | 2 | 2 |   |
|                        |                                | Term Paper Writing and Seminar           | 3                              | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 2 | 1 | 2 | 2 |   |
| II<br>Y<br>E<br>A<br>R | SEMESTER III                   | <b>Professional Elective –III</b>        |                                |   |   |   |   |   |   |   |   |   |   |   |   |
|                        |                                | Performance Analysis of Computer Systems | 3                              | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
|                        |                                | Language Technologies                    | 3                              | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
|                        |                                | Computer Vision                          | 3                              | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
|                        |                                | Speech Processing and Synthesis          | 3                              | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 2 |
|                        |                                | Software Quality Assurance and Testing   | 3                              | 3 | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 2 |
|                        |                                | <b>Professional Elective –IV</b>         |                                |   |   |   |   |   |   |   |   |   |   |   |   |
|                        |                                | Formal Models of Software Systems        | 3                              | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 |
|                        |                                | Embedded Software Development            | 3                              | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 |
|                        |                                | Social Network Analysis                  | 3                              | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 |
|                        |                                | Bio-Inspired Computing                   | 3                              | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 |
|                        |                                | Compiler Optimization Techniques         | 3                              | 3 | 3 | 3 | 3 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 |
|                        |                                | <b>Professional Elective v</b>           |                                |   |   |   |   |   |   |   |   |   |   |   |   |
|                        |                                | <b>SEMESTER IV</b>                       | <b>Professional Elective v</b> |   |   |   |   |   |   |   |   |   |   |   |   |
|                        | Data Visualization Techniques  | 3  | 3                              | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |   |
|                        | Reconfigurable Computing       | 3  | 3                              | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |   |
|                        | Mobile Application Development | 3  | 3                              | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |   |
|                        | Bio Informatics                | 3  | 3                              | 3 | 3 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |   |
|                        | Information Storage Management | 3  | 3                              | 3 | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 2 |   |
|                        | Project Work Phase – I         | 3  | 3                              | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 1 |   |
|                        | Project Work Phase – II        | 3  | 3                              | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 | 3 | 3 | 1 |   |

**ANNA UNIVERSITY, CHENNAI**  
**AFFILIATED INSTITUTIONS**  
**M.E. COMPUTER SCIENCE AND ENGINEERING**  
**REGULATIONS – 2017**  
**CHOICE BASED CREDIT SYSTEM**  
**CURRICULA AND SYLLABI**

**SEMESTER I**

| SL. NO            | COURSE CODE | COURSE TITLE                            | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|---|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |   |          |                 |           |          |          |           |
| 1.                | MA5160      | Applied Probability and Statistics      | FC       | 4               | 4         | 0        | 0        | 4         |
| 2.                | CP5151      | Advanced Data Structures and Algorithms | PC       | 4               | 4         | 0        | 0        | 4         |
| 3.                | CP5152      | Advanced Computer Architecture          | PC       | 3               | 3         | 0        | 0        | 3         |
| 4.                | CP5153      | Operating System Internals              | PC       | 3               | 3         | 0        | 0        | 3         |
| 5.                | CP5154      | Advanced Software Engineering           | PC       | 3               | 3         | 0        | 0        | 3         |
| 6.                | CP5191      | Machine Learning Techniques             | PC       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |   |          |                 |           |          |          |           |
| 7.                | CP5161      | Data Structures Laboratory              | PC       | 4               | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>      |             |   |          | <b>24</b>       | <b>20</b> | <b>0</b> | <b>4</b> | <b>22</b> |

**SEMESTER II**

| SL. NO            | COURSE CODE | COURSE TITLE                    | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|---------------------------------|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |                                 |          |                 |           |          |          |           |
| 1.                | CP5201      | Network Design and Technologies | PC       | 3               | 3         | 0        | 0        | 3         |
| 2.                | CP5291      | Security Practices              | PC       | 3               | 3         | 0        | 0        | 3         |
| 3.                | CP5292      | Internet of Things              | PC       | 3               | 3         | 0        | 0        | 3         |
| 4.                | CP5293      | Big Data Analytics              | PC       | 3               | 3         | 0        | 0        | 3         |
| 5.                |             | Professional Elective –I        | PE       | 3               | 3         | 0        | 0        | 3         |
| 6.                |             | Professional Elective –II       | PE       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |                                 |          |                 |           |          |          |           |
| 7.                | CP5261      | Data Analytics Laboratory       | PC       | 4               | 0         | 0        | 4        | 2         |
| 8.                | CP5281      | Term Paper Writing and Seminar  | EEC      | 2               | 0         | 0        | 2        | 1         |
| <b>TOTAL</b>      |             |                                 |          | <b>24</b>       | <b>18</b> | <b>0</b> | <b>6</b> | <b>21</b> |

**SEMESTER III**

| SL. NO            | COURSE CODE | COURSE TITLE               | CATEGORY | CONTACT PERIODS | L        | T        | P         | C         |
|-------------------|-------------|----------------------------|----------|-----------------|----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |                            |          |                 |          |          |           |           |
| 1.                |             | Professional Elective –III | PE       | 3               | 3        | 0        | 0         | 3         |
| 2.                |             | Professional Elective –IV  | PE       | 3               | 3        | 0        | 0         | 3         |
| 3.                |             | Professional Elective –V   | PE       | 3               | 3        | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |                            |          |                 |          |          |           |           |
| 4.                | CP5311      | Project Work Phase – I     | EEC      | 12              | 0        | 0        | 12        | 6         |
| <b>TOTAL</b>      |             |                            |          | <b>21</b>       | <b>9</b> | <b>0</b> | <b>12</b> | <b>15</b> |

**SEMESTER IV**

| SL. NO            | COURSE CODE | COURSE TITLE            | CATEGORY | CONTACT PERIODS | L        | T        | P         | C         |
|-------------------|-------------|-------------------------|----------|-----------------|----------|----------|-----------|-----------|
| <b>PRACTICALS</b> |             |                         |          |                 |          |          |           |           |
| 1.                | CP5411      | Project Work Phase – II | EEC      | 24              | 0        | 0        | 24        | 12        |
| <b>TOTAL</b>      |             |                         |          | <b>24</b>       | <b>0</b> | <b>0</b> | <b>24</b> | <b>12</b> |

**TOTAL NO. OF CREDITS:70**

**FOUNDATION COURSES (FC)**

| SL. NO | COURSE CODE | COURSE TITLE                       | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|------------------------------------|----------|-----------------|---|---|---|---|
| 1.     | MA5160      | Applied Probability and Statistics | FC       | 4               | 4 | 0 | 0 | 4 |

**PROFESSIONAL CORE (PC)**

| SL. NO | COURSE CODE | COURSE TITLE                            | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|---|----------|-----------------|---|---|---|---|
| 1.     | CP5151      | Advanced Data Structures and Algorithms | PC       | 4               | 4 | 0 | 0 | 4 |
| 2.     | CP5152      | Advanced Computer Architecture          | PC       | 3               | 3 | 0 | 0 | 3 |
| 3.     | CP5153      | Operating System Internals              | PC       | 3               | 3 | 0 | 0 | 3 |
| 4.     | CP5154      | Advanced Software Engineering           | PC       | 3               | 3 | 0 | 0 | 3 |
| 5.     | CP5191      | Machine Learning Techniques             | PC       | 3               | 3 | 0 | 0 | 3 |
| 6.     | CP5161      | Data Structures Laboratory              | PC       | 4               | 0 | 0 | 4 | 2 |
| 7.     | CP5201      | Network Design and Technologies         | PC       | 3               | 3 | 0 | 0 | 3 |
| 8.     | CP5291      | Security Practices                      | PC       | 3               | 3 | 0 | 0 | 3 |
| 9.     | CP5292      | Internet of Things                      | PC       | 3               | 3 | 0 | 0 | 3 |
| 10.    | CP5293      | Big Data Analytics                      | PC       | 3               | 3 | 0 | 0 | 3 |
| 11.    | CP5261      | Data Analytics Laboratory               | PC       | 4               | 0 | 0 | 4 | 2 |

**EMPLOYABILITY ENHANCEMENT COURSE (EEC)**

| SL. NO | COURSE CODE | COURSE TITLE            | CATEGORY | CONTACT PERIODS | L | T | P  | C  |
|--------|-------------|-------------------------|----------|-----------------|---|---|----|----|
| 1.     | CP5281      | Term Paper and Seminar  | EEC      | 2               | 0 | 0 | 2  | 1  |
| 2.     | CP5311      | Project Work Phase – I  | EEC      | 12              | 0 | 0 | 12 | 6  |
| 3.     | CP5411      | Project Work Phase – II | EEC      | 24              | 0 | 0 | 24 | 12 |

**LIST OF ELECTIVES  
II SEMESTER  
ELECTIVE I**

| SL. NO. | COURSE CODE | COURSE TITLE                        | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|-------------------------------------|----------|-----------------|---|---|---|---|
| 1.      | IF5191      | Advanced Databases                  | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.      | CP5001      | Principles of Programming Languages | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.      | CP5071      | Image Processing and Analysis       | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.      | CP5091      | Web Engineering                     | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.      | CP5092      | Cloud Computing Technologies        | PE       | 3               | 3 | 0 | 0 | 3 |

**II SEMESTER  
ELECTIVE II**

| SL. NO | COURSE CODE | COURSE TITLE                      | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|-----------------------------------|----------|-----------------|---|---|---|---|
| 1.     | MP5291      | Real Time Systems                 | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.     | CP5093      | Mobile and Pervasive Computing    | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.     | CP5002      | Parallel Programming Paradigms    | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.     | CP5094      | Information Retrieval Techniques  | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.     | CP5072      | Software Architectures and Design | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER III  
ELECTIVE III**

| SL. NO. | COURSE CODE | COURSE TITLE                             | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|--|----------|-----------------|---|---|---|---|
| 1.      | CP5003      | Performance Analysis of Computer Systems | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.      | CP5004      | Language Technologies                    | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.      | CP5095      | Computer Vision                          | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.      | CP5096      | Speech Processing and Synthesis          | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.      | CP5005      | Software Quality Assurance and Testing   | PE       | 3               | 3 | 0 | 0 | 3 |

**SEMESTER III  
ELECTIVE IV**

| <b>SL. NO.</b> | <b>COURSE CODE</b> | <b>COURSE TITLE</b>               | <b>CATEGORY</b> | <b>CONTACT PERIODS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------|--------------------|-----------------------------------|-----------------|------------------------|----------|----------|----------|----------|
| 1.             | CP5006             | Formal models of software systems | PE              | 3                      | 3        | 0        | 0        | 3        |
| 2.             | CP5073             | Embedded Software Development     | PE              | 3                      | 3        | 0        | 0        | 3        |
| 3.             | CP5074             | Social Network Analysis           | PE              | 3                      | 3        | 0        | 0        | 3        |
| 4.             | CP5007             | Bio-inspired Computing            | PE              | 3                      | 3        | 0        | 0        | 3        |
| 5.             | CP5008             | Compiler Optimization Techniques  | PE              | 3                      | 3        | 0        | 0        | 3        |

**SEMESTER III  
ELECTIVE V**

| <b>SL. NO</b> | <b>COURSE CODE</b> | <b>COURSE TITLE</b>            | <b>CATEGORY</b> | <b>CONTACT PERIODS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|---------------|--------------------|--------------------------------|-----------------|------------------------|----------|----------|----------|----------|
| 1.            | CP5009             | Data Visualization Techniques  | PE              | 3                      | 3        | 0        | 0        | 3        |
| 2.            | CP5010             | Reconfigurable Computing       | PE              | 3                      | 3        | 0        | 0        | 3        |
| 3.            | CP5097             | Mobile Application Development | PE              | 3                      | 3        | 0        | 0        | 3        |
| 4.            | CP5075             | Bio Informatics                | PE              | 3                      | 3        | 0        | 0        | 3        |
| 5.            | CP5076             | Information Storage Management | PE              | 3                      | 3        | 0        | 0        | 3        |



**OBJECTIVES:**

This course is designed to provide the solid foundation on topics in applied probability and various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling. It is framed to address the issues and the principles of estimation theory, testing of hypothesis and multivariate analysis.

**UNIT I PROBABILITY AND RANDOM VARIABLES 12**

Probability – Axioms of probability – Conditional probability – Baye’s theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

**UNIT II TWO DIMENSIONAL RANDOM VARIABLES 12**

Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

**UNIT III ESTIMATION THEORY 12**

Unbiased estimators – Method of moments – Maximum likelihood estimation - Curve fitting by principle of least squares – Regression lines.

**UNIT IV TESTING OF HYPOTHESIS 12**

Sampling distributions – Type I and Type II errors – Small and large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.

**UNIT V MULTIVARIATE ANALYSIS 12**

Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components - Population principal components – Principal components from standardized variables

**TOTAL: 60 PERIODS****OUTCOMES:**

**After completing this course, students should demonstrate competency in the following topics:**

- Basic probability axioms and rules and the moments of discrete and continuous random variables.
- Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.

The students should have the ability to use the appropriate and relevant, fundamental and applied mathematical and statistical knowledge, methodologies and modern computational tools.

## REFERENCES:

1. Devore, J. L., -Probability and Statistics for Engineering and the SciencesII, 8<sup>th</sup> Edition, Cengage Learning, 2014.
2. Dallas E. Johnson, -Applied Multivariate Methods for Data AnalysisII, Thomson and Duxbury press, 1998.
3. Gupta S.C. and Kapoor V.K.,II Fundamentals of Mathematical StatisticsII, Sultan and Sons, New Delhi, 2001.
4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers ", Pearson Education, Asia, 8<sup>th</sup> Edition, 2015.
5. Richard A. Johnson and Dean W. Wichern, -Applied Multivariate Statistical AnalysisII, 5<sup>th</sup> Edition, Pearson Education, Asia, 2002.

CP5151

ADVANCED DATA STRUCTURES AND ALGORITHMS

L T P C

4 0 0 4

## OBJECTIVES:

- To understand the usage of algorithms in computing.
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications.
- To select and design data structures and algorithms that is appropriate for problems.
- To study about NP Completeness of problems.

### UNIT I      ROLE OF ALGORITHMS IN COMPUTING

12

Algorithms – Algorithms as a Technology- Insertion Sort – Analyzing Algorithms – Designing Algorithms- Growth of Functions: Asymptotic Notation – Standard Notations and Common Functions- Recurrences: The Substitution Method – The Recursion-Tree Method

### UNIT II      HIERARCHICAL DATA STRUCTURES

12

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red-Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of B-trees – Basic operations on B-Trees – Deleting a key from a B-Tree- Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and deleting a node-Bounding the maximum degree.

### UNIT III      GRAPHS

12

Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra's Algorithm; All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm;

**UNIT IV ALGORITHM DESIGN TECHNIQUES 12**  
 Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming –Longest Common Subsequence- Greedy Algorithms: An Activity-Selection Problem – Elements of the Greedy Strategy- Huffman Codes.

**UNIT V NP COMPLETE AND NP HARD 12**  
 NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducability – NP-Completeness Proofs – NP-Complete Problems

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**Upon the completion of the course the students should be able to:**

- Design data structures and algorithms to solve computing problems
- Design algorithms using graph structure and various string matching algorithms to solve real-life problems
- Apply suitable design strategy for problem solving

**REFERENCES:**

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, -Data Structures and AlgorithmsII, Pearson Education, Reprint 2006.
2. Robert Sedgewick and Kevin Wayne, -ALGORITHMSII, Fourth Edition, Pearson Education.
3. S.Sridhar,IIDesign and Analysis of AlgorithmsII, First Edition, Oxford University Press. 2014
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, -Introduction to AlgorithmsII, Third Edition, Prentice-Hall, 2011.

|               |                                       |          |          |          |          |
|---------------|---------------------------------------|----------|----------|----------|----------|
| <b>CP5152</b> | <b>ADVANCED COMPUTER ARCHITECTURE</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters.
- To learn the different multiprocessor issues.
- To expose the different types of multicore architectures.
- To understand the design of the memory hierarchy.

**UNIT I FUNDAMENTALS OF COMPUTER DESIGN AND ILP 9**  
 Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges –Exposing ILP - Advanced Branch Prediction - Dynamic Scheduling - Hardware-Based Speculation - Exploiting ILP - Instruction Delivery and Speculation - Limitations of ILP - Multithreading

**UNIT II MEMORY HIERARCHY DESIGN 9**  
 Introduction – Optimizations of Cache Performance – Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.

**UNIT III      MULTIPROCESSOR ISSUES      9**

Introduction- Centralized, Symmetric and Distributed Shared Memory Architectures –Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency – Case Study-Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks

**UNIT IV      MULTICORE ARCHITECTURES      9**

Homogeneous and Heterogeneous Multi-core Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture. Introduction to Warehouse-scale computers- Architectures- Physical Infrastructure and Costs- Cloud Computing –Case Study- Google Warehouse-Scale Computer.

**UNIT V      VECTOR, SIMD AND GPU ARCHITECTURES      9**

Introduction-Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPGPU Computing – Detecting and Enhancing Loop Level Parallelism-Case Studies.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon completion of this course, the students should be able to:**

- Identify the limitations of ILP.
- Discuss the issues related to multiprocessing and suggest solutions
- Point out the salient features of different multicore architectures and how they exploit parallelism.
- Discuss the various techniques used for optimising the cache performance
- Design hierarchal memory system
- Point out how data level parallelism is exploited in architectures

**REFERENCES:**

1. Darryl Gove, -Multicore Application Programming: For Windows, Linux, and Oracle Solarisll, Pearson, 2011
2. David B. Kirk, Wen-mei W. Hwu, -Programming Massively Parallel Processorsll, Morgan Kauffman, 2010
3. David E. Culler, Jaswinder Pal Singh, -Parallel computing architecture : A hardware/software approachll , Morgan Kaufmann /Elsevier Publishers, 1999
4. John L. Hennessey and David A. Patterson, -Computer Architecture – A Quantitative Approachll, Morgan Kaufmann / Elsevier, 5th edition, 2012.
5. Kai Hwang and Zhi.Wei Xu, -Scalable Parallel Computingll, Tata McGraw Hill, NewDelhi, 2003

**OBJECTIVES :**

- To be able to read and understand sample open source programs and header files.
- To learn how the processes are implemented in linux.
- To understand the implementation of the Linux file system.
- To study Linux memory management data structures and algorithms.
- To acquire the knowledge in the implementation of interprocess communication.
- To understand how program execution happens in Linux.

**UNIT I INTRODUCTION****9**

Basic Operating System Concepts - Overview of Unix File System - Files - Links - Types - Inodes - Access Rights - System Calls - Overview of Unix Kernels - Model - Implementation - Reentrant Kernels - Address Space - Synchronization - Interprocess Communication - Process Management - Memory Management - Device Drivers.

**UNIT II PROCESSES****9**

Processes, Lightweight Processes, and Threads - Process Descriptor - State - Identifying a Process - Relationships among processes - Organization - Resource Limits - Creating Processes - System Calls - Kernel Threads - Destroying Processes - Termination - Removal.

**UNIT III FILE SYSTEM****9**

The Virtual File System (VFS) - Role - File Model - System Calls - Data Structures - Super Block, Inode, File, dentry Objects - dentry Cache - Files Associated with a Process - Filesystem Types - Special Filesystems - Filesystem Type Registration - Filesystem Handling - Namespaces - Mounting - Unmounting - Implementation of VFS System Calls.

**UNIT IV MEMORY MANAGEMENT****9**

Page frame management - page descriptors - non-uniform memory access - memory zones - reserved page frames - zoned page frame allocator - kernel mappings - buddy system algorithm - page frame cache - zone allocator.

**UNIT V PROCESS COMMUNICATION AND PROGRAM EXECUTION****9**

Process Communication - Pipes - Usage - Data Structures - Creating and Destroying a Pipe - Reading From and Writing into a Pipe. Program Execution - Executable Files - Process Credentials - Command-Line Arguments and Shell Environment - Libraries - Program Segments and Process Memory Regions - Execution tracing - Executable Formats - Execution Domains - The exec Functions

**TOTAL: 45 PERIODS****OUTCOMES:**

**At the end of this course, the students should be able to:**

- To explain the functionality of a large software system by reading its source.
- To revise any algorithm present in a system.
- To design a new algorithm to replace an existing one.
- To appropriately modify and use the data structures of the linux kernel for a different software system.

## REFERENCES:

1. Daniel P. Bovet and Marco Cesati, "Understanding the Linux Kernel", 3rd Edition, O'Reilly Publications, 2005.
2. Harold Abelson, Gerald Jay Sussman and Julie Sussman, -Structure and Interpretation of Computer Programs, Second Edition, Universities Press, 2013.
3. Maurice J. Bach, -The Design of the Unix Operating System, 1<sup>st</sup> Edition Pearson Education, 2003.
4. Michael Beck, Harald Bohme, Mirko Dziadzka, Ulrich Kunitz, Robert Magnus, Dirk Verworner, -Linux Kernel Internals, 2nd Edition, Addison-Wesley, 1998.
5. Robert Love, -Linux Kernel Development, 3<sup>rd</sup> Edition, Addison-Wesley, 2010.

**CP5154**

**ADVANCED SOFTWARE ENGINEERING**

**L T P C**  
**3 0 0 3**

## OBJECTIVES:

- To understand Software Engineering Lifecycle Models
- To do project management and cost estimation
- To gain knowledge of the System Analysis and Design concepts.
- To understand software testing approaches
- To be familiar with DevOps practices

### **UNIT I INTRODUCTION 9**

Software engineering concepts – Development activities – Software lifecycle models - Classical waterfall - Iterative waterfall – Prototyping – Evolutionary - Spiral – Software project management – Project planning – Estimation – Scheduling – Risk management – Software configuration management.

### **UNIT II SOFTWARE REQUIREMENT 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.

### **UNIT III ARCHITECTURE AND 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

### **UNIT IV TESTING 9**

Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking

### **UNIT V DEVOPS 9**

DevOps: Motivation-Cloud as a platform-Operations- Deployment Pipeline:Overall Architecture-Building and Testing-Deployment- Case study: Migrating to Microservices.

**TOTAL: 45 PERIODS**

## OUTCOMES:

At the end of this course, the students will be able to:

- Understand the advantages of various Software Development Lifecycle Models
- Gain knowledge on project management approaches as well as cost and schedule estimation strategies
- Perform formal analysis on specifications
- Use UML diagrams for analysis and design
- Architect and design using architectural styles and design patterns
- Understand software testing approaches
- Understand the advantages of DevOps practices

## REFERENCES:

1. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 2<sup>nd</sup> edition, Pearson Education, 2004.
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2<sup>nd</sup> edition, PHI Learning Pvt. Ltd., 2010.
3. Craig Larman, Applying UML and Patterns, 3rd ed, Pearson Education, 2005.
4. Len Bass, Ingo Weber and Liming Zhu, -DevOps: A Software Architect's Perspective, Pearson Education, 2016
5. Rajib Mall, Fundamentals of Software Engineering, 3<sup>rd</sup> edition, PHI Learning Pvt. Ltd., 2009.
6. Stephen Schach, Software Engineering 7th ed, McGraw-Hill, 2007.

CP5191

**MACHINE LEARNING TECHNIQUES**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

## OBJECTIVES:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques
- To study the various probability based learning techniques
- To understand graphical models of machine learning algorithms

## UNIT I INTRODUCTION

9

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.

## UNIT II LINEAR MODELS

9

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.

**UNIT III TREE AND PROBABILISTIC MODELS 9**

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map

**UNIT IV DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS 9**

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process

**UNIT V GRAPHICAL MODELS 9**

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods

**TOTAL: 45 PERIODS**

**OUTCOMES:**

**Upon completion of this course, the students will be able to:**

- Distinguish between, supervised, unsupervised and semi-supervised learning
- Apply the appropriate machine learning strategy for any given problem
- Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem
- Design systems that uses the appropriate graph models of machine learning
- Modify existing machine learning algorithms to improve classification efficiency

**REFERENCES:**

- 1 Ethem Alpaydin, -Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)ll, Third Edition, MIT Press, 2014
- 2 Jason Bell, -Machine learning – Hands on for Developers and Technical Professionalsll, First Edition, Wiley, 2014
- 3 Peter Flach, -Machine Learning: The Art and Science of Algorithms that Make Sense of Datal, First Edition, Cambridge University Press, 2012.
- 4 Stephen Marsland, -Machine Learning – An Algorithmic Perspectivell, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
- 5 Tom M Mitchell, -Machine Learningll, First Edition, McGraw Hill Education, 2013.



**CP5161**

**DATA STRUCTURES LABORATORY**

**L T P C**  
**0 0 4 2**

**OBJECTIVES:**

- To acquire the knowledge of using advanced tree structures.
- To learn the usage of heap structures.
- To understand the usage of graph structures and spanning trees.

**LIST OF EXPERIMENTS:**

Each student has to work individually on assigned lab exercises. Lab sessions could be scheduled as one contiguous four-hour session per week or two two-hour sessions per week. There will be about 15 exercises in a semester. It is recommended that all implementations are carried out in Java. If C or C++ has to be used, then the threads library will be required for concurrency. Exercises should be designed to cover the following topics:

**EXPERIMENTS:**

1. Implementation of Merge Sort and Quick Sort-Analysis
2. Implementation of a Binary Search Tree
3. Red-Black Tree Implementation
4. Heap Implementation
5. Fibonacci Heap Implementation
6. Graph Traversals
7. Spanning Tree Implementation
8. Shortest Path Algorithms (Dijkstra's algorithm, Bellmann Ford Algorithm)
9. Implementation of Matrix Chain Multiplication
10. Activity Selection and Huffman Coding Implementation.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**Upon Completion of this course, the students will be able to:**

- Design and implement basic and advanced data structures extensively.
- Design algorithms using graph structures
- Design and develop efficient algorithms with minimum complexity using design techniques.

**CP5201**

**NETWORK DESIGN AND TECHNOLOGIES**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To understand the principles required for network design
- To explore various technologies in the wireless domain
- To study about 3G and 4G cellular networks
- To understand the paradigm of Software defined networks

**UNIT I NETWORK DESIGN 10**

Advanced multiplexing – Code Division Multiplexing, DWDM and OFDM – Shared media networks – Switched networks – End to end semantics – Connectionless, Connection oriented, Wireless Scenarios –Applications, Quality of Service – End to end level and network level solutions. LAN cabling topologies – Ethernet Switches, Routers, Firewalls and L3 switches – Remote Access Technologies and Devices – Modems and DSLs – SLIP and PPP – Core networks, and distribution networks.

**UNIT II WIRELESS NETWORKS 9**

IEEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX - 802.16e – Network Infrastructure – WLAN – Configuration – Management Operation – Security – IEEE 802.11e and WMM – QoS – Comparison of WLAN and UMTS – Bluetooth – Protocol Stack – Security – Profiles

**UNIT III CELLULAR NETWORKS 9**

GSM – Mobility Management and call control – GPRS – Network Elements – Radio Resource Management – Mobility Management and Session Management – Small Screen Web Browsing over GPRS and EDGE – MMS over GPRS – UMTS – Channel Structure on the Air Interface – UTRAN –Core and Radio Network Mobility Management – UMTS Security

**UNIT IV 4G NETWORKS 9**

LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks – Scheduling – Mobility Management and Power Optimization – LTE Security Architecture – Interconnection with UMTS and GSM – LTE Advanced (3GPP Release 10) - 4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Introduction to 5G

**UNIT V SOFTWARE DEFINED NETWORKS 9**

Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types – Virtualization – Data Plane – I/O – Design of SDN Framework

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon completion of this course, the students should be able to**

- Identify the components required for designing a network
- Design a network at a high-level using different networking technologies
- Analyze the various protocols of wireless and cellular networks
- Discuss the features of 4G and 5G networks
- Experiment with software defined networks

## REFERENCES:

1. Erik Dahlman, Stefan Parkvall, Johan Skold, –4G: LTE/LTE-Advanced for Mobile BroadbandII, Academic Press, 2013.
2. Jonathan Rodriguez, –Fundamentals of 5G Mobile NetworksII, Wiley, 2015.
3. Larry Peterson and Bruce Davie, –Computer Networks: A Systems ApproachII, 5<sup>th</sup> edition, Morgan Kauffman, 2011
4. Martin Sauter, "From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband", Wiley, 2014.
5. Martin Sauter, –Beyond 3G - Bringing Networks, Terminals and the Web Together: LTE, WiMAX, IMS, 4G Devices and the Mobile Web 2.0II, Wiley, 2009.
6. Naveen Chilamkurti, Sherali Zeadally, Hakima Chaouchi, –Next-Generation Wireless TechnologiesII, Springer, 2013.
7. Paul Goransson, Chuck Black, –Software Defined Networks: A Comprehensive ApproachII, Morgan Kauffman, 2014.
8. Savo G Glisic, –Advanced Wireless Networks – 4G TechnologiesII, John Wiley & Sons, 2007.
9. Thomas D.Nadeau and Ken Gray, –SDN – Software Defined NetworksII, O'Reilly Publishers, 2013.
10. Ying Dar Lin, Ren-Hung Hwang and Fred Baker, –Computer Networks: An Open Source ApproachII, McGraw Hill, 2011

**CP5291**

**SECURITY PRACTICES**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

## OBJECTIVES:

- To learn the core fundamentals of system and web security concepts
- To have through understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and encryption Concepts
- To perform a detailed study of Privacy and Storage security and related Issues.

### **UNIT I                    SYSTEM SECURITY**

**9**

Building a secure organization- A Cryptography primer- detecting system Intrusion- Preventing system Intrusion- Fault tolerance and Resilience in cloud computing environments- Security web applications, services and servers.

### **UNIT II                    NETWORK SECURITY**

**9**

Internet Security - Botnet Problem- Intranet security- Local Area Network Security -Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security-Optical Network Security- Optical wireless Security.

### **UNIT III                  SECURITY      MANEGEMENT**

**9**

Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and User Management System - Intrusion and Detection and Prevention System.

**UNIT IV CYBER SECURITY AND CRYPTOGRAPHY 9**

Cyber Forensics- Cyber Forensics and Incidence Response - Security e-Discovery - Network Forensics - Data Encryption- Satellite Encryption - Password based authenticated Key establishment Protocols.

**UNIT V PRIVACY AND STORAGE SECURITY 9**

Privacy on the Internet - Privacy Enhancing Technologies - Personal privacy Policies - Detection of Conflicts in security policies- privacy and security in environment monitoring systems. Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon completion of this course the students should be able to**

- Understand the core fundamentals of system security
- Apply the security concepts related to networks in wired and wireless scenario
- Implement and Manage the security essentials in IT Sector
- Able to explain the concepts of Cyber Security and encryption Concepts
- Able to attain a through knowledge in the area of Privacy and Storage security and related Issues.

**REFERENCES:**

1. John R.Vacca, Computer and Information Security Handbook, Second Edition, Elsevier 2013.
2. Michael E. Whitman, Herbert J. Mattord, Principal of Information Security, Fourth Edition, Cengage Learning, 2012.
3. Richard E.Smith, Elementary Information Security, Second Edition, Jones and Bartlett Learning, 2016

**CP5292**

**INTERNET OF THINGS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To understand the fundamentals of Internet of Things
- To learn about the basics of IOT protocols
- To build a small low cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real world scenario.

**UNIT I INTRODUCTION TO IoT 9**

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

**UNIT II IoT ARCHITECTURE 9**

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture

**UNIT III IoT PROTOCOLS****9**

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security

**UNIT IV BUILDING IoT WITH RASPBERRY PI & ARDUINO****9**

Building IOT with RASPBERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

**UNIT V CASE STUDIES AND REAL-WORLD APPLICATIONS****9**

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

**TOTAL : 45 PERIODS****OUTCOMES:****Upon completion of this course, the students should be able to:**

- Analyze various protocols for IoT
- Develop web services to access/control IoT devices.
- Design a portable IoT using Rasperry Pi
- Deploy an IoT application and connect to the cloud.
- Analyze applications of IoT in real time scenario

**REFERENCES:**

1. Arshdeep Bahga, Vijay Madiseti, -Internet of Things – A hands-on approachll, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), -Architecting the Internet of Thingsll, Springer, 2011.
3. Honbo Zhou, -The Internet of Things in the Cloud: A Middleware Perspectivell, CRC Press, 2012.
4. Jan Ho" ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , -The Internet of Things – Key applications and Protocolsl, Wiley, 2012

**CP5293****BIG DATA ANALYTICS****L T P C  
3 0 0 3****OBJECTIVES:**

- To understand the competitive advantages of big data analytics
- To understand the big data frameworks
- To learn data analysis methods
- To learn stream computing
- To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

|   |                                 |           |
|---|---------------------------------|-----------|
| <b>UNIT I</b>   | <b>INTRODUCTION TO BIG DATA</b> | <b>7</b>  |
| Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools.  |                                 |           |
| <b>UNIT II</b>  | <b>HADOOP FRAMEWORK</b>         | <b>9</b>  |
| Distributed File Systems - Large-Scale FileSystem Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN  |                                 |           |
| <b>UNIT III</b>   | <b>DATA ANALYSIS</b>            | <b>13</b> |
| Statistical Methods:Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R.         |                                 |           |
| <b>UNIT IV</b>  | <b>MINING DATA STREAMS</b>      | <b>7</b>  |
| Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream - Mining Data Streams and Mining Time-series data - Real Time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.  |                                 |           |
| <b>UNIT V</b>   | <b>BIG DATA FRAMEWORKS</b>      | <b>9</b>  |
| Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries |                                 |           |
| <b>TOTAL: 45 PERIODS</b>  |                                 |           |

**OUTCOMES:**

**At the end of this course, the students will be able to:**

- Understand how to leverage the insights from big data analytics
- Analyze data by utilizing various statistical and data mining approaches
- Perform analytics on real-time streaming data
- Understand the various NoSql alternative database models

**REFERENCES:**

1. Bill Franks, -Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced AnalyticsII, Wiley and SAS Business Series, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
3. Michael Berthold, David J. Hand, -Intelligent Data AnalysisII, Springer, Second Edition, 2007.
4. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
5. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
6. Richard Cotton, "Learning R – A Step-by-step Function Guide to Data Analysis, , O'Reilly Media, 2013.

CP5261

**DATA ANALYTICS LABORATORY**

**L T P C**  
**0 0 4 2**

**OBJECTIVES:**

- To implement Map Reduce programs for processing big data
- To realize storage of big data using H base, Mongo DB
- To analyse big data using linear models
- To analyse big data using machine learning techniques such as SVM / Decision tree classification and clustering

**LIST OF EXPERIMENTS**

**Hadoop**

1. Install, configure and run Hadoop and HDFS
2. Implement word count / frequency programs using MapReduce
3. Implement an MR program that processes a weather dataset

**R**

4. Implement Linear and logistic Regression
5. Implement SVM / Decision tree classification techniques
6. Implement clustering techniques
7. Visualize data using any plotting framework
8. Implement an application that stores big data in Hbase / MongoDB / Pig using Hadoop / R.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**Upon Completion of this course, the students will be able to:**

- Process big data using Hadoop framework
- Build and apply linear and logistic regression models
- Perform data analysis with machine learning methods
- Perform graphical data analysis

**LIST OF SOFTWARE FOR A BATCH OF 30 STUDENTS:**

Hadoop  
YARN  
R Package  
Hbase  
MongoDB

**REFERENCES:**

1. Alan Gates and Daniel Dai, "Programming Pig – Dataflow scripting with Hadoop", O'Reilley, 2<sup>nd</sup> Edition, 2016.
2. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, –An Introduction to Statistical Learning with Applications in R, Springer Publications, 2015(Corrected 6<sup>th</sup> Printing)
3. Hadley Wickham,ggplot2 – Elegant Graphics for Data Analysis, Springer Publications,2<sup>nd</sup> Edition, 2016
4. Kristina Chodorow, "MongoDB: The Definitive Guide – Powerful and Scalable Data Storage", O'Reilley, 2<sup>nd</sup> Edition, 2013.
5. Lars George, "HBase: The Definitive Guide", O'Reilley, 2015.
6. Tom White, –Hadoop: The Definitive Guide – Storage and Analysis at Internet Scale, O'Reilley, 4<sup>th</sup> Edition, 2015.

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained.

Activities to be carried out

| Activity                                       | Instructions  | Submission week      | Evaluation  |
|--|---|----------------------|---|
| Selection of area of interest and Topic        | You are requested to select an area of interest, topic and state an objective   | 2 <sup>nd</sup> week | <b>3 %</b><br>Based on clarity of thought, current relevance and clarity in writing                       |
| Stating an Objective                           |   |                      |   |
| Collecting Information about your area & topic | <ol style="list-style-type: none"> <li>1. List 1 Special Interest Groups or professional society</li> <li>2. List 2 journals</li> <li>3. List 2 conferences, symposia or workshops</li> <li>4. List 1 thesis title</li> <li>5. List 3 web presences (mailing lists, forums, news sites)</li> <li>6. List 3 authors who publish regularly in your area</li> <li>7. Attach a call for papers (CFP) from your area.</li> </ol> | 3 <sup>rd</sup> week | <b>3%</b><br>( the selected information must be area specific and of international and national standard) |



|   |   |                            |  |
|---|---|----------------------------|--|
| <p>Collection of Journal papers in the topic in the context of the objective – collect 20 &amp; then filter</p> | <ul style="list-style-type: none"> <li>• You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar</li> <li>• When picking papers to read - try to: <ul style="list-style-type: none"> <li>• Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them,</li> <li>• Favour papers from well-known journals and conferences,</li> <li>• Favour -firstll or -foundationall papers in the field (as indicated in other people’s survey paper),</li> <li>• Favour more recent papers,</li> <li>• Pick a recent survey of the field so you can quickly gain an overview,</li> <li>• Find relationships with respect to each other and to your topic area (classification scheme/categorization)</li> <li>• Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered</li> </ul> </li> </ul> | <p>4<sup>th</sup> week</p> | <p><b>6%</b><br/>( the list of standard papers and reason for selection)</p>   |
| <p>Reading and notes for first 5 papers</p>   | <p>Reading Paper Process</p> <ul style="list-style-type: none"> <li>• For each paper form a Table answering the following questions:</li> <li>• What is the main topic of the article?</li> <li>• What was/were the main issue(s) the author said they want to discuss?</li> <li>• Why did the author claim it was important?</li> <li>• How does the work build on other’s work, in the author’s opinion?</li> <li>• What simplifying assumptions does the author claim to be making?</li> <li>• What did the author do?</li> <li>• How did the author claim they were going to evaluate their work and compare it to others?</li> <li>• What did the author say were the limitations of their research?</li> <li>• What did the author say were the important directions for future research?</li> </ul> <p>Conclude with limitations/issues not addressed by the paper ( from the perspective of your survey)</p>  | <p>5<sup>th</sup> week</p> | <p><b>8%</b><br/>( the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)</p> |

|                                      |  |  |  |
|--------------------------------------|--|--|--|
| Reading and notes for next 5 papers  | Repeat Reading Paper Process   | 6 <sup>th</sup> week                     | <b>8%</b><br>( the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper) |
| Reading and notes for final 5 papers | Repeat Reading Paper Process   | 7 <sup>th</sup> week                     | <b>8%</b><br>( the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper) |
| Draft outline 1 and Linking papers   | Prepare a draft Outline, your survey goals, along with a classification / categorization diagram                               | 8 <sup>th</sup> week                     | <b>8%</b><br>( this component will be evaluated based on the linking and classification among the papers)  |
| Abstract                             | Prepare a draft abstract and give a presentation   | 9 <sup>th</sup> week                     | <b>6%</b><br>(Clarity, purpose and conclusion)<br><b>6%</b> Presentation & Viva Voce   |
| Introduction Background              | Write an introduction and background sections  | 10 <sup>th</sup> week                    | <b>5%</b><br>( clarity)  |
| Sections of the paper                | Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey | 11 <sup>th</sup> week                    | <b>10%</b><br>(this component will be evaluated based on the linking and classification among the papers)  |
| Your conclusions                     | Write your conclusions and future work   | 12 <sup>th</sup> week                    | <b>5%</b> ( conclusions – clarity and your ideas)  |
| Final Draft                          | Complete the final draft of your paper   | 13 <sup>th</sup> week                    | <b>10%</b> (formatting, English, Clarity and linking)<br><b>4%</b> Plagiarism Check Report   |
| Seminar                              | A brief 15 slides on your paper  | 14 <sup>th</sup> & 15 <sup>th</sup> week | <b>10%</b><br>(based on presentation and Viva-voce)  |

**TOTAL: 30 PERIODS**

IF5191

**ADVANCED DATABASES**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To understand the design of databases.
- To acquire knowledge on parallel and distributed databases and its applications.
- To study the usage and applications of Object Oriented and Intelligent databases.
- To understand the emerging databases like Mobile, XML, Cloud and Big Data

**UNIT I PARALLEL AND DISTRIBUTED DATABASES 9**

Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Case Studies

**UNIT II INTELLIGENT DATABASES 9**

Active Databases: Syntax and Semantics (Starburst, Oracle, DB2)- Taxonomy-Applications- Design Principles for Active Rules- Temporal Databases: Overview of Temporal Databases TSQL2- Deductive Databases-Recursive Queries in SQL- Spatial Databases- Spatial Data Types - Spatial Relationships- Spatial Data Structures-Spatial Access Methods- Spatial DB Implementation.

**UNIT III XML DATABASES 9**

XML Databases: XML Data Model – DTD – XML Schema – XML Querying – Web Databases – Open Database Connectivity.

**UNIT IV MOBILE DATABASES 9**

Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit Protocols

**UNIT V MULTIMEDIA DATABASES 9**

Multidimensional Data Structures – Image Databases – Text / Document Databases –Video Databases – Audio Databases – Multimedia Database Design.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon completion of this course, a students should be able:**

- To develop skills on databases to optimize their performance in practice.
- To analyze each type of databases and its necessity
- To design faster algorithms in solving practical database problems

## REFERENCES:

1. C.J.Date, A.Kannan, S.Swamynathan, –An Introduction to Database SystemsII, Eighth Edition, Pearson Education, 2006.
2. Carlo Zaniolo, Stefano Ceri, Christos Faloutsos, Richard T.Snodgrass, V.S.Subrahmanian, Roberto Zicari, –Advanced Database SystemsII, Morgan Kaufmann publishers,2006.
3. Henry F Korth, Abraham Silberschatz, S. Sudharshan, –Database System ConceptsII, Sixth Edition, McGraw Hill, 2011.
4. R. Elmasri, S.B. Navathe, –Fundamentals of Database SystemsII, Sixth Edition, Pearson Education/Addison Wesley, 2010.
5. Vijay Kumar, –Mobile Database SystemsII, John Wiley & Sons, 2006.

|               |  |          |          |          |          |
|---------------|--|----------|----------|----------|----------|
| <b>CP5001</b> | <b>PRINCIPLES OF PROGRAMMING LANGUAGES</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

## OBJECTIVES:

- To understand and describe syntax and semantics of programming languages.
- To understand Data, Data types, and Bindings.
- To learn the concepts of functional and logical programming.
- To explore the knowledge about concurrent Programming paradigms.

## **UNIT I                    ELEMENTS OF PROGRAMMING LANGUAGES                    9**

Reasons for studying, concepts of programming languages, Language Evaluation Criteria, influences on Language design, Language categories. Programming Language Implementation – Compilation, Hybrid Implementation, Pure Interpretation and Virtual Machines. Describing Syntax and Semantics -Introduction - The General Problem of Describing Syntax-Formal Methods of Describing Syntax - Attribute Grammars - Describing the Meanings of Programs: Dynamic Semantics.

## **UNIT II                    DATA TYPES-ABSTRACTION                    9**

Introduction - Primitive Data Types- Character String Types- User-Defined Ordinal Types- Array types- Associative Arrays-Record Types- Tuple Types-List Types -Union Types - Pointer and Reference Types -Type Checking- Strong Typing -Type Equivalence - Theory and Data Types-Variables-The Concept of Binding -Scope - Scope and Lifetime - Referencing Environments - Named Constants- The Concept of Abstraction- Parameterized Abstract Data Types- Encapsulation Constructs- Naming Encapsulations

## **UNIT III                    FUNCTIONAL PROGRAMMING                    9**

Introduction- Mathematical Functions- Fundamentals of Functional Programming Languages- The First Functional Programming Language: LISP- An Introduction to Scheme- Common LISP- Haskell-F# - ML : Implicit Types- Data Types- Exception Handling in ML. Functional Programming with Lists- Scheme, a Dialect of Lisp- The Structure of Lists- List Manipulation- A Motivating Example: Differentiation- Simplification of Expressions- Storage Allocation for Lists.

**UNIT IV LOGIC PROGRAMMING****9**

Relational Logic Programming- Syntax- Basics- Facts- Rules- Syntax- Operational Semantics- Relational logic programs and SQL operations- Logic Programming- Syntax- Operational semantics- Data Structures-Meta-tools: Backtracking optimization (cuts); Unify; Meta-circular interpreters- The Origins of Prolog- Elements- of Prolog-Deficiencies of Prolog- Applications of Logic Programming.

**UNIT V CONCURRENT PROGRAMMING****9**

Parallelism in Hardware- Streams: Implicit Synchronization-Concurrency as Interleaving-Liveness Properties- Safe Access to Shared Data- Concurrency in Ada- Synchronized Access to Shared Variables- Synthesized Attributes- Attribute Grammars- Natural Semantics- Denotational Semantics -A Calculator in Scheme-Lexically Scoped Lambda Expressions- An Interpreter-Recursive Functions.

**TOTAL: 45 PERIODS****OUTCOMES:****Upon completion of this course, the students will be able to**

- Describe syntax and semantics of programming languages
- Explain data, data types, and basic statements of programming languages
- Design and implement subprogram constructs, Apply object - oriented, concurrency, pro
- and event handling programming constructs
- Develop programs in LISP, ML, and Prolog.

**REFERENCES:**

1. Ghezzi, -Programming LanguagesII, 3rd Edition, John Wiley, 2008
2. John C. Mitchell, -Concepts in Programming LanguagesII, Cambridge University Press, 2004.
3. Louden, -Programming LanguagesII, 3rd Edition, 2012.
4. Ravi Sethi, -Programming Languages: Concepts and ConstructsII, 2nd Edition, Addison Wesley, 1996.
5. Robert .W. Sebesta, -Concepts of Programming LanguagesII, 10th Edition, Pearson Education, 2002.

**CP5071****IMAGE PROCESSING AND ANALYSIS**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To understand the image processing concepts and analysis
- To understand the image processing techniques
- To familiarize the image processing environment and their applications,
- To appreciate the use of image processing in various applications

**UNIT I IMAGE PROCESSING FUNDAMENTALS****9**

Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System - Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – colour images and models - Image Operations – Arithmetic, logical, statistical and spatial operations.

**UNIT II IMAGE ENHANCEMENT AND RESTORATION 9**

Image Transforms -Discrete and Fast Fourier Transform and Discrete Cosine Transform ,Spatial Domain - Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain –Smoothing and Sharpening filters – Homomorphic Filtering., Noise models, Constrained and Unconstrained restoration models.

**UNIT III IMAGE SEGMENTATION AND MORPHOLOGY 9**

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations - Erosion, Dilation, Opening and Closing Operations Distance Transforms- Basic morphological Algorithms. Features – Textures - Boundary representations and Descriptions- Component Labeling – Regional descriptors and Feature Selection Techniques.

**UNIT IV IMAGE ANALYSIS AND CLASSIFICATION 9**

Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification.

**UNIT V IMAGE REGISTRATION AND VISUALIZATION 9**

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon completion of this course, a students should be able to:**

- Design and implement algorithms for image processing applications that incorporates different concepts of medical Image Processing
- Familiar with the use of MATLAB and its equivalent open source tools
- Critically analyze different approaches to image processing applications
- Explore the possibility of applying Image processing concepts in various applications

**REFERENCES:**

1. Alasdair McAndrew, —Introduction to Digital Image Processing with Matlabll, Cengage Learning 2011,India
2. Anil J Jain, —Fundamentals of Digital Image Processingll, PHI, 2006.
3. Kavyan Najarian and Robert Splerstor,ll Biomedical signals and Image processingll,CRC – Taylor and Francis, New York, 2006
4. Rafael C.Gonzalez and Richard E.Woods, —Digital Image Processingll, Third Edition, Pearson Education, 2008, New Delhi
5. S.Sridhar, -Digital Image Processingll, Oxford University Press, 2011

**CP5091**

**WEB ENGINEERING**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- Understand the characteristics of web applications
- Learn to Model web applications
- Be aware of Systematic design methods
- Be familiar with the testing techniques for web applications

**UNIT I INTRODUCTION TO WEB ENGINEERING 9**

Motivation, Categories of Web Applications, Characteristics of Web Applications. Requirements of Engineering in Web Applications- Web Engineering-Components of Web Engineering-Web Engineering Process-Communication-Planning.

**UNIT II WEB APPLICATION ARCHITECTURES & MODELLING WEB APPLICATIONS 9**

Introduction- Categorizing Architectures- Specifics of Web Application Architectures, Components of a Generic Web Application Architecture- Layered Architectures, 2-Layer Architectures, N-Layer Architectures-Data-aspect Architectures, Database-centric Architectures- Architectures for Web Document Management- Architectures for Multimedia Data- Modeling Specifics in Web Engineering, Levels, Aspects, Phases Customization, Modeling Requirements, Hypertext Modeling, Hypertext Structure Modeling Concepts, Access Modeling Concepts, Relation to Content Modeling, Presentation Modeling, Relation to Hypertext Modeling, Customization Modeling, Modelling Framework-Modeling languages-Analysis Modeling for Web Apps-The Content Model-The Interaction Model-Configuration Model.

**UNIT III WEB APPLICATION DESIGN 9**

Design for WebApps- Goals-Design Process-Interactive Design- Principles and Guidelines-Workflow-Preliminaries-Design Steps- Usability- Issues- Information Design- Information Architecture- structuring- Accessing Information-Navigation Design- Functional Design-Wep App Functionality- Design Process- Functional Architecture- Detailed Functional Design.

**UNIT IV TESTING WEB APPLICATIONS 9**

Introduction-Fundamentals-Test Specifics in Web Engineering-Test Approaches-Conventional Approaches, Agile Approaches- Testing concepts- Testing Process -Test Scheme- Test Methods and Techniques- Link Testing- Browser Testing-Usability Testing-Load, Stress, and Continuous Testing, Testing Security, Test-driven Development, -Content Testing-User Interface testing-Usability Testing-Compatibility Testing-Component Level Testing-Navigation Testing-Configuration testing-Security and Performance Testing- Test Automation.

**UNIT V PROMOTING WEB APPLICATIONS AND WEB PROJECT MANAGEMENT 9**

Introduction-challenges in launching the web Application-Promoting Web Application-Content Management-Usage Analysis-Web Project Management-Challenges in Web Project Management-Managing Web Team- Managing the Development Process of a Web Application- Risk, Developing a Schedule, Managing Quality, Managing Change, Tracking the Project. Introduction to node JS - web sockets.

**TOTAL : 45 PERIODS**

## OUTCOMES:

Upon completion of this course, the students should be able to:

- Explain the characteristics of web applications.
- Model web applications.
- Design web applications.
- Test web applications.

## REFERENCES:

1. Chris Bates, –Web Programming: Building Internet ApplicationsII, Third Edition, Wiley India Edition, 2007.
2. Gerti Kappel, Birgit Proll, –Web EngineeringII, John Wiley and Sons Ltd, 2006.
3. Guy W. Lecky-Thompson, –Web ProgrammingII, Cengage Learning, 2008.
4. John Paul Mueller, –Web Development with Microsoft Visual Studio 2005II, Wiley Dream tech, 2006.
5. Roger S. Pressman, David Lowe, –Web EngineeringII, Tata McGraw Hill Publication, 2007.

|               |                                     |          |          |          |          |
|---------------|-------------------------------------|----------|----------|----------|----------|
| <b>CP5092</b> | <b>CLOUD COMPUTING TECHNOLOGIES</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                     | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

## OBJECTIVES:

- To understand the concepts of virtualization and virtual machines
- To gain expertise in server, network and storage virtualization.
- To understand and deploy practical virtualization solutions and enterprise solutions
- To gain knowledge on the concept of virtualization that is fundamental to cloud computing
- To understand the various issues in cloud computing
- To be able to set up a private cloud
- To understand the security issues in the grid and the cloud environment

## UNIT I      **VIRTUALIZATION**      **9**

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines –Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization –Management Virtualization — Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization

## UNIT II      **VIRTUALIZATION INFRASTRUCTURE**      **9**

Comprehensive Analysis – Resource Pool – Testing Environment –Server Virtualization – Virtual Workloads – Provision Virtual Machines – Desktop Virtualization – Application Virtualization - Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.



**UNIT III CLOUD PLATFORM ARCHITECTURE 9**

Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Virtualization Support and Disaster Recovery – Architectural Design Challenges - Public Cloud Platforms : GAE,AWS – Inter-cloud Resource Management

**UNIT IV PROGRAMMING MODEL 9**

Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster - Cloud Software Environments -Eucalyptus, Open Nebula, Open Stack, Nimbus

**UNIT V CLOUD SECURITY 9**

Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud –Cloud Security and Trust Management

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon completion of this course, the students should be able to:**

- Employ the concepts of storage virtualization, network virtualization and its management
- Apply the concept of virtualization in the cloud computing
- Identify the architecture, infrastructure and delivery models of cloud computing
- Develop services using Cloud computing
- Apply the security models in the cloud environment

**REFERENCES:**

1. Danielle Ruest, Nelson Ruest, -Virtualization: A Beginner"s Guidell, McGraw-Hill Osborne Media, 2009.
2. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005
3. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
4. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
5. Tim Mather, Subra Kumaraswamy, and Shahed Latif , "Cloud Security and Privacy", O'Reilly Media, Inc.,2009.
6. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
7. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

**OBJECTIVES:**

- To learn real time operating system concepts, the associated issues & Techniques.
- To understand design and synchronization problems in Real Time System.
- To explore the concepts of real time databases.
- To understand the evaluation techniques present in Real Time System.

**UNIT I REAL TIME SYSTEM AND SCHEDULING 9**

Introduction– Structure of a Real Time System –Task classes – Performance Measures for Real Time Systems – Estimating Program Run Times – Issues in Real Time Computing – Task Assignment and Scheduling – Classical uniprocessor scheduling algorithms –Fault Tolerant Scheduling.

**UNIT II SOFTWARE REQUIREMENTS ENGINEERING 9**

Requirements engineering process – types of requirements – requirements specification for real time systems – Formal methods in software specification – structured Analysis and Design – object oriented analysis and design and unified modelling language – organizing the requirements document – organizing and writing documents –requirements validation and revision.

**UNIT III INTERTASK COMMUNICATION AND MEMORY MANAGEMENT 9**

Buffering data – Time relative Buffering- Ring Buffers – Mailboxes – Queues – Critical regions – Semaphores – other Synchronization mechanisms – deadlock – priority inversion – process stack management – run time ring buffer – maximum stack size – multiple stack arrangement – memory management in task control block - swapping – overlays – Block page management – replacement algorithms – memory locking – working sets – real time garbage collection – contiguous file systems.

**UNIT IV REAL TIME DATABASES 9**

Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two– phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems.

**UNIT V EVALUATION TECHNIQUES AND CLOCK SYNCHRONIZATION 9**

Reliability Evaluation Techniques – Obtaining parameter values, Reliability models for Hardware Redundancy–Software error models. Clock Synchronization–Clock, A Nonfault–Tolerant Synchronization Algorithm – Impact of faults – Fault Tolerant Synchronization in Hardware – Fault Tolerant Synchronization in software.

**TOTAL: 45 PERIODS****OUTCOMES:****Upon completion of this course, the students should be able to:**

- Apply principles of real time system design techniques to develop real time applications.
- Make use of database in real time applications.
- Make use of architectures and behaviour of real time operating systems.
- Apply evaluation techniques in application.

## REFERENCES:

1. C.M. Krishna, Kang G. Shin, –Real-Time SystemsII, McGraw-Hill International Editions, 1997
2. Philip.A.Laplante, –Real Time System Design and AnalysisII, Prentice Hall of India, 3<sup>rd</sup> Edition, 2004
3. Rajib Mall, –Real-time systems: theory and practicell, Pearson Education, 2009
4. R.J.A Buhur, D.L Bailey, –An Introduction to Real-Time SystemsII, Prentice Hall International, 1999
5. Stuart Bennett, –Real Time Computer Control-An IntroductionII, Prentice Hall of India, 1998
6. Allen Burns, Andy Wellings, –Real Time Systems and Programming LanguagesII, Pearson Education, 2003.

CP5093

## MOBILE AND PERVASIVE COMPUTING

L T P C  
3 0 0 3

### OBJECTIVES:

- To learn the basic architecture and concepts till Third Generation Communication systems.
- To understand the latest 4G Telecommunication System Principles.
- To introduce the broad perspective of pervasive concepts and management
- To explore the HCI in Pervasive environment
- To apply the pervasive concepts in mobile environment

### UNIT I INTRODUCTION

9

History – Wireless communications: GSM – DECT – TETRA – UMTS – IMT – 2000 – Blue tooth, WiFi, WiMAX, 3G ,WATM.- Mobile IP protocols -WAP push architecture-Wml scripts and applications. Data networks – SMS – GPRS – EDGE – Hybrid Wireless100 Networks – ATM – Wireless ATM.

### UNIT II OVERVIEW OF A MODERN 4G TELECOMMUNICATIONS SYSTEM

9

Introduction. LTE-A System Architecture. LTE RAN. OFDM Air Interface. Evolved Packet Core. LTE Requirements. LTE-Advanced. LTE-A in Release. OFDMA – Introduction. OFDM Principles. LTE Uplink—SC-FDMA. Summary of OFDMA.

### UNIT III PERVASIVE CONCEPTS AND ELEMENTS

9

Technology Trend Overview - Pervasive Computing: Concepts - Challenges - Middleware - Context Awareness - Resource Management - Human–Computer Interaction - Pervasive Transaction Processing - Infrastructure and Devices - Wireless Networks - Middleware for Pervasive Computing Systems - Resource Management - User Tracking- Context Management -Service Management - Data Management - Security Management - Pervasive Computing Environments - Smart Car Space - Intelligent Campus

#### **UNIT IV HCI IN PERVASIVE COMPUTING**

**9**

Prototype for Application Migration - Prototype for Multimodalities - Human–Computer Interface in Pervasive Environments - HCI Service and Interaction Migration - Context-Driven HCI Service Selection - Interaction Service Selection Overview - User Devices - Service-Oriented Middleware Support - User History and Preference - Context Manager - Local Service Matching - Global Combination - Effective Region - User Active Scope - Service Combination Selection Algorithm

#### **UNIT V PERVASIVE MOBILE TRANSACTIONS**

**9**

Pervasive Mobile Transactions - Introduction to Pervasive Transactions - Mobile Transaction Framework - Unavailable Transaction Service - Pervasive Transaction Processing Framework - Context-Aware Pervasive Transaction Model - Context Model for Pervasive Transaction Processing - Context-Aware Pervasive Transaction Model - A Case of Pervasive Transactions - Dynamic Transaction Management - Context-Aware Transaction Coordination Mechanism - Coordination Algorithm for Pervasive Transactions - Participant Discovery - Formal Transaction Verification - Petri Net with Selective Transition.

**TOTAL :45 PERIODS**

#### **OUTCOMES:**

**Upon completion of this course the students should be able to:**

- Obtain a thorough understanding of Basic architecture and concepts of till Third Generation Communication systems.
- Explain the latest 4G Telecommunication System Principles.
- Incorporate the pervasive concepts.
- Implement the HCI in Pervasive environment.
- Work on the pervasive concepts in mobile environment.

#### **REFERENCES:**

1. Alan Colman, Jun Han, and Muhammad Ashad Kabir, Pervasive Social Computing Socially-Aware Pervasive Systems and Mobile Applications, Springer, 2016.
2. J.Schiller, -Mobile CommunicationII, Addison Wesley, 2000.
3. Juha Korhonen, -Introduction to 4G Mobile CommunicationsII , Artech House Publishers, 2014
4. Kolomvatsos, Kostas, Intelligent Technologies and Techniques for Pervasive Computing, IGI Global, 2013.
5. M. Bala Krishna, Jaime Lloret Mauri, -Advances in Mobile Computing and Communications: Perspectives and Emerging Trends in 5G NetworksII, CRC 2016
6. Minyi Guo, Jingyu Zhou, Feilong Tang, Yao Shen, – Pervasive Computing: Concepts, Technologies and Applications II CRC Press, 2016

**OBJECTIVES:**

- To familiarize the issues in parallel computing.
- To describe distributed memory programming using MPI.
- To understand shared memory paradigm with Pthreads and with OpenMP.
- To learn the GPU based parallel programming using OpenCL.

**UNIT I FOUNDATIONS OF PARALLEL PROGRAMMING 9**

Motivation for parallel programming – Need-Concurrency in computing – Basics of processes, multitasking and threads – cache – cache mappings – caches and programs – virtual memory – Instruction level parallelism – hardware multi-threading – Parallel Hardware-SIMD – MIMD – Interconnection networks – cache coherence –Issues in shared memory model and distributed memory model –Parallel Software- Caveats- coordinating processes/ threads- hybrid model – shared memory model and distributed memory model - I/O – performance of parallel programs— parallel program design.

**UNIT II DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9**

Basic MPI programming – MPI\_Init and MPI\_Finalize – MPI communicators – SPMD-programs– MPI\_Send and MPI\_Recv – message matching – MPI- I/O – parallel I/O – collective communication – Tree-structured communication -MPI\_Reduce – MPI\_Allreduce, broadcast, scatter, gather, allgather – MPI derived types – dynamic process management – performance evaluation of MPI programs- A Parallel Sorting Algorithm

**UNIT III SHARED MEMORY PARADIGM WITH PTHREADS 9**

Basics of threads, Pthreads – thread synchronization – critical sections – busy waiting – mutex – semaphores – barriers and condition variables – read write locks with examples - Caches, cache coherence and false sharing – Thread safety-Pthreads case study.

**UNIT IV SHARED MEMORY PARADIGM: OPENMP 9**

Basics OpenMP – Trapezoidal Rule-scope of variables – reduction clause – parallel for directive – loops in OpenMP – scheduling loops –Producer Consumer problem – cache issues – threads safety in OpenMP – Two- body solvers- Tree Search

**UNIT V GRAPHICAL PROCESSING PARADIGMS: OPENCL AND INTRODUCTION TO CUDA 9**

Introduction to OpenCL – Example-OpenCL Platforms- Devices-Contexts - OpenCL programming – Built-In Functions-Programs Object and Kernel Object – Memory Objects - Buffers and Images – Event model – Command-Queue - Event Object - case study. Introduction to CUDA programming.

**TOTAL: 45 PERIODS****OUTCOMES:****Upon completion of this course, the students should be able to:**

- Identify issues in parallel programming.
- Develop distributed memory programs using MPI framework.
- Design and develop shared memory parallel programs using Pthreads and using OpenMP.
- Implement Graphical Processing OpenCL programs.

## REFERENCES:

1. A. Munshi, B. Gaster, T. G. Mattson, J. Fung, and D. Ginsburg, -OpenCL programming guidell, Addison Wesley, 2011
2. M. J. Quinn, -Parallel programming in C with MPI and OpenMPI, Tata McGraw Hill, 2003.
3. Peter S. Pacheco, -An introduction to parallel programmingll, Morgan Kaufmann, 2011.
4. Rob Farber, -CUDA application design and developmentll, Morgan Kaufmann, 2011.
5. W. Gropp, E. Lusk, and A. Skjellum, -Using MPI: Portable parallel programming with the message passing interfacell, Second Edition, MIT Press, 1999

|               |   |          |          |          |          |
|---------------|---|----------|----------|----------|----------|
| <b>CP5094</b> | <b>INFORMATION RETRIEVAL TECHNIQUES</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

## OBJECTIVES:

- To understand the basics of information retrieval with pertinence to modeling, query operations and indexing
- To get an understanding of machine learning techniques for text classification and clustering.
- To understand the various applications of information retrieval giving emphasis to multimedia IR, web search
- To understand the concepts of digital libraries

## UNIT I INTRODUCTION: MOTIVATION 9

Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval – Retrieval Evaluation – Open Source IR Systems–History of Web Search – Web Characteristics– The impact of the web on IR —IR Versus Web Search–Components of a Search engine

## UNIT II MODELING 9

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing

## UNIT III INDEXING 9

Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency

## UNIT IV CLASSIFICATION AND CLUSTERING 9

Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents. Flat Clustering – Hierarchical Clustering –Matrix decompositions and latent semantic indexing – Fusion and Meta learning

**UNIT V      SEARCHING THE WEB****9**

Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries

**TOTAL : 45 PERIODS****OUTCOMES:****Upon completion of this course, the students should be able to:**

- Build an Information Retrieval system using the available tools.
- Identify and design the various components of an Information Retrieval system.
- Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.
- Design an efficient search engine and analyze the Web content structure.

**REFERENCES:**

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, -Introduction to Information Retrieval, Cambridge University Press, First South Asian Edition, 2008.
2. Implementing and Evaluating Search Engines, The MIT Press, Cambridge, Massachusetts London, England, 2010
3. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, -Modern Information Retrieval: The concepts and Technology behind Search (ACM Press Books), Second Edition, 2011.
4. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, -Information Retrieval

**CP5072****SOFTWARE ARCHITECTURES AND DESIGN**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation.
- To learn the design principles and to apply for large scale systems
- To design architectures for distributed heterogeneous systems ,environment through brokerage interaction
- To build design knowledge on service oriented and model driven architectures and the aspect oriented architecture.
- To develop appropriate architectures for various Case studies like semantic web services, supply chain cloud services.

**UNIT I****10**

Introduction to Software Architecture-Bridging Requirements and Implementation, Design Guidelines, Software Quality attributes. Software Architecture Design Space. Agile Approach to Software Architecture Design, Models for Software Architecture Description Languages (ADL).

**UNIT II****8**

Object-Oriented Paradigm -Design Principles. Data-Centered Software Architecture: Repository Architecture, Blackboard Architecture. Hierarchical Architecture Main-Subroutine, Master-Slave, Layered, Virtual Machine. Interaction-Oriented Software Architectures: Model-View-Controller (MVC), Presentation-Abstraction-Control (PAC ).

**UNIT III** **9**  
 Distributed Architecture: Client-Server, Middleware, Multi-tiers, Broker Architecture – MOM, CORBA Message Broker Architecture- Service-Oriented Architecture (SOA), SOAP, UDDI, SOA Implementation in Web Services, Grid/cloud Service Computing. Heterogeneous Architecture- Methodology of Architecture Decision, Quality Attributes.

**UNIT IV** **9**  
 Architecture of User Interfaces containers, case study-web service. Product Line Architectures - methodologies, processes and tools. Software Reuse and Product Lines -Product Line Analysis, Design and implementation, configuration Models. Model Driven Architectures (MDA) –why MDA- Model transformation and software architecture, SOA and MDA. Eclipse modeling framework.

**UNIT V** **9**  
 Aspect Oriented Architectures- AOP in UML, AOP tools, Architectural aspects and middleware Selection of Architectures, Evaluation of Architecture Designs, Case Study: Online Computer Vendor, order processing, manufacture & shipping –inventory, supply chain cloud service Management, semantic web services

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon completion of this course, the students should be able to:**

- Understand the need of software architecture for sustainable dynamic systems.
- Have a sound knowledge on design principles and to apply for large scale systems
- Design architectures for distributed heterogeneous systems
- Have good knowledge on service oriented and model driven architectures and the aspect oriented architecture.
- Have a working knowledge to develop appropriate architectures through various case studies.

**REFERENCES :**

1. Essentials of software Architecture , Ion Gorton, Second Edition, Springer-verlag, 2011
2. Software Architecture Design Illuminated, Kai Qian Jones and Bartlett Publishers Canada, 2010

|               |   |          |          |          |          |
|---------------|---|----------|----------|----------|----------|
| <b>CP5003</b> | <b>PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | 3        | 0        | 0        | 3        |

**OBJECTIVES:**

- To understand the mathematical foundations needed for performance evaluation of computer systems
- To understand the metrics used for performance evaluation
- To understand the analytical modeling of computer systems
- To enable the students to develop new queuing analysis for both simple and complex systems
- To appreciate the use of smart scheduling and introduce the students to analytical techniques for evaluating scheduling policies



**UNIT I OVERVIEW OF PERFORMANCE EVALUATION 9**

Need for Performance Evaluation in Computer Systems – Overview of Performance Evaluation Methods – Introduction to Queuing – Probability Review – Generating Random Variables for Simulation – Sample Paths, Convergence and Averages – Little’s Law and other Operational Laws – Modification for Closed Systems.

**UNIT II MARKOV CHAINS AND SIMPLE QUEUES 9**

Discrete-Time Markov Chains – Ergodicity Theory – Real World Examples – Google, Aloha – Transition to Continuous-Time Markov Chain – M/M/1.

**UNIT III MULTI-SERVER AND MULTI-QUEUE SYSTEMS 9**

Server Farms: M/M/k and M/M/k/k – Capacity Provisioning for Server Farms – Time Reversibility and Burke’s Theorem – Networks of Queues and Jackson Product Form –Classed and Closed Networks of Queues.

**UNIT IV REAL-WORLD WORKLOADS 9**

Case Study of Real-world Workloads – Phase-Type Distributions and Matrix-Analytic Methods – Networks with Time-Sharing Servers – M/G/1 Queue and the Inspection Paradox – Task Assignment Policies for Server Farms.

**UNIT V SMART SCHEDULING IN THE M/G/1 9**

Performance Metrics – Scheduling Non-Preemptive and Preemptive Non-Size-Based Policies - . Scheduling Non-Preemptive and Preemptive Size-Based Policies – Scheduling - SRPT and Fairness.

**TOTAL : 45 PERIODS**

**OUTCOMES :**

**Upon completion of this course, the students should be able to**

- Identify the need for performance evaluation and the metrics used for it
- Distinguish between open and closed queuing networks
- Use Little’e law and other operational laws
- Apply the operational laws to open and closed systems
- Use discrete-time and continuous-time Markov chains to model real world systems
- Develop analytical techniques for evaluating scheduling policies

**REFERENCES:**

1. K. S. Trivedi, -Probability and Statistics with Reliability, Queueing and Computer Science ApplicationsII, John Wiley and Sons, 2001.
2. Krishna Kant, -Introduction to Computer System Performance EvaluationII, McGraw-Hill, 1992.
3. Lieven Eeckhout, -Computer Architecture Performance Evaluation MethodsII, Morgan and Claypool Publishers, 2010.
4. Mor Harchol - Balter, -Performance Modeling and Design of Computer Systems – Queueing Theory in ActionII, Cambridge University Press, 2013.
5. Paul J. Fortier and Howard E. Michel, -Computer Systems Performance Evaluation and PredictionII, Elsevier, 2003.
6. Raj Jain, -The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation and ModelingII, Wiley-Interscience, 1991.

**CP5004**

**LANGUAGE TECHNOLOGIES**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To learn the fundamentals of natural language processing
- To appreciate the use of CFG and PCFG in NLP
- To understand the role of semantics and pragmatics

**UNIT I INTRODUCTION 9**

Words - Regular Expressions and Automata - Words and Transducers - N-grams - Part-of-Speech – Tagging - Hidden Markov and Maximum Entropy Models.

**UNIT II SPEECH 9**

Speech – Phonetics - Speech Synthesis - Automatic Speech Recognition - Speech Recognition: - Advanced Topics - Computational Phonology.

**UNIT III SYNTAX 9**

Formal Grammars of English - Syntactic Parsing - Statistical Parsing - Features and Unification - Language and Complexity.

**UNIT IV SEMANTICS AND PRAGMATICS 9**

The Representation of Meaning - Computational Semantics - Lexical Semantics - Computational Lexical Semantics - Computational Discourse.

**UNIT V APPLICATIONS 9**

Information Extraction - Question Answering and Summarization - Dialogue and Conversational Agents - Machine Translation.

**TOTAL :45 PERIODS**

**OUTCOMES:**

**Upon completion of this course, the students should be able to:**

- To tag a given text with basic Language features
- To design an innovative application using NLP components
- To implement a rule based system to tackle morphology/syntax of a language
- To design a tag set to be used for statistical processing for real-time applications
- To compare and contrast use of different statistical approaches for different types of NLP applications.

**REFERENCES:**

1. Breck Baldwin, "Language Processing with Java and LingPipe Cookbook", Atlantic Publisher, 2015.
2. Daniel Jurafsky, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech", Pearson Publication, 2014.
3. Nitin Indurkha and Fred J. Damerau, "Handbook of Natural Language Processing", Second Edition, Chapman and Hall/CRC Press, 2010.
4. Richard M Reese, "Natural Language Processing with Java", O\_Reilly Media, 2015.
5. Steven Bird, Ewan Klein and Edward Loper, -"Natural Language Processing with Python", First Edition, O\_Reilly Media, 2009.

**OBJECTIVES:**

- To review image processing techniques for computer vision.
- To understand shape and region analysis.
- To understand Hough Transform and its applications to detect lines, circles, ellipses.
- To understand three-dimensional image analysis techniques.
- To understand motion analysis.
- To study some applications of computer vision algorithms.

**UNIT I IMAGE PROCESSING FOUNDATIONS 9**

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture.

**UNIT II SHAPES AND REGIONS 9**

Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

**UNIT III HOUGH TRANSFORM 9**

Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform (GHT) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation.

**UNIT IV 3D VISION AND MOTION 9**

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.

**UNIT V APPLICATIONS 9**

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

**TOTAL : 45 PERIODS****OUTCOMES:**

**Upon completion of this course, the students should be able to**

- Implement fundamental image processing techniques required for computer vision.
- Perform shape analysis.
- Implement boundary tracking techniques.
- Apply chain codes and other region descriptors.
- Apply Hough Transform for line, circle, and ellipse detections.
- Apply 3D vision techniques.
- Implement motion related techniques.
- Develop applications using computer vision techniques.



**UNIT V SPEECH SYNTHESIS**

**9**

Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon completion of this course, the students should be able to**

- Identify the various temporal, spectral and cepstral features required for identifying speech units – phoneme, syllable and word
- Determine and apply Mel-frequency cepstral coefficients for processing all types of signals
- Justify the use of formant and concatenative approaches to speech synthesis
- Identify the apt approach of speech synthesis depending on the language to be processed
- Determine the various encoding techniques for representing speech.

**REFERENCES:**

1. Joseph Mariani, -Language and Speech Processingll, Wiley, 2009.
2. Lawrence Rabiner and Biing-Hwang Juang, -Fundamentals of Speech Recognitionll, Prentice Hall Signal Processing Series, 1993.
3. Sadaoki Furui, -Digital Speech Processing: Synthesis, and Recognition, Second Edition, (Signal Processing and Communications)ll, Marcel Dekker, 2000.
4. Thomas F.Quatieri, -Discrete-Time Speech Signal Processingll, Pearson Education, 2002.
5. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, -Spoken Language Processing – A guide to Theory, Algorithm and System Developmentll, Prentice Hall PTR, 2001.

**CP5005**

**SOFTWARE QUALITY ASSURANCE AND TESTING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To understand the basics of testing, test planning & design and test team organization
- To study the various types of test in the life cycle of the software product.
- To build design concepts for system testing and execution
- To learn the software quality assurance ,metrics, defect prevention techniques
- To learn the techniques for quality assurance and applying for applications.

**UNIT I SOFTWARE TESTING - CONCEPTS, ISSUES, AND TECHNIQUES**

**9**

Quality Revolution, Verification and Validation, Failure, Error, Fault, and Defect, Objectives of Testing, Testing Activities, Test Case Selection White-Box and Black ,test Planning and design, Test Tools and Automation, . Power of Test. Test Team Organization and Management-Test Groups, Software Quality Assurance Group ,System Test Team Hierarchy, Team Building.

**UNIT II SYSTEM TESTING**

**9**

System Testing - System Integration Techniques-Incremental, Top Down Bottom Up Sandwich and Big Bang, Software and Hardware Integration, Hardware Design Verification Tests, Hardware and Software Compatibility Matrix Test Plan for System Integration. Built-in Testing. functional testing - Testing a Function in Context. Boundary Value Analysis, Decision Tables. acceptance testing - Selection of Acceptance Criteria, Acceptance Test Plan, Test Execution Test. software reliability - Fault and Failure, Factors Influencing Software, Reliability Models

### **UNIT III SYSTEM TEST CATEGORIES**

**10**

System test categories Taxonomy of System Tests, Interface Tests Functionality Tests. GUI Tests, Security Tests Feature Tests, Robustness Tests, Boundary Value Tests Power Cycling Tests Interoperability Tests, Scalability Tests, Stress Tests, Load and Stability Tests, Reliability Tests, Regression Tests, Regulatory Tests.

Test Generation from FSM models- State-Oriented Model. Finite-State Machine Transition Tour Method, Testing with State Verification. Test Architectures-Local, distributed, Coordinated, Remote. system test design- Test Design Factors Requirement Identification, modeling a Test Design Process Test Design Preparedness, Metrics, Test Case Design Effectiveness. system test execution- Modeling Defects, Metrics for Monitoring Test Execution .Defect Reports, Defect Causal Analysis, Beta testing, measuring Test Effectiveness.

### **UNIT IV SOFTWARE QUALITY**

**8**

Software quality - People's Quality Expectations, Frameworks and ISO-9126, McCall's Quality Factors and Criteria – Relationship. Quality Metrics. Quality Characteristics ISO 9000:2000 Software Quality Standard. Maturity models- Test Process Improvement ,Testing Maturity Model.

### **UNIT V SOFTWARE QUALITY ASSURANCE**

**9**

Quality Assurance - Root Cause Analysis, modeling, technologies, standards and methodologies for defect prevention. Fault Tolerance and Failure Containment - Safety Assurance and Damage Control, Hazard analysis using fault-trees and event-trees. Comparing Quality Assurance Techniques and Activities. QA Monitoring and Measurement, Risk Identification for Quantifiable Quality Improvement. Case Study: FSM-Based Testing of Web-Based Applications.

**TOTAL :45 PERIODS**

#### **OUTCOMES:**

**Upon completion of this course, the students should be able to**

- Perform functional and nonfunctional tests in the life cycle of the software product.
- Understand system testing and test execution process.
- Identify defect prevention techniques and software quality assurance metrics.
- Apply techniques of quality assurance for typical applications.

#### **REFERENCES:**

1. Software Testing And Quality Assurance-Theory and Practice, Kshirasagar Nak Priyadarshi Tripathy, John Wiley & Sons Inc,2008
2. Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement, Jeff Tian, John Wiley & Sons, Inc., Hoboken, New Jersey. 2005.
3. Software Quality Assurance - From Theory to Implementation, Daniel Galin, Pearson Education Ltd UK, 2004
4. Software Quality Assurance, Milind Limaye, TMH ,New Delhi, 2011

**OBJECTIVES:**

- To understand the goals, complexity of software systems, the role of Specification activities and qualities to control complexity.
- To understand the fundamentals of abstraction and formal systems
- To learn fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems
- To understand formal specification models based on set theory, calculus and algebra and apply to a case study
- To learn Z, Object Z and B Specification languages with case studies.

**UNIT I SPECIFICATION FUNDAMENTALS 10**

Role of Specification- Software Complexity - Size, Structural, Environmental, Application, domain, Communication Complexity, How to Control Complexity. Software specification, Specification Activities-Integrating Formal Methods into the Software Life-Cycle. Specification Qualities- Process Quality Attributes of Formal Specification Languages, Model of Process Quality, Product Quality and Utility, Conformance to Stated Goals Quality Dimensions and Quality Model.

**UNIT II FORMAL METHODS 8**

Abstraction- Fundamental Abstractions in Computing. Abstractions for Software Construction.

Formalism Fundamentals - Formal Systems, Formalization Process in Software Engineering Components of a Formal System- Syntax, Semantics, and Inference Mechanism. Properties of Formal Systems - Consistency.

Automata-Deterministic Finite Accepters, State Machine Modeling Nondeterministic Finite Accepters, Finite State Transducers Extended Finite State Machine. Case Study—Elevator Control. Classification of C Methods-Property-Oriented Specification Methods, Model-Based Specification Techniques.

**UNIT III LOGIC 9**

Propositional Logic - Reasoning Based on Adopting a Premise, Inference Based on Natural Deduction. Predicate Logic - Syntax and Semantics, Policy Language Specification, knowledge Representation Axiomatic Specification. Temporal Logic -.Temporal Logic for Specification and Verification, Temporal Abstraction Propositional Temporal Logic (PTL), First Order Temporal Logic (FOTL).Formal Verification, Verification of Simple FOTL, Model Checking, Program Graphs, Transition Systems.

**UNIT IV SPECIFICATION MODELS 9**

Mathematical Abstractions for Model-Based Specifications-Formal Specification Based on Set Theory, Relations and Functions. Property-Oriented Specifications- Algebraic Specification, Properties of Algebraic Specifications, Reasoning, Structured Specifications. Case Study—A Multiple Window Environment: requirements, Modeling Formal Specifications. Calculus of Communicating Systems: Specific Calculus for Concurrency. Operational Semantics of Agents, Simulation and Equivalence, Derivation Trees, Labeled Transition Systems.

**UNIT V FORMAL LANGUAGES****9**

The Z Notation, abstractions in Z, Representational Abstraction, Types, Relations and Functions, Sequences, Bags. Free Types-Schemas, Operational Abstraction -Operations Schema Decorators, Generic Functions, Proving Properties from Z specifications, Consistency of Operations. Additional Features in Z. Case Study: An Automated Billing System. The Object-Z Specification Language- Basic Structure of an Object-Z, Specification. Parameterized Class, Object-Orientation, composition of Operations-Parallel Communication Operator, Nondeterministic Choice Operator, and Environment Enrichment. The B-Method -Abstract Machine Notation (AMN), Structure of a B Specification, arrays, statements. Structured Specifications, Case Study- A Ticketing System in a Parking.

**TOTAL :45 PERIODS****OUTCOMES:****Upon completion of this course, the students should be able to**

- Understand the complexity of software systems, the need for formal specifications activities and qualities to control complexity.
- Gain knowledge on fundamentals of abstraction and formal systems
- Learn the fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems
- Develop formal specification models based on set theory, calculus and algebra and apply to a typical case study
- Have working knowledge on Z, Object Z and B Specification languages with case studies.

**REFERENCES:**

- 1 Mathematical Logic for computer science ,second edition, M.Ben-Ari ,Springer,2003.
- 2 Logic in Computer Science- modeling and reasoning about systems, 2<sup>nd</sup> Edition, Cambridge University Press, 2004.
- 3 Specification of Software Systems, V.S. Alagar, K. Periyasamy, David Grises and Fred B Schneider, Springer –Verlag London, 2011
- 4 The ways Z: Practical programming with formal methods, Jonathan Jacky, Cambridge University Press,1996.
- 5 Using Z-Specification Refinement and Proof,Jim Woodcock and Jim Devies Prentice Hall, 1996
- 6 Z: An introduction to formal methods, Second Edition, Antoi Diller, Wiley, 1994.

**CP5073****EMBEDDED SOFTWARE DEVELOPMENT****L T P C  
3 0 0 3****OBJECTIVES:**

- To understand the architecture of embedded processor, microcontroller and peripheral devices.
- To interface memory and peripherals with embedded systems.
- To study the embedded network environment.
- To understand challenges in Real time operating systems.
- To study, analyze and design applications on embedded systems.





**CP5074**

**SOCIAL NETWORK ANALYSIS**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To understand the components of the social network.
- To model and visualize the social network.
- To mine the users in the social network.
- To understand the evolution of the social network.
- To know the applications in real time systems.

**UNIT I INTRODUCTION 9**

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

**UNIT II MODELING AND VISUALIZATION 9**

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.

**UNIT III MINING COMMUNITIES 9**

Aggregating and reasoning with social network data, Advanced Representations –Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

**UNIT IV EVOLUTION 9**

Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models.

**UNIT V APPLICATIONS 9**

A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection

**TOTAL : 45 PERIODS**

**OUTCOMES:****Upon Completion of the course, the students should be able to**

- Work on the internal components of the social network
- Model and visualize the social network
- Mine the behaviour of the users in the social network
- Predict the possible next outcome of the social network
- Apply social network in real time applications

**REFERENCES:**

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, -Computational Social Network Analysis: Trends, Tools and Research Advances, Springer, 2012
2. Borko Furht, -Handbook of Social Network Technologies and Applications, Springer, 1<sup>st</sup> edition, 2011
3. Charu C. Aggarwal, -Social Network Data Analytics, Springer, 2014
4. Giles, Mark Smith, John Yen, -Advances in Social Network Mining and Analysis, Springer, 2010.
5. Guangdong Xu, Yanchun Zhang and Lin Li, -Web Mining and Social Networking – Techniques and applications, Springer, 1st edition, 2012
6. Peter Mika, -Social Networks and the Semantic Web, Springer, 1st edition, 2007.
7. Przemyslaw Kazienko, Nitesh Chawla, Applications of Social Media and Social Network Analysis, Springer, 2015

**CP5007****BIO-INSPIRED COMPUTING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To Learn bio-inspired theorem and algorithms
- To Understand random walk and simulated annealing
- To Learn genetic algorithm and differential evolution
- To Learn swarm optimization and ant colony for feature selection
- To understand bio-inspired application in image processing

**UNIT I INTRODUCTION 9**

Introduction to algorithm - Newton's method - optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Metaheuristics -Analysis of Algorithms -Nature Inspires Algorithms -Parameter tuning and parameter control.

**UNIT II RANDOM WALK AND ANEALING 9**

Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - step sizes and search efficiency - Modality and intermittent search strategy - importance of randomization- Eagle strategy-Annealing and Boltzmann Distribution - parameters -SA algorithm - Stochastic Tunneling.

**UNIT III GENETIC ALGORITHM AND DIFFERENTIAL EVOLUTION 9**

Introduction to genetic algorithms and - role of genetic operators - choice of parameters - GA variants - schema theorem - convergence analysis - introduction to differential evolution - variants - choice of parameters - convergence analysis - implementation.

**UNIT IV SWARM OPTIMIZATION AND FIREFLY ALGORITHM 9**

Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation - variants- Ant colony optimization toward feature selection.

**UNIT V APPLICATION IN IMAGE PROCESSING 9**

Bio-Inspired Computation and its Applications in Image Processing: An Overview - Fine-Tuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization - Fine-Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted Thresholded Histogram Equalization Algorithm for Digital Image Contrast Enhancement Using Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the students should be able to**

- Implement and apply bio-inspired algorithms
- Explain random walk and simulated annealing
- Implement and apply genetic algorithms
- Explain swarm intelligence and ant colony for feature selection
- Apply bio-inspired techniques in image processing.

**REFERENCES:**

1. Eiben,A.E.,Smith,James E, "Introduction to Evolutionary Computing", Springer 2015.
2. Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech 2013
3. Xin-She Yang , Jao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing",Elsevier 2016
4. Xin-She Yang, "Nature Ispired Optimization Algorithm,Elsevier First Edition 2014
5. Yang ,Cui,Xlao,Gandomi,Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013

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|---------------|---|----------|----------|----------|----------|
| <b>CP5008</b> | <b>COMPILER OPTIMIZATION TECHNIQUES</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To be aware of different forms of intermediate languages and analyzing programs.
- To understand optimizations techniques for simple program blocks.
- To apply optimizations on procedures, control flow and parallelism.
- To learn the inter procedural analysis and optimizations.
- To explore the knowledge about resource utilization.

**UNIT I INTERMEDIATE REPRESENTATIONS AND ANALYSIS 9**

Review of Compiler Structure- Structure of an Optimizing Compiler – Intermediate Languages - LIR, MIR, HIR – Control Flow Analysis – Iterative Data Flow Analysis – Static Single Assignment – Dependence Relations - Dependences in Loops and Testing-Basic Block Dependence DAGs – Alias Analysis.

**UNIT II EARLY AND LOOP OPTIMIZATIONS 9**

Importance of Code Optimization Early Optimizations: Constant-Expression Evaluation - Scalar Replacement of Aggregates - Algebraic Simplifications and Re-association - Value Numbering - Copy Propagation - Sparse Conditional Constant Propagation. Redundancy Elimination: Common - Subexpression Elimination - Loop-Invariant Code Motion - Partial-Redundancy Elimination - Redundancy Elimination and Reassociation - Code Hoisting. Loop Optimizations: Induction Variable Optimizations - Unnecessary Bounds Checking Elimination.

**UNIT III PROCEDURE OPTIMIZATION AND SCHEDULING 9**

Procedure Optimizations: Tail-Call Optimization and Tail-Recursion Elimination - Procedure Integration - In-Line Expansion - Leaf-Routine Optimization and Shrink Wrapping. Code Scheduling: Instruction Scheduling - Speculative Loads and Boosting - Speculative Scheduling - Software Pipelining - Trace Scheduling - Percolation Scheduling. Control-Flow and Low-Level Optimizations : Unreachable-Code Elimination - Straightening - If Simplifications - Loop Simplifications -Loop Inversion – Un-switching - Branch Optimizations - Tail Merging or Cross Jumping - Conditional Moves - Dead-Code Elimination - Branch Prediction - Machine Idioms and Instruction Combining.

**UNIT IV INTER PROCEDURAL OPTIMIZATION 9**

Symbol table – Runtime Support - Interprocedural Analysis and Optimization: Interprocedural Control Flow Analysis - The Call Graph - Interprocedural Data-Flow Analysis - Interprocedural Constant Propagation - Interprocedural Alias Analysis - Interprocedural Optimizations - Interprocedural Register Allocation - Aggregation of Global References.

**UNIT V REGISTER ALLOCATION AND OPTIMIZING FOR MEMORY 9**

Register Allocation: Register Allocation and Assignment - Local Methods - Graph Coloring – Priority Based Graph Coloring - Other Approaches to Register Allocation. Optimization for the Memory Hierarchy: Impact of Data and Instruction Caches - Instruction-Cache Optimization - Scalar Replacement of Array Elements - Data-Cache Optimization - Scalar vs. Memory-Oriented Optimizations.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon completion of this course, the student should be able to:**

- Identify the different optimization techniques for simple program blocks.
- Design performance enhancing optimization techniques.
- Perform the optimization on procedures.
- Ensure better utilization of resources.

**REFERENCES:**

1. Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques, and Tools", Addison Wesley, Second Edition, 2007.
2. Andrew W. Appel, Jens Palsberg, "Modern Compiler Implementation in Java", Cambridge University Press, Second Edition, 2002.
3. Keith Cooper, Linda Torczon, "Engineering a Compiler", Morgan Kaufmann, Second Edition, 2011. 5. Randy Allen and Ken Kennedy, -Optimizing Compilers for Modern Architectures: A Dependence based Approach, Morgan Kaufman, 2001.
4. Robert Morgan ,Building an Optimizing Compiler, Digital Press, 1998
5. Steven Muchnick, -Advanced Compiler Design and Implementation, Morgan Kaufman Publishers, 1997.

**CP5009**

**DATA VISUALIZATION TECHNIQUES**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To develop skills to both design and critique visualizations.
- To introduce visual perception and core skills for visual analysis.
- To understand visualization for time-series analysis.
- To understand visualization for ranking analysis.
- To understand visualization for deviation analysis.
- To understand visualization for distribution analysis.
- To understand visualization for correlation analysis.
- To understand visualization for multivariate analysis.
- To understand issues and best practices in information dashboard design.

**UNIT I CORE SKILLS FOR VISUAL ANALYSIS 9**

Information visualization – effective data analysis – traits of meaningful data – visual perception –making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.

**UNIT II TIME-SERIES, RANKING, AND DEVIATION ANALYSIS 9**

Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.

**UNIT III DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS 9**

Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.

**UNIT IV INFORMATION DASHBOARD DESIGN 9**

Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence.

**UNIT V INFORMATION DASHBOARD DESIGN 9**

Advantages of Graphics \_Library of Graphs – Designing Bullet Graphs – Designing Sparklines – Dashboard Display Media –Critical Design Practices – Putting it all together- Unveiling the dashboard.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the students should be able to:**

- Explain principles of visual perception
- Apply core skills for visual analysis
- Apply visualization techniques for various data analysis tasks
- Design information dashboard

## REFERENCES:

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
2. Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001.
3. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011.
4. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.
5. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
6. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.
7. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.
8. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014

CP5010

RECONFIGURABLE COMPUTING

L T P C  
3 0 0 3

## OBJECTIVES:

- To understand the need for reconfigurable computing
- To expose the students to various device architectures
- To examine the various reconfigurable computing systems
- To understand the different types of compute models for programming reconfigurable architectures
- To expose the students to HDL programming and familiarize with the development environment
- To expose the students to the various placement and routing protocols
- To develop applications with FPGAs

### UNIT I      **DEVICE ARCHITECTURE**      **9**

General Purpose Computing Vs Reconfigurable Computing – Simple Programmable Logic Devices – Complex Programmable Logic Devices – FPGAs – Device Architecture - Case Studies.

### UNIT II      **RECONFIGURABLE COMPUTING ARCHITECTURES AND SYSTEMS**      **9**

Reconfigurable Processing Fabric Architectures – RPF Integration into Traditional Computing Systems – Reconfigurable Computing Systems – Case Studies – Reconfiguration Management.

### UNIT III      **PROGRAMMING RECONFIGURABLE SYSTEMS**      **9**

Compute Models - Programming FPGA Applications in HDL – Compiling C for Spatial Computing – Operating System Support for Reconfigurable Computing.

### UNIT IV      **MAPPING DESIGNS TO RECONFIGURABLE PLATFORMS**      **9**

The Design Flow - Technology Mapping – FPGA Placement and Routing – Configuration Bitstream Generation – Case Studies with Appropriate Tools.

**UNIT V APPLICATION DEVELOPMENT WITH FPGAS****9**

Case Studies of FPGA Applications – System on a Programmable Chip (SoPC) Designs.

**TOTAL: 45 PERIODS****OUTCOMES:****Upon completion of the course, the students should be able to:**

- Identify the need for reconfigurable architectures.
- Discuss the architecture of FPGAs.
- Point out the salient features of different reconfigurable architectures.
- Build basic modules using any HDL.
- Develop applications using any HDL and appropriate tools.
- Design and build an SoPC for a particular application.

**REFERENCES:**

1. Christophe Bobda, -Introduction to Reconfigurable Computing – Architectures, Algorithms and Applications, Springer, 2010.
2. Maya B. Gokhale and Paul S. Graham, -Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays, Springer, 2005.
3. FPGA Frontiers: New Applications in Reconfigurable Computing, 2017, Nicole Hemsoth, Timothy Prickett Morgan, Next Platform.
4. Reconfigurable Computing: From FPGAs to Hardware/Software Codesign 2011 Edition by Joao Cardoso (Editor), Michael Hübne, Springer
5. Scott Hauck and Andre Dehon (Eds.), -Reconfigurable Computing – The Theory and Practice of FPGA-Based Computation, Elsevier / Morgan Kaufmann, 2008.

**CP5097****MOBILE APPLICATION DEVELOPMENT****L T P C****3 0 0 3****OBJECTIVES:**

- Understand system requirements for mobile applications.
- Generate suitable design using specific mobile development frameworks.
- Generate mobile application design.
- Implement the design using specific mobile development frameworks.
- Deploy the mobile applications in marketplace for distribution.

**UNIT I INTRODUCTION****5**

Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications.

**UNIT II BASIC DESIGN****8**

Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – User interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.



**UNIT III      ADVANCED DESIGN      8**

Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.

**UNIT IV      ANDROID      12**

Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.

**UNIT V      IOS      12**

Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.

**TOTAL :45 PERIODS**

**OUTCOMES:**

**Upon completion of the course, the students should be able to:**

- Describe the requirements for mobile applications.
- Explain the challenges in mobile application design and development.
- Develop design for mobile applications for specific requirements.
- Implement the design using Android SDK.
- Implement the design using Objective C and iOS.
- Deploy mobile applications in Android and iPhone marketplace for distribution.

**REFERENCES:**

1. Charlie Collins, Michael Galpin and Matthias Kappler, -Android in Practicell, DreamTech, 2012.
2. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, -Beginning iOS 6 Development: Exploring the iOS SDKII, Apress, 2013.
3. <http://developer.android.com/develop/index.html>.
4. James Dovey and Ash Furrow, -Beginning Objective CII, Apress, 2012.
5. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox,2012.
6. Reto Meier, -PProfessional android DevelopmentII, Wiley-India Edition, 2012.

**CP5075**

**BIO INFORMATICS**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To get exposed to the fundamentals of bioinformatics.
- To learn bio-informatics algorithm and phylogenetic concept.
- To understand open problems and issues in replication and molecular clocks .
- To learn assemble genomes and corresponding theorem.
- To study and exposed to the domain of human genomics.

|  |  |          |
|--|--|----------|
| <b>UNIT I</b>  | <b>INTRODUCTION AND FUNDAMENTALS</b>         | <b>9</b> |
| Fundamentals of genes , genomics , molecular evolution – genomic technologies – beginning of bioinformatics - genetic data –sequence data formats – secondary database – examples – data retrieval systems – genome browsers.  |  |          |
| <b>UNIT II</b>   | <b>BIOINFORMATICS ALGORITHM AND ANALYSIS</b> | <b>9</b> |
| Sequence alignment and similarity searching in genomic databases: BLAST and FASTA – additional bioinformatics analysis involving nucleic acid sequences-additional bioinformatics analysis involving protein sequences – Phylogenetic Analysis.  |  |          |
| <b>UNIT III</b>  | <b>DNA REPLICATION AND MOLECULAR CLOCKS</b>  | <b>9</b> |
| Beginning of DNA replication – open problems – multiple replication and finding replication – computing probabilities of patterns in a string-the frequency array-converting patterns-solving problems- finding frequents words-Big-O notation –case study-The Tower of Hanoi problem.                         |  |          |
| <b>UNIT IV</b>   | <b>ASSEMBLE GENOMES AND SEQUENCES</b>        | <b>9</b> |
| Methods of assemble genomes – string reconstruction – De Bruijn graph – Euler’s theorem – assembling genomes –DNA sequencing technologies – sequence antibiotics – Brute Force Algorithm – Branch and Bound algorithm – open problems – comparing biological sequences- Case Study –Manhattan tourist Problem. |  |          |
| <b>UNIT V</b>  | <b>HUMAN GENOME</b>                          | <b>9</b> |
| Human and mouse genomes-random breakage model of chromosome evolution – sorting by reversals – greedy heuristic approach – break points- rearrangements in tumor and break point genomes-break point graphs- synteny block construction -open problems and technologies.                                       |  |          |

**TOTAL : 45 PERIODS**

**OUTCOMES:**

**Upon Completion of the course, the students should be able to:**

- Deploy the genomics technologies in Bioinformatics.
- Able to distinct efficient algorithm and issues.
- Deploy the replication and molecular clocks in bioinformatics.
- Work on assemble genomes and sequences.
- Use the Microarray technologies for genome expression.

**REFERENCES:**

1. Ion Mandoiu and Alexander Zelikovsky , “Computational Methods for Next Generation Sequencing Data Analysis – Wiley series 2016.
2. Istvan Miklos,Renyi Institutue, -Introduction to algorithms in bioinformaticsII, Springer 2016
3. Philip Compeau and Pavel pevzner, -Bioinformatics Algorithms: An Active Learning ApproachII Second edition volume I , Couseira, 2015.
4. Supratim Choudhuri, -Bioinformatics For BeginnersII, Elsevier, 2014.

**CP5076**

**INFORMATION STORAGE MANAGEMENT**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To understand the storage architecture and available technologies.
- To learn to establish & manage datacenter.
- To learn security aspects of storage & data center.

**UNIT I STORAGE TECHNOLOGY 9**

Review data creation and the amount of data being created and understand the value of data to a business, challenges in data storage and data management, Solutions available for data storage, Core elements of a data center infrastructure, role of each element in supporting business activities.

**UNIT II STORAGE SYSTEMS ARCHITECTURE 9**

Hardware and software components of the host environment, Key protocols and concepts used by each component ,Physical and logical components of a connectivity environment ,Major physical components of a disk drive and their function, logical constructs of a physical disk, access characteristics, and performance Implications, Concept of RAID and its components, Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Compare and contrast integrated and modular storage systems ,High-level architecture and working of an intelligent storage system.

**UNIT III INTRODUCTION TO NETWORKED STORAGE 9**

Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, understand the need for long-term archiving solutions and describe how CAS full fill the need, understand the appropriateness of the different networked storage options for different application environments

**UNIT IV INFORMATION AVAILABILITY, MONITORING & MANAGING DATACENTERS 9**

List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime -Business continuity (BC) and disaster recovery (DR) ,RTO and RPO, Identifysingle points of failure in a storage infrastructure and list solutions to mitigate these failures, architecture of backup/recovery and the different backup/ recovery topologies, replication technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their role in providing disaster recovery and business continuity capabilities. Identify key areas to monitor in a data center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center

**UNIT V SECURING STORAGE AND STORAGE VIRTUALIZATION 9**

Information security, Critical security attributes for information systems, Storage security domains,List and analyzes the common threats in each domain, Virtualization technologies, block-level and file-level virtualization technologies and processes.

**TOTAL : 45 PERIODS**

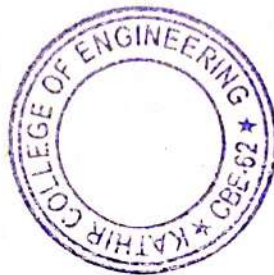
## OUTCOMES:


Upon completion of this course, a student should be able to:

- Select from various storage technologies to suit for required application.
- Apply security measures to safeguard storage & farm.
- Analyse QoS on Storage.

## REFERENCES:

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010
2. Marc Farley, -Building Storage Networksll, Tata McGraw Hill ,Osborne, 2001.
3. Robert Spalding, -Storage Networks: The Complete Reference-, Tata McGraw Hill , Osborne, 2003.



  
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**CHOICE BASED CREDIT SYSTEM**

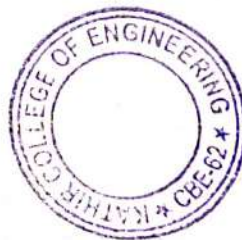
**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :**


- I. To prepare students to excel in research or to succeed in Manufacturing engineering profession through global, rigorous post graduate education.
- II. To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve Manufacturing engineering problems
- III. To train students with good scientific and engineering knowledge so as to comprehend, analyze, design, and create novel products and solutions for the real life problems.
- IV. To inculcate students in professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate Manufacturing engineering issues to broader social context.
- V. To provide student with an academic environment aware of excellence, leadership, written ethical codes and guidelines, and the life-long learning needed for a successful professional career

**PROGRAMME OUTCOMES:**

On successful completion of the programme,

1. Graduates will demonstrate knowledge of mathematics, science and engineering.
2. Graduates will demonstrate an ability to identify, formulate and solve engineering problems.
3. Graduate will demonstrate an ability to design and conduct experiments, analyze and interpret data.
4. Graduates will demonstrate an ability to design a system, component or process as per needs and specifications.
5. Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks.
6. Graduate will demonstrate skills to use modern engineering tools, software and equipment to analyze problems.
7. Graduates will demonstrate knowledge of professional and ethical responsibilities.
8. Graduate will be able to communicate effectively in both verbal and written form.
9. Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
10. Graduate will develop confidence for self education and ability for life-long learning.



  
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**PEO / PO Mapping**

| Programme Educational Objectives | Programme Outcomes |     |     |     |     |     |     |     |     |      |
|----------------------------------|--------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|
|                                  | PO1                | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
| I                                | ✓                  | ✓   |     | ✓   |     |     |     |     |     |      |
| II                               |                    |     |     |     | ✓   | ✓   | ✓   |     |     |      |
| III                              |                    |     |     | ✓   | ✓   | ✓   | ✓   |     |     |      |
| IV                               |                    |     |     |     |     |     | ✓   | ✓   | ✓   |      |
| V                                |                    | ✓   | ✓   |     |     |     |     |     | ✓   | ✓    |

**Semester Course wise PO mapping**

|        |   |   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |   |
|--------|---|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|---|
| YEAR 1 | SEM 1                                   | Applied Probability and Statistics        | ✓   | ✓   |     |     |     |     |     |     | ✓   |      |   |
|        |   | Advanced in Manufacturing Technology      |     |     |     | ✓   | ✓   | ✓   |     |     |     |      |   |
|        |   | Computer Integrated Manufacturing Systems | ✓   | ✓   |     |     |     |     | ✓   |     |     | ✓    |   |
|        |   | Advances in Casting and Welding           |     | ✓   |     | ✓   |     |     | ✓   |     |     | ✓    |   |
|        |   | Metal Cutting Theory and Practice         | ✓   | ✓   |     | ✓   |     |     | ✓   |     |     |      |   |
|        |   | Professional Elective I                   |     |     |     |     |     |     |     |     |     |      |   |
|        |   | <b>Practical</b>                          |     |     |     |     |     |     |     |     |     |      |   |
|        |   | CAD/CAM Laboratory                        |     |     |     |     |     | ✓   | ✓   | ✓   |     |      |   |
|        | SEM 2                                   | Optimization Techniques in Manufacturing  | ✓   | ✓   |     |     |     | ✓   | ✓   |     |     |      |   |
|        |   | Advances in Metrology and Inspection      |     | ✓   | ✓   |     |     |     |     | ✓   |     |      |   |
|        |   | Theory of Metal Forming                   |     | ✓   | ✓   |     |     |     | ✓   |     |     | ✓    |   |
|        |   | Tooling for Manufacturing                 |     | ✓   | ✓   |     |     |     | ✓   |     |     | ✓    |   |
|        |   | Professional Elective II                  |     |     |     |     |     |     |     |     |     |      |   |
|        |   | Professional Elective III                 |     |     |     |     |     |     |     |     |     |      |   |
|        |   | <b>Practical</b>                          |     |     |     |     |     |     |     |     |     |      |   |
|        | Automation and Metal Forming Laboratory | ✓   |     |     |     |     | ✓   | ✓   | ✓   |     |     |      |   |
|        | Technical Seminar                       |   |     |     |     |     |     | ✓   | ✓   | ✓   |     | ✓    |   |
| YEAR 2 | SEM 3                                   | Professional Elective IV                  |     |     |     |     |     |     |     |     |     |      |   |
|        |   | Professional Elective V                   |     |     |     |     |     |     |     |     |     |      |   |
|        |   | Professional Elective VI                  |     |     |     |     |     |     |     |     |     |      |   |
|        |   | <b>Practical</b>                          |     |     |     |     |     |     |     |     |     |      |   |
|        |   | Project Work Phase I                      |     | ✓   |     |     | ✓   |     |     | ✓   | ✓   |      | ✓ |
| SEM 4  | Project Work Phase II                   |   | ✓   |     |     | ✓   |     |     | ✓   | ✓   |     | ✓    |   |

**List of Electives**  
**MAPPING OF POS WITH SUBJECTS**  
**Semester: I Electives**

| S.No. | Course Title                        | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|-------|-------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| 1     | Fluid Power Automation              | ✓   | ✓   |     | ✓   |     | ✓   |     | ✓   | ✓   |      |
| 2     | Design for Manufacture and Assembly | ✓   | ✓   |     |     | ✓   |     |     |     | ✓   |      |
| 3     | Micro Manufacturing                 | ✓   |     |     | ✓   |     | ✓   |     |     | ✓   |      |
| 4     | Quality and Reliability Engineering | ✓   | ✓   | ✓   |     |     |     |     |     |     |      |

**Semester: II Electives**

| S.No | Course Title   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| 1    | Finite Element Methods for Manufacturing Engineering | ✓   | ✓   | ✓   |     |     | ✓   |     |     |     |      |
| 2    | Materials Management                                 |     | ✓   | ✓   | ✓   | ✓   |     |     |     |     |      |
| 3    | Industrial Ergonomics                                |     | ✓   |     | ✓   |     |     | ✓   |     |     | ✓    |
| 4    | Polymers and Composite Materials                     |     | ✓   |     | ✓   |     | ✓   |     |     |     |      |
| 5    | Non-Destructive Testing and Evaluation               |     | ✓   | ✓   |     |     | ✓   |     | ✓   |     | ✓    |
| 6    | Lean Manufacturing                                   |     | ✓   | ✓   |     |     | ✓   |     | ✓   |     |      |
| 7    | Robot Design and Programming                         | ✓   | ✓   | ✓   |     |     | ✓   |     |     | ✓   |      |
| 8    | MEMS and Nanotechnology                              | ✓   |     |     |     |     | ✓   |     |     | ✓   |      |

**Semester: III Electives**

| S.No | Course Title                                      | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 |
|------|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| 1    | Computer Aided Product Design                     |     | ✓   |     |     |     | ✓   |     |     |     |      |
| 2    | Process Planning and Cost Estimation              | ✓   | ✓   | ✓   |     |     | ✓   |     |     |     |      |
| 3    | Manufacturing Management                          | ✓   | ✓   | ✓   |     |     | ✓   |     |     |     |      |
| 4    | Research Methodology                              | ✓   | ✓   | ✓   |     |     |     |     | ✓   |     |      |
| 5    | Nanotechnology                                    | ✓   |     |     | ✓   |     | ✓   | ✓   |     |     |      |
| 6    | Materials Testing and Characterization Techniques |     | ✓   | ✓   |     |     |     |     |     |     |      |
| 7    | Mechatronics                                      |     | ✓   |     | ✓   |     | ✓   |     |     |     |      |
| 8    | Internet of Things for Manufacturing              |     | ✓   |     |     |     |     | ✓   |     | ✓   |      |
| 9    | Data Analytics                                    | ✓   | ✓   | ✓   |     |     |     |     | ✓   |     |      |
| 10   | Manufacturing System Simulation                   |     | ✓   | ✓   |     |     | ✓   |     | ✓   |     | ✓    |
| 11   | Product Lifecycle Management                      | ✓   | ✓   |     |     |     | ✓   | ✓   | ✓   | ✓   |      |
| 12   | Additive Manufacturing                            |     | ✓   | ✓   |     |     |     |     |     |     | ✓    |
| 13   | Product Design and Development                    |     | ✓   |     | ✓   |     | ✓   | ✓   | ✓   |     |      |
| 14   | Entrepreneurship Development                      |     | ✓   |     |     |     |     |     |     | ✓   |      |
| 15   | Industrial Safety                                 |     | ✓   |     |     |     |     |     |     | ✓   | ✓    |

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**CHOICE BASED CREDIT SYSTEM**  
**I TO IV SEMESTERS (FULL TIME) CURRICULUM AND SYLLABUS**

**SEMESTER I**

| SL. NO.          | COURSE CODE | COURSE TITLE                              | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|------------------|-------------|---|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>    |             |   |          |                 |           |          |          |           |
| 1.               | MA5160      | Applied Probability and Statistics        | FC       | 4               | 4         | 0        | 0        | 4         |
| 2.               | MF5101      | Advanced in Manufacturing Technology      | PC       | 3               | 3         | 0        | 0        | 3         |
| 3.               | MF5102      | Computer Integrated Manufacturing Systems | PC       | 3               | 3         | 0        | 0        | 3         |
| 4.               | MF5103      | Advances in Casting and Welding           | PC       | 3               | 3         | 0        | 0        | 3         |
| 5.               | MF5104      | Metal Cutting Theory and Practice         | PC       | 4               | 4         | 0        | 0        | 4         |
| 6.               |             | Professional Elective I                   | PE       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICAL</b> |             |   |          |                 |           |          |          |           |
| 7.               | MF5111      | CAD/CAM Laboratory                        | PC       | 4               | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>     |             |   |          | <b>24</b>       | <b>20</b> | <b>0</b> | <b>4</b> | <b>22</b> |

**SEMESTER II**

| SL. NO.          | COURSE CODE | COURSE TITLE                             | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|------------------|-------------|--|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>    |             |  |          |                 |           |          |          |           |
| 1                | MF5201      | Optimization Techniques in Manufacturing | PC       | 5               | 3         | 2        | 0        | 4         |
| 2                | CM5251      | Advances in Metrology and Inspection     | PC       | 3               | 3         | 0        | 0        | 3         |
| 3                | MF5202      | Theory of Metal Forming                  | PC       | 3               | 3         | 0        | 0        | 3         |
| 4                | MF5203      | Tooling for Manufacturing                | PC       | 4               | 4         | 0        | 0        | 4         |
| 5                |             | Professional Elective II                 | PE       | 3               | 3         | 0        | 0        | 3         |
| 6                |             | Professional Elective III                | PE       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICAL</b> |             |  |          |                 |           |          |          |           |
| 7                | MF5211      | Automation and Metal Forming Laboratory  | PC       | 4               | 0         | 0        | 4        | 2         |
| 8                | MF5212      | Technical Seminar                        | EEC      | 2               | 0         | 0        | 2        | 1         |
| <b>TOTAL</b>     |             |  |          | <b>28</b>       | <b>19</b> | <b>2</b> | <b>6</b> | <b>23</b> |

**SEMESTER III**

| SL. NO.          | COURSE CODE | COURSE TITLE             | CATEGORY | CONTACT PERIODS | L        | T        | P         | C         |
|------------------|-------------|--------------------------|----------|-----------------|----------|----------|-----------|-----------|
| <b>THEORY</b>    |             |                          |          |                 |          |          |           |           |
| 1                |             | Professional Elective IV | PE       | 3               | 3        | 0        | 0         | 3         |
| 2                |             | Professional Elective V  | PE       | 3               | 3        | 0        | 0         | 3         |
| 3                |             | Professional Elective VI | PE       | 3               | 3        | 0        | 0         | 3         |
| <b>PRACTICAL</b> |             |                          |          |                 |          |          |           |           |
| 4                | MF5311      | Project Work Phase I     | EEC      | 12              | 0        | 0        | 12        | 6         |
| <b>TOTAL</b>     |             |                          |          | <b>21</b>       | <b>9</b> | <b>0</b> | <b>12</b> | <b>15</b> |



**SEMESTER IV**

| <b>SL. NO.</b>   | <b>COURSE CODE</b> | <b>COURSE TITLE</b>   | <b>CATEGORY</b> | <b>CONTACT PERIODS</b> | <b>L</b> | <b>T</b> | <b>P</b>  | <b>C</b>  |
|------------------|--------------------|-----------------------|-----------------|------------------------|----------|----------|-----------|-----------|
| <b>PRACTICAL</b> |                    |                       |                 |                        |          |          |           |           |
| 1                | MF5411             | Project Work Phase II | EEC             | 24                     | 0        | 0        | 24        | 12        |
| <b>TOTAL</b>     |                    |                       |                 | <b>24</b>              | <b>0</b> | <b>0</b> | <b>24</b> | <b>12</b> |

**TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 72**

### FOUNDATION COURSES (FC)

| SL. NO. | COURSE CODE | COURSE TITLE                       | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|------------------------------------|----------|-----------------|---|---|---|---|
| 1.      | MA5160      | Applied Probability and Statistics | FC       | 4               | 4 | 0 | 0 | 4 |

### PROFESSIONAL CORE (PC)

| SL. NO. | COURSE CODE | COURSE TITLE                              | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---------|-------------|---|----------|-----------------|---|---|---|---|
| 1.      | MF5101      | Advanced in Manufacturing Technology      | PC       | 3               | 3 | 0 | 0 | 3 |
| 2.      | MF5102      | Computer Integrated Manufacturing Systems | PC       | 3               | 3 | 0 | 0 | 3 |
| 3.      | MF5103      | Advances in Casting and Welding           | PC       | 3               | 3 | 0 | 0 | 3 |
| 4.      | MF5104      | Metal Cutting Theory and Practice         | PC       | 5               | 4 | 0 | 0 | 4 |
| 5.      | MF5111      | CAD/CAM Laboratory                        | PC       | 4               | 0 | 0 | 4 | 2 |
| 6.      | MF5201      | Optimization Techniques in Manufacturing  | PC       | 5               | 3 | 2 | 0 | 4 |
| 7.      | CM5251      | Advances in Metrology and Inspection      | PC       | 5               | 3 | 0 | 2 | 4 |
| 8.      | MF5202      | Theory of Metal Forming                   | PC       | 3               | 3 | 0 | 0 | 3 |
| 9.      | MF5203      | Tooling for Manufacturing                 | PC       | 5               | 3 | 2 | 0 | 4 |
| 10.     | MF5211      | Automation and Metal Forming Laboratory   | PC       | 4               | 0 | 0 | 4 | 2 |

## LIST OF ELECTIVES FOR M.E. MANUFACTURING ENGINEERING

### SEMESTER I (Elective I)

| SL. NO | COURSE CODE | COURSE TITLE                        | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|-------------------------------------|----------|-----------------|---|---|---|---|
| 1.     | MF5001      | Fluid Power Automation              | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.     | MF5002      | Design for Manufacture and Assembly | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.     | MF5003      | Micro Manufacturing                 | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.     | MF5004      | Quality and Reliability Engineering | PE       | 3               | 3 | 0 | 0 | 3 |

### SEMESTER II (Elective II & III)

| SL. NO | COURSE CODE | COURSE TITLE   | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|--|----------|-----------------|---|---|---|---|
| 1.     | MF5005      | Finite Element Methods for Manufacturing Engineering | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.     | MF5006      | Materials Management                                 | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.     | MF5007      | Industrial Ergonomics                                | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.     | MF5008      | Polymers and Composite Materials                     | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.     | MF5009      | Non-Destructive Testing and Evaluation               | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.     | MF5071      | Lean Manufacturing                                   | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.     | MF5010      | Robot Design and Programming                         | PE       | 3               | 3 | 0 | 0 | 3 |
| 8.     | MF5011      | MEMS and Nanotechnology                              | PE       | 3               | 3 | 0 | 0 | 3 |

### SEMESTER III (Elective IV, V & VI)

| SL. NO | COURSE CODE | COURSE TITLE                                      | CATEGORY | CONTACT PERIODS | L | T | P | C |
|--------|-------------|---|----------|-----------------|---|---|---|---|
| 1.     | MF5012      | Computer Aided Product Design                     | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.     | MF5013      | Process Planning and Cost Estimation              | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.     | MF5014      | Manufacturing Management                          | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.     | MF5072      | Research Methodology                              | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.     | MF5015      | Nanotechnology                                    | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.     | MF5016      | Materials Testing and Characterization Techniques | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.     | MF5017      | Mechatronics                                      | PE       | 3               | 3 | 0 | 0 | 3 |
| 8.     | MF5073      | Internet of Things for Manufacturing              | PE       | 3               | 3 | 0 | 0 | 3 |
| 9.     | IL5091      | Data Analytics                                    | PE       | 3               | 3 | 0 | 0 | 3 |
| 10.    | CM5093      | Manufacturing System Simulation                   | PE       | 3               | 3 | 0 | 0 | 3 |
| 11.    | PD5091      | Product Lifecycle Management                      | PE       | 3               | 3 | 0 | 0 | 3 |
| 12.    | CM5091      | Additive Manufacturing                            | PE       | 3               | 3 | 0 | 0 | 3 |
| 13.    | MF5018      | Product Design and Development                    | PE       | 3               | 3 | 0 | 0 | 3 |
| 14.    | MF5074      | Entrepreneurship Development                      | PE       | 3               | 3 | 0 | 0 | 3 |
| 15.    | MF5075      | Industrial Safety                                 | PE       | 3               | 3 | 0 | 0 | 3 |

**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

| <b>SL. NO.</b> | <b>COURSE CODE</b> | <b>COURSE TITLE</b>   | <b>CATEGORY</b> | <b>CONTACT PERIODS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------|--------------------|-----------------------|-----------------|------------------------|----------|----------|----------|----------|
| 1.             | MF5212             | Technical Seminar     | EEC             | 2                      | 0        | 0        | 2        | 1        |
| 2.             | MF5311             | Project Work Phase I  | EEC             | 12                     | 0        | 0        | 12       | 6        |
| 3.             | MF5411             | Project Work Phase II | EEC             | 24                     | 0        | 0        | 24       | 12       |

**OBJECTIVES :**

This course is designed to provide the solid foundation on topics in applied probability and various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling. It is framed to address the issues and the principles of estimation theory, testing of hypothesis and multivariate analysis.

**UNIT I PROBABILITY AND RANDOM VARIABLES****12**

Probability - Axioms of probability - Conditional probability - Baye's theorem - Random variables - Probability function - Moments - Moment generating functions and their properties - Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions - Function of a random variable.

**UNIT II TWO DIMENSIONAL RANDOM VARIABLES****12**

Joint distributions - Marginal and conditional distributions - Functions of two dimensional random variables - Regression curve - Correlation.

**UNIT III ESTIMATION THEORY****12**

Unbiased estimators - Method of moments - Maximum likelihood estimation - Curve fitting by principle of least squares - Regression lines.

**UNIT IV TESTING OF HYPOTHESIS****12**

Sampling distributions - Type I and Type II errors - Small and large samples - Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions - Tests for independence of attributes and goodness of fit.

**UNIT V MULTIVARIATE ANALYSIS****12**

Random vectors and matrices - Mean vectors and covariance matrices - Multivariate normal density and its properties - Principal components - Population principal components - Principal components from standardized variables

**TOTAL : 60 PERIODS****OUTCOMES :**

After completing this course, students should demonstrate competency in the following topics:

- Basic probability axioms and rules and the moments of discrete and continuous random variables.
- Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.
- The students should have the ability to use the appropriate and relevant, fundamental and applied mathematical and statistical knowledge, methodologies and modern computational tools.

**REFERENCES :**

1. Dallas E. Johnson, "Applied Multivariate Methods for Data Analysis", Thomson and Duxbury press, 1998.
2. Devore, J. L., "Probability and Statistics for Engineering and the Sciences", 8<sup>th</sup> Edition, Cengage Learning, 2014.
3. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan and Sons, New Delhi, 2001.

4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8<sup>th</sup> Edition, 2015.
5. Richard A. Johnson and Dean W. Wichern, "Applied Multivariate Statistical Analysis", 5<sup>th</sup> Edition, Pearson Education, Asia, 2002.

**MF5101**

**ADVANCES IN MANUFACTURING TECHNOLOGY**

**L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- The students are expected to understand special machining processes, unconventional machining processes, micro machining process, nano fabrication processes and rapid prototyping.

**UNIT I UNCONVENTIONAL MACHINING 10**

Introduction-Bulk processes - surface processes- Plasma Arc Machining- Laser Beam Machining- Electron Beam Machining-Electrical Discharge Machining - Electro chemical Machining-Ultrasonic Machining- Water Jet Machining-Electro Gel Machining-Anisotropic machining-Isotropic machining-Elastic Emission machining - Ion Beam Machining.

**UNIT II PRECISION MACHINING: 10**

Ultra Precision turning and grinding: Chemical Mechanical Polishing (CMP) - ELID process - Partial ductile mode grinding-Ultra precision grinding- Binderless wheel - Free form optics. aspherical surface generation Grinding wheel- Design and selection of grinding wheel-High-speed grinding-High-speed milling- Diamond turning.

**UNIT III ADVANCES IN METAL FORMING 7**

Orbital forging, Isothermal forging, Warm forging, Overview of Powder Metal techniques -Hot and Cold isostatic pressing - high speed extrusion, rubber pad forming, Hydroforming, Superplastic forming, Peen forming-micro blanking -Powder rolling - Tooling and process parameters.

**UNIT IV MICRO MACHINING AND NANO FABRICATION 10**

Theory of micromachining-Chip formation-size effect in micromachining-microturning, micromilling, microdrilling- Micromachining tool design-Micro EDM-Microwire EDM-Nano fabrication:LIGA, Ion beam etching, Molecular manufacturing techniques -Atomic machining- Nano machining techniques - Top/Bottom up Nano fabrication techniques - Sub micron lithographic technique, conventional film growth technique, Chemical etching, Quantum dot fabrication techniques - MOCVD - Epitaxy techniques.

**UNIT V RAPID PROTOTYPING AND SURFACE MODIFICATION TECHNIQUES 8**

Introduction - Classification - Principle advantages limitations and applications- Stereo lithography - Selective laser sintering -FDM, SGC, LOM, 3D Printing-Surface modification Techniques: Sputtering-CVD-PVD-Diamond like carbon coating-Plasma Spraying Technique.-Diffusion coatings-Pulsed layer deposition.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

At the end of this course the students are expected

1. to produce useful research output in machining of various materials
2. use this knowledge to develop hybrid machining techniques
3. Application of this knowledge to manage shop floor problems

## REFERENCES

1. Benedict, G.F., "Non Traditional manufacturing Processes", CRC press, 2011
2. Madou, M.J., Fundamentals of Micro fabrication: The Science of Miniaturization, Second Edition, CRC Press (ISBN: 0849308267), 2006.
3. McGeough, J.A., "Advanced methods of Machining", Springer, 2011
4. Narayanaswamy, R., Theory of Metal Forming Plasticity, Narosa Publishers, 1989.
5. Pandey, P.S. and Shah, N., "Modern Manufacturing Processes", Tata McGraw Hill, 1980.
6. Serop Kalpakjian., "Manufacturing Engineering and Technology" Pearson Education, 2001

**MF5102**

**COMPUTER INTEGRATED MANUFACTURING SYSTEMS**

**L T P C**

**3 0 0 3**

### OBJECTIVES:

This course will enable the Student

- To gain knowledge about the basic fundamental of CAD.
- To gain knowledge on how computers are integrated at various levels of planning and manufacturing understand computer aided planning and control and computer monitoring.

### UNIT I COMPUTER AIDED DESIGN

**9**

Concept of CAD as drafting and designing facility, desirable features of CAD package, drawing features in CAD – Scaling, rotation, translation, editing, dimensioning, labeling, Zoom, pan, redraw and regenerate, typical CAD command structure, wire frame modeling, surface modeling and solid modeling (concepts only) in relation to popular CAD packages.

### UNIT II COMPONENTS OF CIM

**9**

CIM as a concept and a technology, CASA/Sme model of CIM, CIM II, benefits of CIM, communication matrix in CIM, fundamentals of computer communication in CIM – CIM data transmission methods - serial, parallel, asynchronous, synchronous, modulation, demodulation, simplex and duplex. Types of communication in CIM – point to point (PTP), star and multiplexing. Computer networking in CIM - the seven layer OSI model, LAN model, MAP model, network topologies – star, ring and bus, advantages of networks in CIM

### UNIT III GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING

**9**

History Of Group Technology - role of G.T in CAD/CAM Integration - part families- classification and coding - DCLASS and MCLASS and OPTIZ coding systems - facility design using G.T - benefits of G.T - cellular manufacturing. Process planning - role of process planning in CAD/CAM Integration - approaches to computer aided process planning - variant approach and generative approaches – CAPP and CMPP systems.

### UNIT IV SHOP FLOOR CONTROL AND INTRODUCTION TO FMS

**9**

Shop floor control - phases - factory data collection system - automatic identification methods - Bar code technology - automated data collection system.

FMS - components of FMS - types - FMS workstation - material handling and storage system - FMS layout- computer control systems - applications and benefits.

### UNIT V COMPUTER AIDED PLANNING AND CONTROL AND COMPUTER MONITORING

**9**

Production planning and control - cost planning and control - inventory management - material requirements planning (MRP) - shop floor control. Lean and Agile Manufacturing. Types of production monitoring systems - structure model of manufacturing - process control and strategies - direct digital control.

## OUTCOMES:

At the end of this course the students are expected

1. to produce useful research output in computer integrated manufacturing
2. use this knowledge to develop computer techniques
3. Application of this knowledge to functionalise computer aided planning.

**TOTAL: 45 PERIODS**

## REFERENCES:

1. Chris McMahon and Jimmie Browne, "CAD CAM Principles, Practice and Manufacturing Management", Pearson Education second edition, 2005. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice hall of India Pvt. Ltd., 2005.
2. James A. Regh and Henry W. Kreabber, "Computer Integrated Manufacturing", Pearson Education second edition, 2005.
3. Mikell. P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education 2001.
4. Mikell. P. Groover and Emory Zimmers Jr., "CAD/CAM", Prentice hall of India Pvt.Ltd., 1998.
5. P N Rao, "CAD/CAM Principles and Applications", TMH Publications, 2007.
6. Yorem Koren, "Computer Integrated Manufacturing", McGraw Hill, 2005.

**MF5103**

**ADVANCES IN CASTING AND WELDING**

**L T P C**  
**3 0 0 3**

## OBJECTIVES:

- To study the metallurgical concepts and applications of casting and welding process.
- To acquire knowledge in CAD of casting and automation of welding process.

### **UNIT I CASTING DESIGN**

**8**

Heat transfer between metal and mould — Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating and risering

### **UNIT II CASTING METALLURGY**

**8**

Solidification of pure metal and alloys - shrinkage in cast metals - progressive and directional solidification – Degassing of the melt-casting defects - Castability of steel , Cast Iron, Al alloys, Babbit alloy and Cu alloy.

### **UNIT III RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT**

**8**

Shell moulding, precision investment casting, CO<sub>2</sub> moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry – Computer aided design of casting.

### **UNIT IV WELDING METALLURGY AND DESIGN**

**10**

Heat affected Zone and its characteristics - Weldability of steels, cast iron, stainless steel, aluminum, Mg , Cu , Zirconium and titanium alloys - Carbon Equivalent of Plain and alloy steels Hydrogen embrittlement - Lamellar tearing - Residual stress - Distortion and its control . Heat transfer and solidification - Analysis of stresses in welded structures - pre and post welding heat treatments - weld joint design - welding defects - Testing of weldment.



**UNIT V RECENT TRENDS IN WELDING****11**

Friction welding, friction stir welding - explosive welding - diffusion bonding - high frequency induction welding - ultrasonic welding - electron beam welding - Laser beam welding - Plasma welding - Electroslag welding- narrow gap, hybrid twin wire active TIG - Tandem MIG- modern brazing and soldering techniques - induction, dip resistance, diffusion processes - Hot gas, wave and vapour phase soldering. Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.

**OUTCOMES:**

At the end of this course the students are expected to impart knowledge on basic concepts and advances in casting and welding processes.

**TOTAL: 45 PERIODS****REFERENCES:**

1. ASM Handbook vol.6, welding Brazing & Soldering, 2003
2. ASM Handbook, Vol 15, Casting, 2004
3. Carry B., Modern Welding Technology, Prentice Hall Pvt Ltd., 2002
4. CORNU.J. Advanced welding systems - Volumes I, II and III, JAICO Publishers, 1994.
5. HEINLOPER & ROSENTHAL, Principles of Metal Casting, Tata McGraw Hill, 2000.
6. IOTROWSKI - Robotic welding - A guide to selection and application - Society of mechanical Engineers, 1987.
7. Jain P.L., Principles of Foundry Technology, Tata McGraw Hill Publishers, 2003
8. LANCASTER.J.F. - Metallurgy of welding - George Alien & Unwin Publishers, 1980
9. Parmer R.S., Welding Engineering and Technology, Khanna Publishers, 2002
10. SCHWARIZ, M.M. - Source book on innovative welding processes - American Society for Metals (OHIO), 1981
11. Srinivasan N.K., Welding Technology, Khanna Tech Publishers, 2002

**MF5104****METAL CUTTING THEORY AND PRACTICE****L T P C  
4 0 0 4****OBJECTIVES:**

- To make the students familiar with the various principles of metal cutting, cutting tool materials and its wear mechanisms during the machining operation.

**UNIT I INTRODUCTION****12**

Need for rational approach to the problem of cutting materials-observation made in the cutting of metals-basic mechanism of chip formation-thin and thick zone modes-types of chips-chip breaker-orthogonal Vs oblique cutting-force velocity relationship for shear plane angle in orthogonal cutting-energy consideration in machining-review of Merchant, Lee and Shafter theories-critical comparison.

**UNIT II SYSTEM OF TOOL NOMENCLATURE****12**

Nomenclature of single point cutting tool-System of tool nomenclature and conversion of rake angles-nomenclature of multi point tools like drills, milling-conventional Vs climb milling, mean cross sectional area of chip in milling-specific cutting pressure.

**UNIT III THERMAL ASPECTS OF MACHINING****12**

Heat distribution in machining-effects of various parameters on temperature-methods of temperature measurement in machining-hot machining-cutting fluids.

**UNIT IV TOOL MATERIALS, TOOL LIFE AND TOOL WEAR 12**

Essential requirements of tool materials-development in tool materials-ISO specification for inserts and tool holders-tool life-conventional and accelerated tool life tests-concept of mach inability index-economics of machining.

**UNIT V WEAR MECHANISMS AND CHATTER IN MACHINING 12**

Processing and Machining - Measuring Techniques - Reasons for failure of cutting tools and forms of wear-mechanisms of wear-chatter in machining-factors effecting chatter in machining-types of chatter-mechanism of chatter.

**OUTCOMES :**

At the end of this course the students are expected to impart the knowledge and train the students in the area of metal cutting theory and its importance.

**TOTAL: 60 PERIODS**

**REFERENCES**

1. Bhattacharya.A., Metal Cutting Theory and practice, Central Book Publishers, India, 1984.
2. Boothroid D.G. & Knight W.A., Fundamentals of machining and machine tools, Marcel Dekker, Newyork, 1989.
3. Shaw.M.C.Metal cutting principles, oxford Clare don press, 1984.

**MF5111**

**CAD / CAM LABORATORY**

**L T P C  
0 0 4 2**

**OBJECTIVES:**

- To teach the students about the drafting of 3D components and analyzing the same using various CAD packages and programming of CNC machines
- To train them to use the various sensors

**CAM LABORATORY**

1. Exercise on CNC Lathe: Plain Turning, Step turning, Taper turning, Threading, Grooving canned cycle
2. Exercise on CNC Milling Machine: Profile Milling, Mirroring, Scaling & canned cycle. Study of Sensors, Transducers & PLC: Hall-effect sensor, Pressure sensors, Strain gauge, PLC, LVDT, Load cell, Angular potentiometer, Torque, Temperature & Optical Transducers.

**CAD LABORATORY**

2D modeling and 3D modeling of components such as

1. Bearing
2. Couplings
3. Gears
4. Sheet metal components
5. Jigs, Fixtures and Die assemblies.

**TOTAL: 60 PERIODS**

**OUTCOMES :**

At the end of this course the students are expected

- To impart the knowledge on training the students in the area of CAD/CAM

## LIST OF EQUIPMENTS

| S.NO            | EQUIPMENT   | QUANTITY    |
|-----------------|---|-------------|
| 1.              | Computer Server   | 1           |
| 2.              | Computer nodes or systems (High end CPU with atleast 1 GB main memory) networked to the server  | 30          |
| 3.              | A3 size plotter   | 1           |
| 4.              | Laser Printer   | 1           |
| 5.              | CNC Lathe   | 1           |
| 6.              | CNC milling machine   | 1           |
| <b>SOFTWARE</b> |   |             |
| 7.              | Any High end integrated modeling and manufacturing CAD / CAM software   | 15 licenses |
| 8.              | CAM Software for machining centre and turning centre (CNC Programming and tool path simulation for FANUC / Sinumeric and Heidenhain controller) | 15 licenses |
| 9.              | Licensed operating system   | adequate    |
| 10.             | Support for CAPP  | adequate    |

**MF5201                      OPTIMIZATION TECHNIQUES IN MANUFACTURING**

**L T P C**  
**3 2 0 4**

**OBJECTIVES:**

- To make use of the above techniques while modeling and solving the engineering problems of different fields.

**UNIT I                      INTRODUCTION**

**5**

Optimization - Historical Development - Engineering applications of optimization - Statement of an Optimization problem - classification of optimization problems.

**UNIT II                      CLASSIC OPTIMIZATION TECHNIQUES**

**10**

Linear programming - Graphical method - simplex method - dual simplex method - revised simplex method - duality in LP - Parametric Linear programming - Goal Programming.

**UNIT III                      NON-LINEAR PROGRAMMING**

**9**

Introduction - Lagrangeon Method - Kuhn-Tucker conditions - Quadratic programming - Separable programming - Stochastic programming - Geometric programming

|  |   |                          |
|--|---|--------------------------|
| <b>UNIT IV</b>   | <b>INTEGER PROGRAMMING AND DYNAMIC PROGRAMMING AND NETWORK TECHNIQUES</b> | <b>12</b>                |
| Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration - Dynamic Programming - Formulation, Various applications using Dynamic Programming. Network Techniques - Shortest Path Model - Minimum Spanning Tree Problem - Maximal flow problem. |   |                          |
| <b>UNIT V</b>  | <b>ADVANCES IN SIMULATION</b>   | <b>9</b>                 |
| Genetic algorithms - simulated annealing - Neural Network and Fuzzy systems  |   |                          |
|  |   | <b>TOTAL: 75 PERIODS</b> |

**OUTCOME :**

At the end of this course the students will be expected to introduce the various optimization techniques and their advancements.

**REFERENCES:**

1. Hamdy A. Taha, Operations Research - An Introduction, Prentice Hall of India, 1997
2. J.K.Sharma, Operations Research - Theory and Applications - Macmillan India Ltd., 1997
3. P.K. Guptha and Man-Mohan, Problems in Operations Research - Sultan chand & Sons, 1994
4. R. Panneerselvam, "Operations Research", Prentice Hall of India Private Limited, New Delhi 1 – 2005
5. Ravindran, Philips and Solberg, Operations Research Principles and Practice, John Wiley & Sons, Singapore, 1992

|               |   |                |
|---------------|---|----------------|
| <b>CM5251</b> | <b>ADVANCES IN METROLOGY AND INSPECTION</b> | <b>L T P C</b> |
|               |   | <b>3 0 0 3</b> |

**OBJECTIVES:**

- To teach the students basic concepts in various methods of engineering measurement techniques and applications, understand the importance of measurement and inspection in manufacturing industries.
- To make the students capable of learning to operate and use advanced metrological devices with ease in industrial environments.

**UNIT I CONCEPTS OF METROLOGY: 8**  
Terminologies - Standards of measurement - Errors in measurement - Interchangeability and Selective assembly - Accuracy and Precision - Calibration of instruments - Basics of Dimensional metrology and Form metrology

**UNIT II MEASUREMENT OF SURFACE ROUGHNESS: 9**  
Definitions – Types of Surface Texture: Surface Roughness Measurement Methods- Comparison, Contact and Non Contact type roughness measuring devices, 3D Surface Roughness Measurement, Nano Level Surface Roughness Measurement - Instruments.

**UNIT III INTERFEROMETRY: 8**  
Introduction, Principles of light interference - Interferometers - Measurement and Calibration - Laser Interferometry.

**UNIT IV MEASURING MACHINES AND LASER METROLOGY: 10**  
Tool Makers Microscope - Microhite - Coordinate Measuring Machines - Applications - Laser Micrometer, Laser Scanning gauge, Computer Aided Inspection techniques - In-process inspection, Machine Vision system-Applications.

**UNIT V IMAGE PROCESSING FOR METROLOGY: 10**  
 Overview, Computer imaging systems, Image Analysis, Preprocessing, Human vision system, Image model, Image enhancement, gray scale models, histogram models, Image Transforms - Examples.  
**TOTAL: 45 PERIODS**

**OUTCOMES:**

- At the end of this course the students are expected to
1. Understand the advanced measurement principles with ease.
  2. Operate sophisticated measurement and inspection facilities.
  3. Design and develop new measuring methods.

**REFERENCES**

1. "ASTE Handbook of Industries Metrology", Prentice Hall of India Ltd., 1992.
2. Bewoor, A.K. and Kulkarni, V.A., "Metrology and Measurement", Tata Mc Graw-Hill, 2009.
3. Galyer, F.W. and Shotbolt, C.R., "Metrology for engineers", ELBS, 1990.
4. Gupta, I.C., "A Text Book of engineering metrology", Dhanpat Rai and Sons, 1996.
5. Jain, R.K., "Engineering Metrology", Khqanna Publishers, 2008.
6. Rajput, R.K., "Engineering Metrology and Instrumentations", Kataria & Sons Publishers, 2001.
7. Smith, G.T., "Industrial Metrology", Springer, 2002
8. Sonka, M., Hlavac, V. and Boyle, R., "Image Processing, Analysis, and Machine Vision", Cengage-Engineering, 2007.
9. Whitehouse, D.J., "Surface and their measurement", Hermes Penton Ltd, 2004.

**MF5202 THEORY OF METAL FORMING L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To study the basic concepts of metal forming techniques and to develop force calculation in metal forming process.
- To study the thermo mechanical regimes and its requirements of metal forming

**UNIT I THEORY OF PLASTICITY 9**

Theory of plastic deformation - Yield criteria - Tresca and Von-mises - Distortion energy - Stress-strain relation - Mohr's circle representation of a state of stress - cylindrical and spherical co-ordinate system - upper and lower bound solution methods - Overview of FEM applications in Metal Forming analysis.

**UNIT II THEORY AND PRACTICE OF BULK FORMING PROCESSES 8**

Analysis of plastic deformation in Forging, Rolling, Extrusion, rod/wire drawing and tube drawing - Effect of friction - calculation of forces, work done - Process parameters, equipment used - Defects - applications - Recent advances in Forging, Rolling, Extrusion and Drawing processes - Design consideration in forming.

**UNIT III SHEET METAL FORMING 8**

Formability studies - Conventional processes - H E R F techniques - Superplastic forming techniques - Hydro forming - Stretch forming - Water hammer forming - Principles and process parameters - Advantage, Limitations and application

**UNIT IV POWDER METALLURGY AND SPECIAL FORMING PROCESSES 9**

Overview of P/M technique - Advantages - applications - Powder preform forging - powder rolling - Tooling, process parameters and applications. - Orbital forging - Isothermal forging - Hot and cold isostatic pressing - High speed extrusion - Rubber pad forming - Fine blanking - LASER beam forming

**UNIT V SURFACE TREATMENT AND METAL FORMING APPLICATIONS 9**

Experiment techniques of evaluation of friction in metal forming selection - influence of temperature and gliding velocity - Friction heat generation - Friction between metallic layers - Lubrication carrier layer - Surface treatment for drawing, sheet metal forming, Extrusion, hot and cold forging. Processing of thin Al tapes – Cladding of Al alloys – Duplex and triplex steel rolling – Thermo mechanical regimes of Ti and Al alloys during deformation - Formability of welded blank sheet - Laser structured steel sheet - Formability of laminated sheet.

**OUTCOMES :**

At the end of this course the students are expected to upgrade their knowledge on plasticity, surface treatment for forming of various types of metal forming process.

**TOTAL: 45 PERIODS**

**REFERENCES:**

1. Altan T., Metal forming - Fundamentals and applications - American Society of Metals, Metals park, 2003
2. ALTAN.T, SOO-IK-oh, GEGEL, HL – Metal forming, fundamentals and Applications, American Society of Metals, Metals Park, Ohio, 1995.
3. ASM Hand book, Forming and Forging, Ninth edition, Vol - 14, 2003
4. Dieter G.E., Mechanical Metallurgy (Revised Edition II) McGraw Hill Co., 1988
5. Helmi A Youssef, Hassan A. El-Hofy, Manufacturing Technology: Materials, Processes and Equipment, CRC publication press, 2012.
6. Marciniak,Z., Duncan J.L., Hu S.J., 'Mechanics of Sheet Metal Forming', Butterworth-Heinemann An Imprint of Elsevier, 2006
7. Nagpal G.R., Metal Forming Processes- Khanna publishers, 2005.
8. Proc. Of National Seminar on "Advances in Metal Forming" MIT, March 2000
9. SAE Transactions, Journal of Materials and Manufacturing Section 5, 1993-2007
10. SHIRO KOBAYASHI, SOO-IK-oh-ALTAN, T, Metal forming and Finite Element Method, Oxford University Press, 2001.
11. Surender kumar, Technology of Metal Forming Processes, Prentice Hall India Publishers,2010

**MF5203**

**TOOLING FOR MANUFACTURING**

**L T P C  
4 0 0 4**

**OBJECTIVES:**

- To study the various design considerations for tooling.
- Develop knowledge in tooling and work holding devices

**UNIT I INTRODUCTION 12**

Manufacturing Processes-objectives of manufacturing processes-classification of manufacturing process-Objectives of Tool design-tool design process-Nature and scope of Tool engineering-principles of economy for tooling-problems of economy in tooling-planning and tooling for economy-Manufacturing principles applicable to process and tool planning-tool control-tool maintenance-tool materials and its selection

**UNIT II TOOLING FOR METAL REMOVAL PROCESSES 12**

Traditional machining processes -work and tool holding devices-tool nomenclatures-Mechanism of machining-force temperature and tool life of single point tool-multipoint tools -tool design-tool wear-special processes-capstan and turret lathe-tooling layout of automats-tooling in NC and CNC machines-tooling for machining centres-CAD in tool design-Jigs and fixtures-design-Non-traditional material removal processes-mechanical, electrical thermal and chemical energy processes-principles-operation-equipment-tooling parameters and limitations

**UNIT III TOOLING FOR METAL FORMING PROCESSES 12**

Classification of Forming processes-Types of presses-design of -blanking and piercing dies-simple, compound, combination and progressive dies-Drawing dies-Bending dies-forging dies-plastic moulding dies

**UNIT IV TOOLING FOR METAL CASTING AND METAL JOINING PROCESSES 12**

Tools and Equipment for moulding-patterns -pattern allowances – pattern construction-die casting tools- mechanization of foundries. Tooling for Physical joining processes Design of welding fixtures - Arc welding, Gas welding, Resistance welding, laser welding fixtures-Tooling for Soldering and Brazing Tooling for Mechanical joining processes

**UNIT V TOOLING FOR INSPECTION AND GAUGING 12**

Survey of linear and angular measurements-standards of measurement-design and manufacturing of gauges- measurement of form-Inspection bench centre-co-ordinate measuring machine-tooling in CMM.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

At the end of this course the students are well versed in

1. State of Art in Tooling in Manufacturing and Inspection
2. Design and Develop tooling for Flexible Manufacturing

**REFERENCES:**

1. Cyril Donaldson Tool Design, Tata McGraw Hill, 1976
2. Hoffman E.G Fundamentals of tool design SME 1984.
3. Kalpak Jian S., Manufacturing Engineering and Technology Addison Wesley 1995.
4. L E Doyle Tool Engineering Prentice Hall 1950
5. Wellar, J Non-Traditional Machining Processes, SME, 1984

**MF5211 AUTOMATION AND METAL FORMING LABORATORY**

**L T P C  
0 0 4 2**

**OBJECTIVE**

- To train the students to have an hands on having the basic concepts of metal forming processes and to determine some metal forming parameters for a given shape.

**EXPERIMENTS**

1. Determination of strain hardening exponent
2. Determination of strain rate sensitivity index
3. Construction of formability limit diagram
4. Determination of efficiency in water hammer forming
5. Determination of interface friction factor
6. Determination of extrusion load
7. Study on two high rolling process

**AUTOMATION LAB**

1. Simulation of single and double acting cylinder circuits
2. Simulation of Hydraulic circuits
3. Simulation of electro pneumatic circuits
4. Simulation of electro hydraulic circuits
5. Simulation of PLC circuits
6. Software simulation of fluid power circuits using Automation studio.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

At the end of this course the students are expected

- To impart practical knowledge on bulk metal forming and sheet metal forming processes

**MF5212****TECHNICAL SEMINAR**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>0</b> | <b>0</b> | <b>2</b> | <b>1</b> |

**OBJECTIVE:**

- To enrich the communication skills of the student through presentation of topics in recent advances in engineering/technology

**OUTCOME:**

Students will develop skills to read, write, comprehend and present research papers.

Students shall give presentations on recent areas of research in manufacturing engineering in two cycles. Depth of understanding, coverage, quality of presentation material (PPT/OHP) and communication skill of the student will be taken as measures for evaluation.

**TOTAL: 30 PERIODS****MF5001****FLUID POWER AUTOMATION**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To make the students to learn the basic concepts of hydraulics and pneumatics and their controlling elements in the area of manufacturing process.
- To train the students in designing the hydraulics and pneumatic circuits using various design procedures.

**UNIT I INTRODUCTION****5**

Need for Automation, Hydraulic & Pneumatic Comparison - ISO symbols for fluid power elements, Hydraulic, pneumatics – Selection criteria.

**UNIT II FLUID POWER GENERATING/UTILIZING ELEMENTS****8**

Hydraulic pumps and motor gears, vane, piston pumps-motors-selection and specification-Drive characteristics - Linear actuator - Types, mounting details, cushioning - power packs - construction. Reservoir capacity, heat dissipation, accumulators - standard circuit symbols, circuit (flow) analysis.

**UNIT III CONTROL AND REGULATION ELEMENTS****8**

Direction flow and pressure control valves-Methods of actuation, types, sizing of ports-pressure and temperature compensation, overlapped and underlapped spool valves-operating characteristics-electro hydraulic servo valves-Different types-characteristics and performance.

**UNIT IV CIRCUIT DESIGN****10**

Typical industrial hydraulic circuits-Design methodology - Ladder diagram-cascade, method-truth table-Karnaugh map method-sequencing circuits-combinational and logic circuit.





**UNIT V MANUFACTURING GUIDELINES 10**  
 DFM guidelines for casting, weldment design - Formed metal components - Turned parts - Milled, Drilled parts - Non metallic parts - Computer Aided DFM software - Boothroyd and Dewhurst method of DFMA - DCS - Vis/VSA - 3D Dimensional control - Statistical tolerance Analysis Software - Applications.

**TOTAL: 45 PERIODS**

**OUTCOMES :**

At the end of this course the students are expected

- To impart the knowledge about the significance of design for manufacturing and assembly

**REFERENCES:**

1. Alex Krulikowski, "Fundamentals GD&T", Delmar Thomson Learning, 1997.
2. C.M. Creveling, "Tolerance Design - A handbook for Developing Optimal Specifications", Addison - Wesley, 1997.
3. James D. Meadows, 'Geometric Dimensioning and Tolerancing", Marcel Dekker Inc., 1995.
4. James G. Bralla, "Handbook of Product Design for Manufacturing", McGraw Hill, 1986.
5. Oliver R. Wade, "Tolerance Control in Design and Manufacturing", Industrial Press, NY, 1967.

**MF5003 MICRO MANUFACTURING L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- The objective of the course is to acquaint the students with the principles, basic machine tools, and developments in the micro manufacturing process and research trends in the area of micro manufacturing process.

**UNIT I MICRO MACHINING I 10**  
 Mechanical Micro machining - Ultra Sonic Micro Machining - Abrasive Jet Micro Machining - Water Jet Micro Machining - Abrasive Water Jet Micro Machining - Micro turning - Chemical and Electro Chemical Micro Machining - Electric discharge micro machining.

**UNIT II MICRO MACHINING II 10**  
 Beam Energy based micro machining - Electron Beam Micro Machining - Laser Beam Micro Machining - Electric Discharge Micro Machining - Ion Beam Micro Machining -Plasma Beam Micro Machining - Hybrid Micro machining - Electro Discharge Grinding - Electro Chemical spark micro machining - Electrolytic in process Dressing.

**UNIT III NANO POLISHING 9**  
 Abrasive Flow finishing - Magnetic Abrasive Finishing - Magneto rheological finishing - Magneto Rheological abrasive flow finishing - Magnetic Float polishing - Elastic Emission Machining - chemo-mechanical Polishing.

**UNIT IV MICRO FORMING AND WELDING 9**  
 Micro extrusion - Micro and Nano structured surface development by Nano plastic forming and Roller Imprinting - Micro bending with LASER - LASER micro welding - Electron beam for micro welding.

**UNIT V RECENT TRENDS AND APPLICATIONS 7**  
 Metrology for micro machined components - Ductile regime machining- AE based tool wear compensation- Machining of Micro gear, micro nozzle, micro pins - Applications.

**TOTAL: 45 PERIODS**

**OUTCOMES :**

At the end of this course the students are well experienced

- To impart the principles of various basic micro manufacturing process

**REFERENCES:**

1. Bandyopadhyay. A.K., Nano Materials, New age international publishers, New Delhi, 2008, ISBN:8122422578.
2. Bharat Bhushan, Handbook of nanotechnology, springer, Germany, 2010.
3. Jain V.K., 'Introduction to Micro machining' Narosa Publishing House, 2011
4. Jain V.K., Advanced Machining Processes, Allied Publishers, Delhi, 2002
5. Jain V. K., Micro Manufacturing Processes, CRC Press, Taylor & Francis Group, 2012
6. Janocha H., Actuators - Basics and applications, Springer publishers - 2012
7. Mcgeoug.J.A., Micromachining of Engineering Materials, CRC press 2001, ISBN-10:0824706447.
8. [www.cmxr.com/industrial/](http://www.cmxr.com/industrial/)
9. [www.sciencemag.org.handbook](http://www.sciencemag.org.handbook)

**MF5004****QUALITY AND RELIABILITY ENGINEERING****L T P C****3 0 0 3****OBJECTIVES:**

To make the students to understand the various quality control techniques and to construct the various quality control charts for variables and attributes and also the design concepts for reliable system and maintenance aspects in industries.

**UNIT I QUALITY & STATISTICAL PROCESS CONTROL****8**

Quality - Definition - Quality Assurance - Variation in process - Factors - process capability - control charts - variables X, R and X, - Attributes P, C and U-Chart tolerance design. Establishing and interpreting control charts - charts for variables - Quality rating - Short run SPC.

**UNIT II ACCEPTANCE SAMPLING****8**

Lot by lot sampling - types - probability of acceptance in single, double, multiple sampling plans - OC curves - Producer's risk and consumer's risk. AQL, LTPD, AOQL, Concepts - standard sampling plans for AQL and LTPD - use of standard sampling plans.

**UNIT III EXPERIMENTAL DESIGN AND TAGUCHI METHOD****9**

Fundamentals - factorial experiments - random design, Latin square design - Taguchi method - Loss function - experiments - S/N ratio and performance measure - Orthogonal array.

**UNIT IV CONCEPT OF RELIABILITY****9**

Definition - reliability vs quality, reliability function - MTBF, MTTR, availability, bathtub curve - time dependent failure models - distributions - normal, weibull, lognormal - Reliability of system and models - serial, parallel and combined configuration - Markove analysis, load sharing systems, standby systems, covariant models, static models, dynamic models.

**UNIT V DESIGN FOR RELIABILITY AND MAINTAINABILITY****11**

Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress-strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, system safety - analysis of down-time - the repair time distribution, stochastic point processes system repair time, reliability under preventive maintenance state dependent system with repair. MTTR - mean system down time, repair vs replacement, replacement models, proactive, preventive, predictive maintenance maintainability and availability, optimization techniques for system reliability with redundancy heuristic methods applied to optimal system reliability.

**TOTAL: 45 PERIODS**

**OUTCOMES :**

At the end of this course the students are exposed to the various quality control techniques , to understand the importance and concept of reliability and maintainability in industries.

**REFERENCES:**

1. Amata Mitra "Fundamentals of Quality Control and improvement" Pearson Education, 2002.
2. Bester field D.H., "Quality Control" Prentice Hall, 1993.
3. Charles E Ebling, An Introduction to Reliability and Maintability Engineering, Tata-McGraw Hill, 2000.
4. David J Smith, Reliability, Maintainability and Risk: Practical Methods for Engineers, Butterworth 2002.
5. Dhillon, Engineering Maintainability – How to design for reliability and easy maintenance, PHI, 2008.
6. Patrick D To' corner, Practical Reliability Engineering, John-Wiley and Sons Inc, 2002

**MF5005****FINITE ELEMENT METHODS FOR MANUFACTURING  
ENGINEERING****L T P C  
3 0 0 3****OBJECTIVE:**

- To study the fundamentals of one dimensional and two dimensional problems using FEA in manufacturing.

**UNIT I INTRODUCTION****6**

Fundamentals - Initial, boundary and eigen value problems - weighted residual, Galerkin and Rayleigh Ritz methods - Integration by parts - Basics of variational formulation - Polynomial and Nodal approximation.

**UNIT II ONE DIMENSIONAL ANALYSIS****10**

Steps in FEM – Discretization. Interpolation, derivation of elements characteristic matrix, shape function, assembly and imposition of boundary conditions-solution and post processing – One dimensional analysis in solid mechanics and heat transfer.

**UNIT III SHAPE FUNCTIONS AND HIGHER ORDER FORMULATIONS****10**

Shape functions for one and two dimensional elements- Three noded triangular and four noded quadrilateral element Global and natural co-ordinates–Non linear analysis - Isoparametric elements - Jacobian matrices and transformations - Basics of two dimensional, plane stress, plane strain and axisymmetric analysis.

**UNIT IV COMPUTER IMPLEMENTATION****9**

Pre Processing, mesh generation, elements connecting, boundary conditions, input of material and processing characteristics – Solution and post processing – Overview of application packages – Development of code for one dimensional analysis and validation

**UNIT V ANALYSIS OF PRODUCTION PROCESSES****10**

FE analysis of metal casting - special considerations, latent heat incorporation, gap element - Time stepping procedures - Crank - Nicholson algorithm - Prediction of grain structure - Basic concepts of plasticity and fracture - Solid and flow formulation - small incremental deformation formulation - Fracture criteria - FE analysis of metal cutting, chip separation criteria, incorporation of strain rate dependency – FE analysis of welding.

**TOTAL: 45 PERIODS****OUTCOMES :**

At the end of this course the students are highly confident in

- Finite element methods and its application in manufacturing.

## REFERENCES:

1. Bathe, K.J., Finite Element procedures in Engineering Analysis, 1990
2. Kobayashi,S, Soo-ik-Oh and Altan,T, Metal Forming and the Finite Element Methods, Oxford University Press, 1989.
3. Lewis R.W. Morgan, K, Thomas, H.R. and Seetharaman, K.N. The Finite Element Method in Heat Transfer Analysis, John Wiley, 1994.
4. Rao, S.S., Finite Element method in engineering, Pergammon press, 2005.
5. Reddy, J.N. An Introduction to the Finite Element Method, McGraw Hill,2005.
6. Seshu P., Textbook of Finite Element Analysis, PHI Learning Pvt. Ltd, 2004.
7. www.pollockeng.com
8. www.tbook.com

**MF5006**

**MATERIALS MANAGEMENT**

**L T P C**  
**3 0 0 3**

## OBJECTIVE :

To introduce to the students the various concepts of materials management

### UNIT I INTRODUCTION

**6**

Introduction to materials management - Objectives - Functions - Operating Cycle - Value analysis - Make or buy decisions.

### UNIT II MANAGEMENT OF PURCHASE

**7**

Purchasing policies and procedures - Selection of sources of supply - Vendor development - Vendor evaluation and rating - Methods of purchasing - Imports - Buyer - Seller relationship - Negotiations.

### UNIT III MANAGEMENT OF STORES AND LOGISTICS

**12**

Stores function - Location - Layout - Stock taking - Materials handling - Transportation - Insurance - Codification - Inventory pricing - stores management - safety - warehousing - Distribution linear programming - Traveling Salesman problems - Network analysis - Logistics Management.

### UNIT IV MATERIALS PLANNING

**10**

Forecasting - Materials requirements planning - Quantity - Periodic - Deterministic models - Finite production.

### UNIT V INVENTORY MANAGEMENT

**10**

ABC analysis - Aggregate planning - Lot size under constraints - Just in Time (JIT) system.

**TOTAL: 45 PERIODS**

## OUTCOMES:

At the end of this course the students are

- Familiarized with the various concepts and functions of material management, so that the students will be in a position to manage the materials management department independently.

## REFERENCES

1. Dr. R. Kesavan, C.Elanchezian and T.SundarSelwyn, Engineering Management - Eswar Press - 2005.
2. Dr.R. Kesavan, C.Elanchezian and B.Vijaya Ramnath, Production Planning and Control, Anuratha Publications, Chennai, 2008.
3. G. Reghuram, N. Rangaraj, Logistics and supply chain management – cases and concepts, Macmillan India Ltd., 2006.
4. Gopalakrishnan.P, Handbook of Materials Management, Prentice Hall of India, 2005.
5. Guptha P.K. and Heera, Operations Research, Suttan Chand & Sons, 2007.
6. Lamer Lee and Donald W.Dobler, Purchasing and Material Management, Text and cases, Tata McGraw Hill, 2006.

**MF5007**

**INDUSTRIAL ERGONOMICS**

**L T P C**  
**3 0 0 3**

**OBJECTIVES :**

To introduce the concepts of Ergonomics and to indicate the areas of Applications.

**UNIT I INTRODUCTION**

**9**

Concepts of human factors engineering and ergonomics - Man - machine system and design philosophy - Physical work - Heat stress - manual lifting - work posture - repetitive motion.

**UNIT II ANTHROPOMETRY**

**9**

Physical dimensions of the human body as a working machine - Motion size relationships - Static and dynamic anthropometry - Anthropometric aids - Design principles - Using anthropometric measures for industrial design - Procedure for anthropometric design.

**UNIT III DESIGN OF SYSTEMS**

**10**

Displays - Controls - Workplace - Seating - Work process - Duration and rest periods - Hand tool design - Design of visual displays - Design for shift work.

**UNIT IV ENVIRONMENTAL FACTORS IN DESIGN**

**10**

Temperature - Humidity - Noise - Illumination -Vibration - Measurement of illumination and contrast - use of photometers - Recommended illumination levels. The ageing eye - Use of indirect (reflected) lighting - cost efficiency of illumination - special purpose lighting for inspection and quality control - Measurement of sound - Noise exposure and hearing loss - Hearing protectors - analysis and reduction of noise - Effects of Noise on performance - annoyance of noise and interference with communication - sources of vibration discomfort.

**UNIT V WORK PHYSIOLOGY**

**8**

Provision of energy for muscular work - Role of oxygen physical exertion - Measurement of energy expenditure Respiration - Pulse rate and blood pressure during physical work - Physical work capacity and its evaluation.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

At the end of this course the students are updated with various concepts of Ergonomics, so that students will able to apply the concepts of ergonomics to Design of man – machine system

**REFERENCES:**

1. E.J. McCormic & Mark S. Sangers, Human factors in engineering design, McGraw Hill 2007
2. Martin Helander, A guide to the ergonomics of manufacturing, East West press, 2007
3. R.S. Bridger Introduction to Ergonomics, McGraw Hill, 1995.

**MF5008**

**POLYMERS AND COMPOSITE MATERIALS**

**L T P C**  
**3 0 0 3**

**OBJECTIVES :**

To impart knowledge on types, physical properties and processing of polymer matrix composites, metal matrix composites and ceramics matrix composites.

**UNIT I PROCESSING OF POLYMERS**

**9**

Chemistry and Classification of Polymers – Properties of Thermo plastics – Properties of Thermosetting Plastics - Extrusion - Injection Moulding - Blow Moulding - Compression and Transfer Moulding - Casting - Thermo Forming. General Machining properties of Plastics - Machining Parameters and their effect - Joining of Plastics - Thermal bonding - Applications.

**UNIT II      FIBERS AND MATRIX MATERIALS      9**

Fibers - Fabrication, Structure, properties and applications - Glass fiber, Boron fiber, carbon fiber, organic fiber, ceramic and metallic fibers - whiskers-Fabrication of Matrix materials - polymers, metals and ceramics and their properties - interfaces - Wettability - Types of bonding at the interface - Tests for measuring interfacial strength - Physical and chemical properties.

**UNIT III      PROCESSING OF POLYMER MATRIX COMPOSITES      9**

Thermoset matrix composites: hand layup, spray, filament winding, Pultrusion, resin transfer moulding, autoclave moulding - bag moulding, compression moulding with Bulk Moulding Compound and sheet Moulding Compound - thermoplastic matrix composites - film stacking, diaphragm forming, thermoplastic tape laying, injection moulding – interfaces in PMCs - structure, properties and application of PMCs -recycling of PMCs.

**UNIT IV      PROCESSING OF METAL MATRIX COMPOSITES      9**

Metallic matrices: aluminium, titanium, magnesium, copper alloys - processing of MMCs: liquid state, Solid state, in situ fabrication techniques - diffusion bonding - powder metallurgy techniques-interfaces in MMCs - mechanical properties - machining of MMCs - Applications.

**UNIT V      PROCESSING OF CERAMIC MATRIX COMPOSITES AND CARBON-CARBON COMPOSITES      9**

Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration, lanxide process - in situ chemical reaction techniques: chemical vapour deposition, chemical vapour impregnation, sol-gel – interfaces in CMCs – mechanical properties and applications of CMCs – Carbon-carbon Composites – applications.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

At the end of this course the students are expected

- To study matrix material, reinforcements of polymer matrix composites, MMC and ceramic matrix composites.
- To develop knowledge on processing, interfacial properties and application of composites.

**REFERENCES:**

1. ASM Handbook - Composites, Vol-21, 2001, ISBN: 978-0-87170-703-1.
2. Harold Belofsky, Plastics, Product Design and Process Engineering, Hanser Publishers, 2002.
3. Jamal Y. Sheikh-Ahmad, Machining of Polymer Composites, Springer, USA, 2009. ISBN: 978-0-387-35539-9.
4. Krishnan K Chawla, Composite Materials: Science and Engineering, International Edition, Springer, 2012, ISBN:978-0-387-74364-6.
5. Mallick P.K., Fiber Reinforced Composites: Materials, Manufacturing and Design, CRC press, New Delhi, 2010, ISBN:0849342058.
6. Mallick, P.K. and Newman.S., Composite Materials Technology, Hanser Publishers, 2003.
7. Said Jahanmir, Ramulu M. and Philp Koshy, Machining of Ceramics and Composites, Marcel Dekker Inc., New York, 1999, ISBN: 0-8247-0178-x.
8. Seamour, E.B. Modern Plastics Technology, Prentice Hall, 2002

**OBJECTIVES :**

To stress the importance of NDT in engineering.

**UNIT I NON-DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION & LIQUID PENETRANT TESTING 6**

Introduction to various non-destructive methods, Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications.

Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods-water washable, Post - Emulsification methods, Applications

**UNIT II EDDY CURRENT TESTING & ACOUSTIC EMISSION 10**

Principles, Instrumentation for ECT, Absolute, differential probes, Techniques – High sensitivity techniques, Multi frequency, Phased array ECT, Applications.

Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

**UNIT III MAGNETIC PARTICLE TESTING & THERMOGRAPHY 10**

Principle of MPT, procedure used for testing a component, Equipment used for MPT, Magnetizing techniques, Applications.

Principle of Thermography, Infrared Radiometry, Active thermography measurements, Applications - Imaging entrapped water under an epoxy coating, Detection of carbon fiber contaminants.

**UNIT IV ULTRASONIC TESTING 10**

Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B-Scan, C- Scan, Applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident Through-transmission Testing, Angle Beam Pulse-Echo testing, TOFD Technique, Applications of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Intergranular cracks - Codes, standards, specification and procedures and case studies in ultrasonics test.

**UNIT V RADIOGRAPHY 9**

Principle of Radiography, x-ray and gamma ray sources- safety procedures and standards, Effect of radiation on Film, Radiographic imaging, Inspection Techniques – Single wall single image, Double wall Penetration, Multiwall Penetration technique, Real Time Radiography - Codes, standards, specification and procedures and case studies in Radiography test.

Case studies on defects in cast, rolled, extruded, welded and heat treated components - Comparison and selection of various NDT techniques

**TOTAL: 45 PERIODS**

**OUTCOMES:**

At the end of this course the students are expected to have hands on experience on all types of NDT and their applications in Engineering.

**REFERENCES:**

1. Baldev Raj, Jeyakumar,T., Thavasimuthu,M., "Practical Non Destructive Testing" Narosa publishing house, New Delhi, 2002
2. Krautkramer. J., "Ultra Sonic Testing of Materials", 1<sup>st</sup> Edition, Springer - Verlag Publication, New York, 1996.
3. Peter J. Shull "Non Destructive Evaluation: Theory, Techniques and Application" Marcel Dekker, Inc., New York, 2002
4. www.ndt.net



**OBJECTIVE:**

- To implement lean manufacturing concepts in the factories.

**UNIT I INTRODUCTION:****9**

The mass production system - Origin of lean production system - Necessity - Lean revolution in Toyota - Systems and systems thinking - Basic image of lean production - Customer focus - Muda (waste).

**UNIT II STABILITY OF LEAN SYSTEM:****9**

Standards in the lean system - 5S system - Total Productive Maintenance - standardized work - Elements of standardized work - Charts to define standardized work - Man power reduction - Overall efficiency - standardized work and Kaizen - Common layouts.

**UNIT III JUST IN TIME:****9**

Principles of JIT - JIT system - Kanban - Kanban rules - Expanded role of conveyance - Production leveling - Pull systems - Value stream mapping.

**UNIT IV JIDOKA (AUTOMATION WITH A HUMAN TOUCH):****9**

Jidoka concept - Poka-Yoke (mistake proofing) systems - Inspection systems and zone control - Types and use of Poka-Yoke systems - Implementation of Jidoka.

**UNIT V WORKER INVOLVEMENT AND SYSTEMATIC PLANNING METHODOLOGY****9**

Involvement - Activities to support involvement - Quality circle activity - Kaizen training - Suggestion Programmes - Hoshin Planning System (systematic planning methodology) - Phases of Hoshin Planning - Lean culture

**TOTAL: 45 PERIODS****OUTCOME:**

The student will be able to practice the principles of lean manufacturing like customer focus, reduction of MUDA, just in time, Jidoka and Hoshin planning.

**REFERENCES**

- Dennis P., "Lean Production Simplified: A Plain-Language Guide to the World's Most Powerful Production System", (Second edition), Productivity Press, New York, 2007.
- Liker, J., "The Toyota Way : Fourteen Management Principles from the World's Greatest Manufacturer", McGraw Hill, 2004.
- Michael, L.G., "Lean Six SIGMA: Combining Six SIGMA Quality with Lean Production Speed", McGraw Hill, 2002.
- Ohno, T., "Toyota Production System: Beyond Large-Scale Production", Taylor & Francis, Inc., 1988.
- Rother, M., and Shook, J., "Learning to See: Value Stream Mapping to Add Value and Eliminate MUDA", Lean Enterprise Institute, 1999.

**OBJECTIVES :**

- To impart knowledge in the area of Robot designing and programming in Robotic languages.

**UNIT I INTRODUCTION****9**

Definition, Need Application, Types of robots - Classifications - Configuration, work volume, control loops, controls and intelligence, specifications of robot, degrees of freedoms, end effectors - types, selection applications.

**UNIT III ROBOT KINEMATICS****9**

Introduction - Matrix representation Homogeneous transformation, forward and inverse - Kinematic equations, Denvit - Hartenbers representations - Inverse Kinematic relations. Fundamental problems with D-H representation, differential motion and velocity of frames - Jacobian, Differential Charges between frames:

**UNIT III ROBOT DYNAMICS AND TRAJECTORY PLANNING****9**

Lagrangeon mechanics, dynamic equations for sing, double and multiple DOF robots – static force analysis of robots, Trajectory planning – joint space, Cartesian space description and trajectory planning – third order, fifth order - Polynomial trajectory planning

**UNIT IV ROBOT PROGRAMMING & AI TECHNIQUES****9**

Types of Programming - Teach Pendant programming - Basic concepts in AI techniques - Concept of knowledge representations - Expert system and its components.

**UNIT V ROBOT SENSORS AND ACTUATORS****9**

Design of Robots – characteristics of actuating systems, comparison, microprocessors control of electric motors, magnetostrictive actuators, shape memory type metals, sensors, position, velocity, force, temperature, pressure sensors – Contact and non contact sensors, infrared sensors, RCC, vision sensors.

**TOTAL: 45 PERIODS****OUTCOMES:**

At the end of this course the students are expected

- To introduce the kinematic arrangement of robots and its applications in the area of manufacturing sectors
- To expose to build a robot for any type of application

**REFERENCES**

- Gordon Mair, 'Industrial Robotics', Prentice Hall (U.K.) 1988
- Groover.M.P. Industrial Robotics, McGraw - Hill International edition, 1996.
- Saeed.B.Niku, 'Introduction to Robotics, Analysis, system, Applications', Pearson educations, 2002
- Wesley E Snyder R, 'Industrial Robots, Computer Interfacing and Control', Prentice Hall International Edition, 1988.

**OBJECTIVES :**

- To inspire the students to expect to the trends in manufacturing of micro components and measuring systems to nano scale.

**UNIT I OVER VIEW OF MEMS AND MICROSYSTEMS 6**

Definition – historical development – properties, design and fabrication micro-system, microelectronics, working principle ,applications and advantages of micro system. Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds - silicon piezo resistors, Gallium arsenide, quartz, polymers for MEMS, conductive polymers.

**UNIT II FABRICATION PROCESSES AND MICRO SYSTEM PACKAGING 10**

Photolithography, photo resist applications, light sources, ion implantation, diffusion-Oxidation - thermal oxidation, silicon dioxide, chemical vapour deposition, sputtering - deposition by epitaxy - etching - bulk and surface machining - LIGA process - LASER, Electron beam ,Ion beam processes - Mask less lithography. Micro system packaging -packaging design- levels of micro system packaging -die level, device level and system level – interfaces in packaging – packaging technologies- Assembly of Microsystems

**UNIT III MICRO DEVICES 8**

Sensors - classification - signal conversion ideal characterization of sensors micro actuators, mechanical sensors - measurands - displacement sensors, pressure sensor, flow sensors, Accelerometer , chemical and bio sensor - sensitivity, reliability and response of micro-sensor - micro actuators – applications.

**UNIT IV SCIENCE AND SYNTHESIS OF NANO MATERIALS 10**

Classification of nano structures - Effects of nano scale dimensions on various properties - structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics -Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon nanotubes – Solid carbon source based production techniques – Gaseous carbon source based production techniques – Diamond like carbon coating. Top down and bottom up processes.

**UNIT V CHARACTERIZATION OF NANO MATERIALS 11**

Nano-processing systems - Nano measuring systems - characterization - analytical imaging techniques - microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques - spectroscopy techniques - Raman spectroscopy, 3D surface analysis - Mechanical, Magnetic and thermal properties – Nano positioning systems.

**TOTAL: 45 PERIODS****OUTCOMES:**

At the end of this course the students are expected

- To expose the evolution of micro electromechanical systems, to the various fabrication techniques and to make students to be aware of micro actuators. Also to impart knowledge to nano materials and various nano measurements techniques.

**REFERENCES:**

- Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003
- Julian W. Hardner Micro Sensors, Principles and Applications, CRC Press 1993.
- Mark Madou , Fundamentals of Microfabrication, CRC Press, New York, 1997.

4. Mohamed Gad-el-Hak, MEMS Handbook, CRC press, 2006, ISBN : 8493-9138-5
5. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003
6. Sami Franssila, Introduction to Micro fabrication, John Wiley & sons Ltd, 2004. ISBN:470-85106-6
7. Tai - Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
8. Waqar Ahmed and Mark J. Jackson, Emerging Nanotechnologies for Manufacturing, Elsevier Inc.,2013,ISBN : 978-93-82291-39-8

**MF5012**

**COMPUTER AIDED PRODUCT DESIGN**

**L T P C**  
**3 0 0 3**

**OBJECTIVES :**

To introduce the computer aided modeling and various concepts of product design.

**UNIT I INTRODUCTION**

**8**

Introduction to Engineering Design - Various phases of systematic design - sequential engineering and concurrent engineering - Computer hardware & Peripherals - software packages for design and drafting.

**UNIT II COMPUTER GRAPHICS FUNDAMENTALS AND GEOMETRIC MODEL**

**8**

Computer graphics – applications – principals of interactive computer graphics – 2D 3D transformations - projections - curves - Geometric Modeling - types - Wire frame surface and solid modeling - Boundary Representation, constructive solid geometry - Graphics standards - assembly modeling – use of software packages

**UNIT III PRODUCT DESIGN CONCEPTS AND PRODUCT DATA MANAGEMENT**

**10**

Understanding customer needs - Product function modeling - Function trees and function structures – Product tear down methods – Bench marking – Product port folio – concept generation and selection - Product Data Management - concepts - Collaborative product design- manufacturing planning factor - Customization factor - Product life cycle management.

**UNIT IV PRODUCT DESIGN TOOLS & TECHNIQUES**

**10**

Product modeling - types of product models; product development process tools - TRIZ - Altshuller's inventive principles - Modeling of product metrics - Design for reliability - design for manufacturability - machining, casting, and metal forming - design for assembly and disassembly - Design for environment

**UNIT V PRODUCT DESIGN TECHNIQUES**

**9**

FMEA - QFD - Poka Yoke - DOE - Taguchi method of DOE - Quality loss functions - Design for product life cycle.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

At the end of this course the students are expected

- To model a product using CAD software.
- To apply the various design concepts and design tools and techniques while designing a product.

**REFERENCES:**

1. Biren Prasad, "Concurrent Engineering Fundamentals Vol.11", Prentice Hall, 1997.
2. David F.Rogers.J, Alan Adams, "Mathematical Elements for Computer Graphics", McGraw Hill, 1990
3. Ibrahim Zeid, "CAD/CAM theory and Practice", Tata McGraw Hill, 1991.
4. James G.Bralla, "Handbook of Product Design for Manufacturing", McGraw Hill, 1994
5. Kevin Otto, Kristin Wood, "Product Design", Pearson Education, 2000

**OBJECTIVES:**

To introduce the process planning concepts to make cost estimation for various products after process planning

**UNIT I INTRODUCTION TO PROCESS PLANNING 10**

Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection

**UNIT II PROCESS PLANNING ACTIVITIES 10**

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods – Set of documents for process planning-Economics of process planning- case studies

**UNIT III INTRODUCTION TO COST ESTIMATION 8**

Importance of costing and estimation -methods of costing-elements of cost estimation -Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost

**UNIT IV PRODUCTION COST ESTIMATION 8**

Estimation of Different Types of Jobs – Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

**UNIT V MACHINING TIME CALCULATION 9**

Estimation of Machining Time – Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring – Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding

**TOTAL: 45 PERIODS****OUTCOMES:**

At the end of this course the students are expected to use the concepts of process planning and cost estimation for various products.

**REFERENCES:**

1. Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002.
2. Ostwalal P.F. and Munez J., “Manufacturing Processes and systems”, 9th Edition, John Wiley, 1998.
3. Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002.
4. Russell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI, 2003.

**OBJECTIVES :**

To introduce the concepts of manufacturing management and various manufacturing management functions to the students.

**UNIT I PLANT ENGINEERING****7**

Plant location - Factors affecting plant location - Techniques - Plant layout - principles - Types - Comparison of layouts - Materials handling - Principles - Factors affecting selection of Materials handling system - Types of materials handling systems - Techniques.

**UNIT II WORK STUDY****8**

Method study - Principles of motion economy - steps in method study - Tool and Techniques - Work measurement - Purpose - stop watch time study - Production studies - work sampling - Ergonomics - Value analysis.

**UNIT III PROCESS PLANNING AND FORECASTING****9**

Process planning - Aims of process planning - steps to prepare the detailed work sheets for manufacturing a given component - Break even analysis - Forecasting - Purpose of forecasting - Methods of forecasting - Time series - Regression and Correlation - Exponential smoothing.

**UNIT IV SCHEDULING AND PROJECT MANAGEMENT****12**

Scheduling - Priority rules for scheduling - sequencing - Johnson's algorithm for job sequencing - n job M machine problems - Project Network analysis - PERT/CPM - Critical path - Floats - Resource leveling - Queuing analysis.

**UNIT V PERSONNEL AND MARKETING MANAGEMENT****9**

Principles of Management - Functions of personnel management - Recruitment - Training - Motivation - Communication - conflicts - Industrial relations - Trade Union - Functions of marketing - Sales promotion methods - Advertising - Product packaging - Distribution channels - Market research and techniques.

**TOTAL: 45 PERIODS****OUTCOMES:**

At the end of this course the students are trained in the various functions of manufacturing management so that the students will be able to take up these functions as they get in to senior managerial positions.

**REFERENCES**

1. Dr. R. Kesavan, C. Elanchezian, and B.Vijayaramnath, Principles of Management - Eswar Press - Chennai - 2004
2. Dr. R. Kesavan, C.Elanchezian and B.Vijayaramnath, Production Planning and Control, Anuratha Publications, Chennai - 2008
3. Dr. R. Kesavan,C. Elanchezian and T.Sundar Selwyn, Engineering Management - Eswar Press, Chennai - 2005
4. Martand T. Telsang, Production Management, S.Chand & Co., 2007

**OBJECTIVES**

- To impart scientific, statistical and analytical knowledge for carrying out research work effectively.

**UNIT I INTRODUCTION TO RESEARCH 9**

The hallmarks of scientific research - Building blocks of science in research - Concept of Applied and Basic research - Quantitative and Qualitative Research Techniques - Need for theoretical frame work - Hypothesis development - Hypothesis testing with quantitative data. Research design - Purpose of the study: Exploratory, Descriptive, Hypothesis Testing.

**UNIT II EXPERIMENTAL DESIGN 9**

Laboratory and the Field Experiment - Internal and External Validity - Factors affecting Internal validity. Measurement of variables - Scales and measurements of variables. Developing scales - Rating scale and attitudinal scales - Validity testing of scales - Reliability concept in scales being developed - Stability Measures.

**UNIT III DATA COLLECTION METHODS 9**

Interviewing, Questionnaires, etc. Secondary sources of data collection. Guidelines for Questionnaire Design - Electronic Questionnaire Design and Surveys. Special Data Sources: Focus Groups, Static and Dynamic panels. Review of Advantages and Disadvantages of various Data-Collection Methods and their utility. Sampling Techniques - Probabilistic and non-probabilistic samples. Issues of Precision and Confidence in determining Sample Size. Hypothesis testing, Determination of Optimal sample size.

**UNIT IV MULTIVARIATE STATISTICAL TECHNIQUES 9**

Data Analysis - Factor Analysis - Cluster Analysis - Discriminant Analysis - Multiple Regression and Correlation - Canonical Correlation - Application of Statistical (SPSS) Software Package in Research.

**UNIT V RESEARCH REPORT 9**

Purpose of the written report - Concept of audience - Basics of written reports. Integral parts of a report - Title of a report, Table of contents, Abstract, Synopsis, Introduction, Body of a report - Experimental, Results and Discussion - Recommendations and Implementation section - Conclusions and Scope for future work.

**TOTAL = 45 PERIODS****OUTCOME**

- After completion of the syllabus students will able to get knowledge about the different research techniques and research report.

**REFERENCES**

- C.R.Kothari, Research Methodology, WishvaPrakashan, New Delhi, 2001.
- Donald H.McBurney, Research Methods, Thomson Asia Pvt. Ltd. Singapore, 2002.
- Donald R. Cooper and Ramela S. Schindler, Business Research Methods, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2000
- G.W.Ticehurst and A.J.Veal, Business Research Methods, Longman, 1999.
- Ranjit Kumar, Research Methodology, Sage Publications, London, New Delhi, 1999.
- Raymond-Alain Thie'tart, *et.al.*, Doing Management Research, Sage Publications, London, 1999
- Uma Sekaran, Research Methods for Business, John Wiley and Sons Inc., New York, 2000.

**OBJECTIVES :**

To inspire the students to expect to the trends in development and synthesizing of nano systems and measuring systems to nano scale.

**UNIT I OVER VIEW OF NANOTECHNOLOGY****6**

Definition - historical development - properties, design and fabrication Nanosystems, , working principle ,applications and advantages of nano system. Nanomaterials - ordered oxides - Nano arrays – potential health effects

**UNIT II NANODEFECTS, NANO PARTILES AND NANOLAYERS****8**

Nanodefects in crystals - applications - Nuclear Track nano defects. Fabrication of nano particles - LASER ablation - sol gels - precipitation of quantum dots. Nano layers - PVD,CVD ,Epitaxy and ion implantation - formation of Silicon oxide- chemical composition - doping properties - optical properties

**UNIT III NANOSTRUCTURING****8**

Nanophotolithography - introduction - techniques - optical - electron beam - ion beam - X-ray and Synchrotron - nanolithography for microelectronic industry - nanopolishign of Diamond - Etching of Nano structures – Nano imprinting technology – Focused ion beams - LASER interference Lithography nanoarrays -Near-Field Optics - case studies and Trends

**UNIT IV SCIENCE AND SYNTHESIS OF NANO MATERIALS****12**

Classification of nano structures - Effects of nano scale dimensions on various properties - structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics -Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon nanotubes – Solid carbon source based production techniques – Gaseous carbon source based production techniques – Diamond like carbon coating. Top down and bottom up processes.

**UNIT V CHARACTERIZATION OF NANO MATERIALS****11**

Nano-processing systems - Nano measuring systems - characterization - analytical imaging techniques - microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques - spectroscopy techniques - Raman spectroscopy, 3D surface analysis - Mechanical, Magnetic and thermal properties – Nano positioning systems.

**TOTAL: 45 PERIODS****OUTCOMES:**

At the end of this course the students are expected

- To evaluate Nano systems, to the various fabrication techniques.
- Also to have deep knowledge in nano materials and various nano measurements techniques.

**REFERENCES:**

1. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003
2. Fahrner W.R., Nanotechnology and Nanoelectronics, Springer (India) Private Ltd., 2011.
3. Julian W. Hardner Micro Sensors, Principles and Applications, CRC Press 1993.
4. Mark Madou , Fundamentals of Microfabrication, CRC Press, New York, 1997.
5. Mohamed Gad-el-Hak, MEMS Handbook, CRC press, 2006, ISBN : 8493-9138-5
6. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003
7. Sami Franssila, Introduction to Micro fabrication , John Wiley & sons Ltd, 2004. ISBN:470-85106-6
8. Tai - Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
9. Waqar Ahmed and Mark J. Jackson, Emerging Nanotechnologies for Manufacturing, Elsevier Inc.,2013,ISBN : 978-93-82291-39-8



**OBJECTIVE:**

This course aims to impart knowledge on various techniques of material characterization.

**UNIT I MICRO AND CRYSTAL STRUCTURE ANALYSIS 10**

Principles of Optical Microscopy - Specimen Preparation Techniques - Polishing and Etching - Polarization Techniques - Quantitative Metallography - Estimation of grain size - ASTM grain size numbers - Microstructure of Engineering Materials - Elements of Crystallography - X-ray Diffraction - Bragg's law - Techniques of X-ray Crystallography - Debye - Scherer camera - Geiger Diffractometer - analysis of Diffraction patterns - Inter planer spacing - Identification of Crystal Structure, Elements of Electron Diffraction.

**UNIT II ELECTRON MICROSCOPY 9**

Interaction of Electron Beam with Materials - Transmission Electron Microscopy - Specimen Preparation - Imaging Techniques - BF & DF - SAD - Electron Probe Microanalysis - Scanning Electron Microscopy - Construction & working of SEM - various Imaging Techniques - Applications- Atomic Force Microscopy- Construction & working of AFM - Applications .

**UNIT III CHEMICAL AND THERMAL ANALYSIS 9**

Basic Principles, Practice and Applications of X-Ray Spectrometry, Wave Dispersive X-Ray Spectrometry, Auger Spectroscopy, Secondary Ion Mass Spectroscopy, Fourier Transform Infra Red Spectroscopy (FTIR)- Proton Induced X-Ray Emission Spectroscopy, Differential Thermal Analysis, Differential Scanning Calorimetry (DSC) And Thermo Gravimetric Analysis (TGA)

**UNIT IV MECHANICAL TESTING – STATIC TESTS 8**

Hardness - Brinell, Vickers, Rockwell and Micro Hardness Test - Tensile Test - Stress - Strain plot - Proof Stress - Torsion Test - Ductility Measurement - Impact Test - Charpy & Izod - DWTT - Fracture Toughness Test, Codes and standards for testing metallic and composite materials.

**UNIT V MECHANICAL TESTING – DYNAMIC TESTS 9**

Fatigue - Low & High Cycle Fatigues - Rotating Beam & Plate Bending HCF tests - S-N curve - LCF tests - Crack Growth studies - Creep Tests - LM parameters - AE Tests-modal analysis - Applications of Dynamic Tests.

**TOTAL: 45 PERIODS****OUTCOMES:**

At the end of this course the students are expected to be knowledgeable in microstructure evaluation, crystal structure analysis, electron microscopy, Chemical Thermal Analysis, static and dynamic mechanical testing methods.

**REFERENCES:**

1. ASM Hand book-Materials characterization, Vol - 10, 2004.
2. Cullity B.D., Stock S.R& Stock S., Elements of X ray Diffraction, (3<sup>rd</sup> Edition). Prentice Hall, 2001.
3. Davis J. R., Tensile Testing, 2<sup>nd</sup> Edition, ASM International, 2004.
4. Davis, H.E., Hauck G. & Troxell G.E., The Testing of engineering Materials, (4<sup>th</sup> Edition), McGraw Hill, College Divn., 1982.
5. Dieter G.E., Mechanical Metallurgy, (3<sup>rd</sup> Edition), ISBN: 0070168938, McGraw Hill, 1988.
6. Goldsten,I.J., Dale.E., Echin.N.P.& Joy D.C., Scanning Electron Microscopy & X ray- Micro Analysis, (2<sup>nd</sup> Edition), ISBN - 0306441756, Plenum Publishing Corp., 2000.
7. Grundy P.J. and Jones G.A., Electron Microscopy in the Study of Materials, Edward Arnold Limited, 1976.
8. Morita.S, Wiesendanger.R, and Meyer.E, "Non-contact Atomic Force Microscopy" Springer, 2002,
9. Newby J., Metals Hand Book- Metallography & Micro Structures, (9<sup>th</sup> Edition), ASM International, 1989.
10. Suryanarayana A. V. K., Testing of metallic materials, (2<sup>nd</sup> Edition), BS publications, 2007.

**OBJECTIVES:**

This syllabus is formed to create knowledge in Mechatronics systems and impart the source of concepts and techniques, which have recently been applied in practical situation. It gives the frame work of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach to engineering.

**UNIT I INTRODUCTION****6**

Introduction to Mechatronics-systems - Mechatronics approach to modern engineering and design - Need of Mechatronics - Emerging areas of Mechatronics - Classification of Mechatronics - Mechatronics elements.

**UNIT II SENSORS AND TRANSDUCERS****12**

Introduction - Performance Terminology - Potentiometers - Strain gauges - I VDT - Eddy current sensor - Hall effect sensor - Capacitance sensors - Digital transducers - Temperature sensors - Optical sensors - Piezo electric sensor-ultrasonic sensors - Proximity sensors - Signal processing techniques.

**UNIT III MICROPROCESSORS AND MICROCONTROLLERS****12**

Introduction – Architectures of 8 – bit microcontrollers (8051) series, PIC Microcontrollers (16f xxx) series – Assembly language programming instruction format, addressing modes, instruction sets, Basic program examples interface of keypads, leds, A/D and D/A Converters, RS 232 serial communication interface, classification of memories.

**UNIT IV ACTUATORS****8**

Switching Devices, Classification of actuators - Electrical actuators - Solid state relays, solenoids, D.C. motors, Servo motors, Stepper motors - Interfacing with microcontroller through H-bridge Circuits – Piezoelectric actuators.

**UNIT V MECHATRONIC SYSTEMS****7**

Design process-stages of design process - Traditional and Mechatronics design concepts - Case studies - Engine management system, Automatic camera, Automatic washing machine, Pick and place robots.

**TOTAL: 45 PERIODS****OUTCOMES:**

At the end of this course the students are experts in designing Mechatronics components.

**REFERENCES:**

1. Devadas shetty, Richard A. Kolk, "Mechatronics System Design", PWS Publishing Company, 2001.
2. M.A. Mazidi & J.G. Mazidi, 8051 Microcontroller and embedded systems, 2002
3. R.K.Rajput.A Text Book of Mechatronics, Chand &Co, 2007
4. W.Bolton, "MECHATRONICS" Pearson Education Limited, 2004

**OBJECTIVES:**

- To discover key IoT concepts including identification, sensors, localization, wireless protocols
- To explore IoT technologies, architectures, standards, and regulation
- To realize the value created by collecting, communicating, coordinating, and leveraging data
- To examine developments that will likely shape the industrial landscape in the future;

**UNIT I INTRODUCTION****9**

Technology of the IoT and applications,. IoT data management requirements, Architecture of IoT, Security issues Opportunities for IoT -Issues in implementing IoT. Technological challenges, RFID and the Electronic Product Code (EPC) network, the web of things.

**UNIT II DESIGN OF IoT****9**

Design challenges in IoT -Standardization, Security and privacy, Infrastructure, Analytics. Design steps for implementing IoT.

**UNIT III PROTOTYPING OF IoT****9**

Design principles for connected devices -Embedded devices, physical design, online components, embedded coding system. Informed Manufacturing plant – Elements, IoT implementation in Transportation and logistics, Energy and utilities, Automotive Connected supply chain, Plant floor control automation, remote monitoring, Management of critical assets, Energy management and resource optimization, proactive maintenance.

**UNIT IV PREREQUISITES FOR IoT****9**

IOT Technologies Wireless protocols low-power design (Bluetooth Low Energy), range extension techniques (data mining and mesh networking), and data-intensive IoT for continuous recognition applications Data storage and analysis Localization algorithms Localization for mobile systems

**UNIT V APPLICATION IN MANUFACTURING****9**

Applications HCI and IoT world -Multilingual interactions Robotics and Autonomous Vehicles Sensing and data processing-Simultaneous mapping and localization-Levels of autonomy, Smart factories, Future research challenges

**TOTAL : 45 PERIODS****OUTCOMES:**

- At the end of this course the students are expected to
- Utilizing sensors to gain greater visibility and real-time situational awareness
- Vertical applications that provide a clear business case and a pressing opportunity
- Emerging technologies to address IoT challenges

**REFERENCES:**

1. Adrian McEwan and Hakim Cassimally, "Designing the internet of things", Wiley, 2013
2. Code Halos: How the Digital Lives of People, Things, and Organizations are Changing the Rules of Business, by Malcolm Frank, Paul Roehrig and Ben Pring, published by John Wiley & Sons.
3. Internet of Things: A Hands-On Approach by Vijay Madiseti, Arshdeep Bahga, VPT; 1st edition 2014.
4. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, "From Machine-to-Machine to the Internet of Things -Introduction to a New Age of Intelligence" Elsevier
5. Meta Products -Building the Internet of Things by Wimer Hazenberg, Menno Huisman, BIS Publishers 2014.

**OBJECTIVES:**

The Student should be made to:

- Be exposed to big data
- Learn the different ways of Data Analysis
- Be familiar with data streams
- Learn the mining and clustering
- Be familiar with the visualization

**UNIT I INTRODUCTION TO BIG DATA****8**

Introduction to Big Data Platform - Challenges of conventional systems - Web data - Evolution of Analytic scalability, analytic processes and tools, Analysis vs reporting - Modern data analytic tools, Stastical concepts: Sampling distributions, resampling, statistical inference, prediction error.

**UNIT II DATA ANALYSIS****12**

Regression modeling, Multivariate analysis, Bayesian modeling, inference and Bayesian networks, Support vector and kernel methods, Analysis of time series: linear systems analysis, nonlinear dynamics – Rule induction – Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, Stochastic search methods.

**UNIT III MINING DATA STREAMS****8**

Introduction to Streams Concepts - Stream data model and architecture - Stream Computing, Sampling data in a stream - Filtering streams - Counting distinct elements in a stream - Estimating moments – Counting oneness in a window – Decaying window – Realtime Analytics Platform(RTAP) applications - case studies - real time sentiment analysis, stock market predictions.

**UNIT IV FREQUENT ITEMSETS AND CLUSTERING****9**

Mining Frequent itemsets - Market based model - Apriori Algorithm - Handling large data sets in Main memory - Limited Pass algorithm - Counting frequent itemsets in a stream - Clustering Techniques – Hierarchical – K- Means – Clustering high dimensional data – CLIQUE and PROCLUS - Frequent pattern based clustering methods - Clustering in non-euclidean space - Clustering for streams and Parallelism.

**UNIT V FRAMEWORKS AND VISUALIZATION****8**

MapReduce - Hadoop, Hive, MapR - Sharding - NoSQL Databases - S3 - Hadoop Distributed file systems - Visualizations - Visual data analysis techniques, interaction techniques; Systems and applications:

**TOTAL : 45 PERIODS****OUTCOMES:**

At the end of this course the students are expected to

- Apply the statistical analysis methods.
- Compare and contrast various soft computing frameworks.
- Design distributed file systems.
- Apply Stream data model.
- Use Visualisation techniques

**REFERENCES:**

1. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge Big Data Glossary, O'Reilly, 2011.
2. Bill Franks, Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analytics, John Wiley & sons, 2012.
3. Glenn J. Myatt, Making Sense of Data, John Wiley & Sons, 2007 Pete Warden,
4. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.
5. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007. University Press, 2012.

**CM5093**

**MANUFACTURING SYSTEM SIMULATION**

**L T P C  
3 0 0 3**

**OBJECTIVES:**

- Introduce computer simulation technologies and techniques
- Introduce concepts of modeling layers of society's critical infrastructure networks
- Build tools to view and control simulations and their results

**UNIT I INTRODUCTION**

**9**

Systems and modeling – statistical models in simulation -discrete and continuous system -Monte Carlo Simulation. Simulation of Single Server Queuing System. Simulation of manufacturing shop Simulation of Inventory System

**UNIT II RANDOM NUMBERS**

**9**

Random number generation -Properties of Random Numbers -Generation of Pseudo Random Numbers – Techniques -Tests for Random Numbers

**UNIT III RANDOM VARIATES**

**9**

Random variate generation-Inverse Transform Technique -Direct Transform Techniques Convolution Method Acceptance Rejection Technique- Routines for Random Variate Generation, Testing – Analysis of simulation data.

**UNIT IV ANALYSIS OF SIMULATION DATA**

**9**

Input modeling-Fitness tests - verification and validation of simulation models - output analysis for a single model, Comparison and evaluation of alternate system design, Optimization using simulation.

**UNIT V SIMULATION LANGUAGES**

**9**

Simulation languages and packages-Case studies in WITNESS; FLEXSIM, ARENA, SIMQUICK-Simulation based optimization-Modelling and Simulation with Petrinets – Case studies in manufacturing and material handling system.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- At the end of this course the students are expected to
- Develop Manufacturing Models of Discrete event systems
- Generation of Uncertainty using Random numbers and Random Variates
- Input, Output Analysis: Verification & Valediction of Models and Optimization

**REFERENCES :**

1. Geoffrey Gordon, "System Simulation", 2nd Edition, Prentice Hall, India, 2002.
2. Jerry Banks & John S.Carson, Barry L Nelson, "Discrete event system simulation", Prentice Hall
3. Law A.M, "Simulation Modelling and Analysis", Tata Mc Graw Hill
4. NarsinghDeo, "System Simulation with Digital Computer", Prentice Hall
5. Pidd, M, "Computer Simulation in Management Science", John Wiley & Sons, Inc.

**OBJECTIVE:**

- To understand history, concepts and terminology of PLM
- To understand functions and features of PLM/PDM
- To understand different modules offered in commercial PLM/PDM tools
- To understand PLM/PDM implementation approaches
- To understand integration of PLM/PDM with other applications

**UNIT I HISTORY, CONCEPTS AND TERMINOLOGY OF PLM****9**

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDM), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications.

**UNIT II PLM/PDM FUNCTIONS AND FEATURES****9**

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions - Communication and Notification, data transport, data translation, image services, system administration and application integration.

**UNIT III DETAILS OF MODULES IN A PDM/PLM SOFTWARE****9**

Case studies based on top few commercial PLM/PDM tools

**UNIT IV ROLE OF PLM IN INDUSTRIES****9**

Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for-business, organisation, users, product or service, process performance.

**UNIT V BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE****9**

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP

**TOTAL: 45 PERIODS****OUTCOMES:**

The students will be able to

1. Understand history, concepts and terminology of PLM.
2. Apply the functions and features of PLM/PDM.
3. Understand different modules offered in commercial PLM/PDM tools.
4. Understand PLM/PDM implementation approaches.
5. Integrate PLM/PDM with other applications.
6. Analyse the case studies.

**REFERENCES**

1. Antti Saaksvuori and Anselmi Immonen, "Product Lifecycle Management", Springer Publisher, 2008 (3<sup>rd</sup> Edition).
2. International Journal of Product Lifecycle Management, Inderscience Publishers
3. Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, "Implementing and Integrating Product Data Management and Software Configuration Management", Artech House Publishers, 2003.
4. John Stark, "Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question", Springer Publisher, 2007.
5. John Stark, "Product Lifecycle Management: 21st Century Paradigm for Product Realisation", Springer Publisher, 2011 (2<sup>nd</sup> Edition).
6. Michael Grieves, "Product Life Cycle Management", Tata McGraw Hill, 2006.

**OBJECTIVE:**

- To educate students with fundamental and advanced knowledge in the field of Additive manufacturing technology and the associated Aerospace, Architecture, Art, Medical and industrial applications.

**UNIT I INTRODUCTION:****8**

Need - Development of AM systems - AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling - RP to AM -Classification of AM processes-Benefits- Applications.

**UNIT II REVERSE ENGINEERING AND CAD MODELING:****10**

Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.

**UNIT III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS****10**

Stereolithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications.

Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications.

Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

**UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS:****10**

Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications- Case Studies.

**UNIT V OTHER ADDITIVE MANUFACTURING SYSTEMS:****7**

Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballistic Particle Manufacturing (BPM), Selective Laser Melting, Electron Beam Melting.

**TOTAL: 45 PERIODS****OUTCOMES:**

On completion of this course the students are expected to learn about a variety of Additive Manufacturing (AM) technologies, their potential to support design and manufacturing, case studies relevant to mass customized manufacturing, and some of the important research challenges associated with AM and its data processing tools

**REFERENCES:**

- Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", second edition, World Scientific Publishers, 2010.
- Gebhardt, A., "Rapid prototyping", Hanser Gardener Publications, 2003.
- Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
- Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.
- Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
- Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, 2011.

**MF5018**

**PRODUCT DESIGN AND DEVELOPMENT**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

Understand the application of product design methods to develop a product

**UNIT I PRODUCT DEVELOPMENT AND CONCEPT SELECTION 10**

Product development process - Product development organizations- Identifying the customer needs - Establishing the product specifications - concept generation - Concept selection.

**UNIT II PRODUCT ARCHITECTURE 7**

Product architecture - Implication of the architecture - Establishing the architecture - Related system level design issues.

**UNIT III INDUSTRIAL AND MANUFACTURING DESIGN 10**

Need for industrial design - Impact of industrial design - Industrial design process. Assessing the quality of industrial design- Human Engineering consideration - Estimate the manufacturing cost - Reduce the component cost - Reduce the assembly cost - Reduce the support cost - Impact of DFM decisions on other factors

**UNIT IV PROTOTYPING AND ECONOMIC ANALYSIS 9**

Principles of prototyping - Planning for prototypes - Elements of economic analysis - Base case financial model - Sensitivity analysis - Influence of the quantitative factors

**UNIT V MANAGING PRODUCT DEVELOPMENT PROJECTS 9**

Sequential, parallel and coupled tasks - Baseline project planning - Project Budget Project execution - Project evaluation- patents- patent search-patent laws International code for patents.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

At the end of this course the students are expected to design and develop various products

**REFERENCES:**

1. Charles Gevirtz, Developing New products with TQM, McGraw - Hill International editions, 1994
2. Karal .T. Ulrich, Steven D.Eppinger, Product Design and Development, McGRAW- HILL International Editions.2003.
3. S.Rosenthal, Effective product design and development, Irwin 1992.

**MF5074**

**ENTREPRENEURSHIP DEVELOPMENT**

**L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- To develop and strengthen entrepreneurial quality and motivation in students. To impart basic entrepreneurial skills and understandings to run a business efficiently and effectively.

**UNIT I ENTREPRENEURIAL COMPETENCE 6**

Entrepreneurship concept - Entrepreneurship as a Career - Entrepreneurial Personality - Characteristics of Successful, Entrepreneur - Knowledge and Skills of Entrepreneur.

**UNIT II ENTREPRENEURIAL ENVIRONMENT 12**

Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organisational Services - Central and State Government Industrial Policies and Regulations - International Business.



|   |                                     |                          |
|---|-------------------------------------|--------------------------|
| <b>UNIT III</b>   | <b>BUSINESS PLAN PREPARATION</b>    | <b>12</b>                |
| Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product - Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria. |                                     |                          |
| <b>UNIT IV</b>  | <b>LAUNCHING OF SMALL BUSINESS</b>  | <b>10</b>                |
| Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching - Incubation, Venture capital, IT startups.  |                                     |                          |
| <b>UNIT V</b>   | <b>MANAGEMENT OF SMALL BUSINESS</b> | <b>5</b>                 |
| Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business.   |                                     |                          |
|   |                                     | <b>TOTAL: 45 PERIODS</b> |

**OUTCOME:**

- Students will gain knowledge and skills needed to run a business.

**REFERENCES:**

1. Hisrich, Entrepreneurship, Edition 9, Tata McGraw Hill, New Delhi, 2014
2. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, (Revised Edition) 2013.
3. Mathew Manimala, Entrepreneurship Theory at the Crossroads, Paradigms & Praxis, Biztrantra, 2<sup>nd</sup> Edition ,2005
4. Prasanna Chandra, Projects - Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill, 1996.
5. P.Saravanavel, Entrepreneurial Development, Ess Pee kay Publishing House, Chennai 1997.
6. Arya Kumar. Entrepreneurship. Pearson, 2012.
7. Donald F Kuratko, T.V Rao. Entrepreneurship: A South Asian perspective. Cengage, 2012

**MF5075**

**INDUSTRIAL SAFETY**

**L T P C**  
**3 0 0 3**

**OBJECTIVE:**

To develop and strengthen the safety ideas and motivate the students to impart basic safety skills and understandings to run an industry efficiently and effectively

|               |                           |          |
|---------------|---------------------------|----------|
| <b>UNIT I</b> | <b>OPERATIONAL SAFETY</b> | <b>9</b> |
|---------------|---------------------------|----------|

Hot metal operation, boiler, pressure vessels - heat treatment shop - gas furnace operation - electroplating - hot bending pipes - safety in welding and cutting, Cold - metal operation - safety in machine shop - cold bending and chamfering of pipesmetal cutting - shot blasting, grinding, painting - power press and other machines. Management of toxic gases and chemicals - industrial fires and prevention - road safety - highway and urban safety - safety of sewage disposal and cleaning - control of environmental pollution - managing emergencies in industries - planning security and risk assessments, on - site and off site. Control of major industrial hazards.

|                |                                       |          |
|----------------|---------------------------------------|----------|
| <b>UNIT II</b> | <b>SAFETY APPRAISA L AND ANALYSIS</b> | <b>9</b> |
|----------------|---------------------------------------|----------|

Human side of safety - personal protective equipment - causes and cost of accidents. Accidents prevention program - specific hazard control strategies - HAZOP training and development of employees - first aid - fire fight devices - accident reporting, investigation. Measurement of safety performance, accident reporting and investigation - plant safety inspection, job safety analysis - safety permit procedures. Product safety - plant safety rules and procedures - safety sampling - safety inventory systems. Determining the cost effectiveness of safety measurement.

### UNIT III OCCUPATIONAL HEALTH

9

Concept and spectrum of health functional units and activities of operational health service - occupational and related disease - levels of prevention of diseases - notifiable occupational diseases Toxicology Lead - Nickel, chromium and manganese toxicity - gas poisoning (such as CO, Ammonia Chlorise, So<sub>2</sub>, H<sub>2</sub>s.) their effects and prevention - effects of ultra violet radiation and infrared radiation on human system.

### UNIT IV SAFETY AND HEALTH REGULATIONS

9

Safety and health standards - industrial hygiene - occupational diseases prevention welfare facilities. The object of factories act 1948 with special reference to safety provisions, model rules 123a, history of legislations related to safety - pressure vessel act - Indian boiler act - the environmental protection act - electricity act - explosive act.

### UNIT V SAFETY MANAGEMENT

9

Evaluation of modern safety concepts - safety management functions - safety organization, safety department- safety committee, safety audit - performance measurements and motivation - employee participation in safety - safety and productivity.

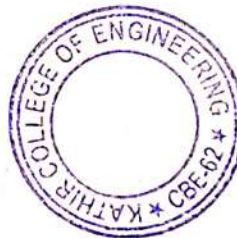
**TOTAL: 45 PERIODS**


### OUTCOME:

At the end of this course the students are expected to gain knowledge and skills needed to run an industry with utmost safety precautions.

### REFERENCES:

1. John V Grimaldi, Safety Management. AITB publishers, 2003.
2. John.V .Grimaldi and Rollin. H Simonds, "Safety Managenent", All India traveler book seller, New Delhi - 1989.
3. Krishnan N.V, "Safety in Industry", Jaico Publisher House, 1996.
4. Singh, U.K and Dewan, J.M., "Sagety, Security And Risk Management", APH publishing company, New Delhi, 1996.



  
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**ANNA UNIVERSITY, CHENNAI  
AFFILIATED INSTITUTIONS  
REGULATIONS – 2017  
CHOICE BASED CREDIT SYSTEM  
M.E. POWER ELECTRONICS AND DRIVES**

**PROGRAM EDUCATIONAL OUTCOMES**

**PEO1:** Graduates of this program will have technical knowledge, skills and ability to design, develop and test power electronic converters and drives using advanced tools.

**PEO2:** Graduates of this program will have skills and knowledge in the field of power electronics and drives to work in the design, fabrication industries and research organizations.

**PEO3:** Graduates of this program will show confidence and exhibit self-learning capability and demonstrate a pursuit in life-long learning through higher studies and research.

**PEO4:** Graduates of this program will show involvement and willingness in assuming responsibility in societal and environmental causes.

**PROGRAM OUTCOMES**

**PO1:** Acquire sound knowledge in power electronics and drives.

**PO2:** Analyse power electronics and drives related engineering problems and synthesize the information for conducting high level of research.

**PO3:** Think widely to offer creative and innovative solutions of engineering problems that are inconformity with social and environmental factors.

**PO4:** Extract the new methodologies by carrying out the literature survey, proper design and conduction of experiments, interpret and analyse the data to arrive at meaningful research methodologies in power electronics and drives.

**PO5:** Learn and apply modern engineering and IT tools to solve complex engineering problems related to power converters and electric drives.

**PO6:** Ability to form, understand group dynamics and work in inter-disciplinary groups in order to achieve the goal.

**PO7:** Ability to communicate effectively in appropriate technical forums and understand the concepts and ideas to prepare reports, to make effective presentations.

**PO8:** Ability to update knowledge and skills through lifelong learning to keep abreast with the technological developments.

**PO9:** Follow the professional and research ethics, comprehend the impact of research and responsibility in order to contribute to the society.

**PO10:** Understand the leadership principles and subject oneself to introspection and take voluntary remedial measures for effective professional practice in the field of power electronics and electric drives.

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|       | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 |
|-------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|
| PEO-1 | x       | x       | x       | x       | x       |         | X       | x       |         |          |
| PEO-2 | x       |         |         | x       | x       | x       | X       | x       | x       | x        |
| PEO-3 |         |         |         | x       | x       | x       |         | x       | x       |          |
| PEO-4 | x       | x       | x       |         |         |         |         |         | x       | x        |

**ANNA UNIVERSITY, CHENNAI**  
**AFFILIATED INSTITUTIONS**  
**REGULATIONS – 2017**  
**CHOICE BASED CREDIT SYSTEM**  
**M.E. POWER ELECTRONICS AND DRIVES (FULL TIME)**  
**CURRICULUM AND SYLLABUS I TO IV SEMESTERS**

**SEMESTER I**

| S.No              | COURSE CODE | COURSE TITLE                                 | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|--|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |  |          |                 |           |          |          |           |
| 1.                | MA5155      | Applied Mathematics for Electrical Engineers | FC       | 4               | 4         | 0        | 0        | 4         |
| 2.                | PX5101      | Power Semiconductor Devices                  | PC       | 3               | 3         | 0        | 0        | 3         |
| 3.                | PX5151      | Analysis of Electrical Machines              | PC       | 3               | 3         | 0        | 0        | 3         |
| 4.                | PX5152      | Analysis and Design of Power Converters      | PC       | 3               | 3         | 0        | 0        | 3         |
| 5.                | IN5152      | System Theory                                | PC       | 5               | 3         | 2        | 0        | 4         |
| 6.                |             | Professional Elective I                      | PE       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |  |          |                 |           |          |          |           |
| 7.                | PX5111      | Power Electronics Circuits Lab               | PC       | 4               | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>      |             |  |          | <b>25</b>       | <b>19</b> | <b>2</b> | <b>4</b> | <b>22</b> |

**SEMESTER II**

| S.No              | COURSE CODE | COURSE TITLE                     | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|----------------------------------|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |                                  |          |                 |           |          |          |           |
| 1.                | PX5201      | Analysis and Design of Inverters | PC       | 3               | 3         | 0        | 0        | 3         |
| 2.                | PX5202      | Solid State Drives               | PC       | 5               | 3         | 2        | 0        | 4         |
| 3.                | PX5251      | Special Electrical Machines      | PC       | 3               | 3         | 0        | 0        | 3         |
| 4.                | PX5252      | Power Quality                    | PC       | 3               | 3         | 0        | 0        | 3         |
| 5.                |             | Professional Elective II         | PE       | 3               | 3         | 0        | 0        | 3         |
| 6.                |             | Professional Elective III        | PE       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |                                  |          |                 |           |          |          |           |
| 7.                | PX5211      | Electrical Drives Laboratory     | PC       | 4               | 0         | 0        | 4        | 2         |
| 8.                | PX5212      | Mini Project                     | EEC      | 4               | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>      |             |                                  |          | <b>28</b>       | <b>18</b> | <b>2</b> | <b>8</b> | <b>23</b> |

**SEMESTER III**

| S.No              | COURSE CODE | COURSE TITLE             | CATEGORY | CONTACT PERIODS | L        | T        | P         | C         |
|-------------------|-------------|--------------------------|----------|-----------------|----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |                          |          |                 |          |          |           |           |
| 1.                |             | Professional Elective IV | PE       | 3               | 3        | 0        | 0         | 3         |
| 2.                |             | Professional Elective V  | PE       | 3               | 3        | 0        | 0         | 3         |
| 3.                |             | Professional Elective VI | PE       | 3               | 3        | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |                          |          |                 |          |          |           |           |
| 4.                | PX5311      | Project Work Phase I     | EEC      | 12              | 0        | 0        | 12        | 6         |
| <b>TOTAL</b>      |             |                          |          | <b>21</b>       | <b>9</b> | <b>0</b> | <b>12</b> | <b>15</b> |

**SEMESTER IV**

| SI.No             | COURSE CODE | COURSE TITLE          | CATEGORY | CONTACT PERIODS | L        | T        | P         | C         |
|-------------------|-------------|-----------------------|----------|-----------------|----------|----------|-----------|-----------|
| <b>PRACTICALS</b> |             |                       |          |                 |          |          |           |           |
| 1.                | PX5411      | Project Work Phase II | EEC      | 24              | 0        | 0        | 24        | 12        |
| <b>TOTAL</b>      |             |                       |          | <b>24</b>       | <b>0</b> | <b>0</b> | <b>24</b> | <b>12</b> |

**TOTAL NO. OF CREDITS: 72**

### FOUNDATION COURSES(FC)

| S.No | COURSE CODE | COURSE TITLE                                   | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|--|----------|-----------------|---|---|---|---|
| 1.   | MA5155      | Applied Mathematics for Electrical Engineering | FC       | 4               | 4 | 0 | 0 | 4 |

### PROFESSIONAL CORE(PC)

| S.No | COURSE CODE | COURSE TITLE                            | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|---|----------|-----------------|---|---|---|---|
| 1.   | PX5101      | Power Semiconductor Devices             | PC       | 3               | 3 | 0 | 0 | 3 |
| 2.   | PX5151      | Analysis of Electrical Machines         | PC       | 3               | 3 | 0 | 0 | 3 |
| 3.   | PX5152      | Analysis and Design of Power Converters | PC       | 3               | 3 | 0 | 0 | 3 |
| 4.   | PX5201      | Analysis and Design of Inverters        | PC       | 3               | 3 | 0 | 0 | 3 |
| 5.   | IN5152      | System Theory                           | PC       | 5               | 3 | 2 | 0 | 4 |
| 6.   | PX5202      | Solid State Drives                      | PC       | 5               | 3 | 2 | 0 | 4 |
| 7.   | PX5251      | Special Electrical Machines             | PC       | 3               | 3 | 0 | 0 | 3 |
| 8.   | PX5252      | Power Quality                           | PC       | 3               | 3 | 0 | 0 | 3 |
| 9.   | PX5111      | Power Electronics Circuits Lab          | PC       | 4               | 0 | 0 | 4 | 2 |
| 10.  | PX5211      | Electrical Drives Laboratory            | PC       | 4               | 0 | 0 | 4 | 2 |

### PROFESSIONAL ELECTIVES(PE)\*

#### Semester I Elective I

| S.No | COURSE CODE | COURSE TITLE                                    | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|---|----------|-----------------|---|---|---|---|
| 1.   | IN5091      | Soft Computing Techniques                       | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.   | PX5001      | Electromagnetic Field Computation and Modelling | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.   | PX5091      | Control System Design for Power Electronics     | PE       | 3               | 3 | 0 | 0 | 3 |

#### Semester II Elective II and III

| S.No | COURSE CODE | COURSE TITLE                   | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|--------------------------------|----------|-----------------|---|---|---|---|
| 1.   | PX5002      | Analog and Digital Controllers | PE       | 3               | 3 | 0 | 0 | 3 |

|    |        |  |    |   |   |   |   |   |
|----|--------|--|----|---|---|---|---|---|
| 2. | PX5003 | Flexible AC Transmission Systems               | PE | 3 | 3 | 0 | 0 | 3 |
| 3. | PX5004 | Modern Rectifiers and Resonant Converters      | PE | 3 | 3 | 0 | 0 | 3 |
| 4. | PX5092 | Electromagnetic Interference and Compatibility | PE | 3 | 3 | 0 | 0 | 3 |
| 5. | ET5091 | MEMS Technology                                | PE | 3 | 3 | 0 | 0 | 3 |
| 6. | PS5071 | Distributed Generation and Microgrid           | PE | 3 | 3 | 0 | 0 | 3 |

**Semester III**  
**Elective IV, V and VI**

| S.No | COURSE CODE | COURSE TITLE                                       | CATEGORY | CONTACT PERIODS | L | T | P | C |
|------|-------------|--|----------|-----------------|---|---|---|---|
| 1.   | PX5005      | High Voltage Direct Current Transmission           | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.   | PS5092      | Solar and Energy Storage Systems                   | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.   | PX5071      | Wind Energy Conversion Systems                     | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.   | PS5072      | Energy Management and Auditing                     | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.   | PS5073      | Electric Vehicles and Power Management             | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.   | PX5006      | Non Linear Dynamics for Power Electronics Circuits | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.   | PS5091      | Smart Grid   | PE       | 3               | 3 | 0 | 0 | 3 |
| 8.   | PX5072      | Power Electronics for Renewable Energy Systems     | PE       | 3               | 3 | 0 | 0 | 3 |
| 9.   | IN5079      | Robotics and Control                               | PE       | 3               | 3 | 0 | 0 | 3 |
| 10.  | PX5007      | Non Linear Control                                 | PE       | 3               | 3 | 0 | 0 | 3 |

**Professional Electives are grouped according to elective number as was done previously.**

**EMPLOYABILITY ENHANCEMENT COURSES(EEC)**

| S.No | COURSE CODE | COURSE TITLE          | CATEGORY | CONTACT PERIODS | L | T | P  | C  |
|------|-------------|-----------------------|----------|-----------------|---|---|----|----|
| 1.   | PX5212      | Mini Project          | EEC      | 4               | 0 | 0 | 4  | 2  |
| 2.   | PX5311      | Project Work Phase I  | EEC      | 12              | 0 | 0 | 12 | 6  |
| 3.   | PX5411      | Project Work Phase II | EEC      | 24              | 0 | 0 | 24 | 12 |



**MA5155**

**APPLIED MATHEMATICS FOR ELECTRICAL ENGINEERS**

**L T P C**  
**4 0 0 4**

**OBJECTIVES :**

The main objective of this course is to demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving and logical thinking applicable for the students of electrical engineering. This course also will help the students to identify, formulate, abstract, and solve problems in electrical engineering using mathematical tools from a variety of mathematical areas, including matrix theory, calculus of variations, probability, linear programming and Fourier series.

**UNIT I      MATRIX THEORY**

**12**

Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR Factorization - Least squares method - Singular value decomposition.

**UNIT II      CALCULUS OF VARIATIONS**

**12**

Concept of variation and its properties – Euler’s equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems - Direct methods : Ritz and Kantorovich methods.

**UNIT III      PROBABILITY AND RANDOM VARIABLES**

**12**

Probability – Axioms of probability – Conditional probability – Baye’s theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

**UNIT IV      LINEAR PROGRAMMING**

**12**

Formulation – Graphical solution – Simplex method – Big M method - Two phase method - Transportation and Assignment models.

**UNIT V      FOURIER SERIES**

**12**

Fourier trigonometric series : Periodic function as power signals – Convergence of series – Even and odd function : Cosine and sine series – Non periodic function : Extension to other intervals - Power signals : Exponential Fourier series – Parseval’s theorem and power spectrum – Eigenvalue problems and orthogonal functions – Regular Sturm - Liouville systems – Generalized Fourier series.

**TOTAL : 60 PERIODS**

**OUTCOMES :**

After completing this course, students should demonstrate competency in the following skills:

- Apply various methods in matrix theory to solve system of linear equations.
- Maximizing and minimizing the functional that occur in electrical engineering discipline.
- Computation of probability and moments, standard distributions of discrete and continuous random variables and functions of a random variable.
- Could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems.

- Fourier series analysis and its uses in representing the power signals.

**REFERENCES :**

1. Andrews L.C. and Phillips R.L., "Mathematical Techniques for Engineers and Scientists", Prentice Hall of India Pvt. Ltd., New Delhi, 2005.
2. Bronson, R. "Matrix Operation", Schaum's outline series, 2<sup>nd</sup> Edition, McGraw Hill, 2011.
3. Elsgolc, L. D. "Calculus of Variations", Dover Publications, New York, 2007.
4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8<sup>th</sup> Edition, 2015.
5. O'Neil, P.V., "Advanced Engineering Mathematics", Thomson Asia Pvt. Ltd., Singapore, 2003.
6. Taha, H.A., "Operations Research, An Introduction", 9<sup>th</sup> Edition, Pearson education, New Delhi, 2016.

|               |                                    |          |          |          |          |
|---------------|------------------------------------|----------|----------|----------|----------|
| <b>PX5101</b> | <b>POWER SEMICONDUCTOR DEVICES</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                    | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To improve power semiconductor device structures for adjustable speed motor control applications.
- To understand the static and dynamic characteristics of current controlled power semiconductor devices
- To understand the static and dynamic characteristics of voltage controlled power semiconductor devices
- To enable the students for the selection of devices for different power electronics applications
- To understand the control and firing circuit for different devices.

**UNIT I INTRODUCTION 9**

Power switching devices overview – Attributes of an ideal switch, application requirements, circuit symbols; Power handling capability – (SOA); Device selection strategy – On-state and switching losses – EMI due to switching - Power diodes - Types, forward and reverse characteristics, switching characteristics – rating.

**UNIT II CURRENT CONTROLLED DEVICES 9**

BJT's – Construction, static characteristics, switching characteristics; Negative temperature coefficient and second breakdown; - Thyristors – Physical and electrical principle underlying operating mode, Two transistor analogy – concept of latching; Gate and switching characteristics; converter grade and inverter grade and other types; series and parallel operation; comparison of BJT and Thyristor – steady state and dynamic models of BJT & Thyristor- Basics of GTO, MCT, FCT, RCT

**UNIT III VOLTAGE CONTROLLED DEVICES 9**

Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types, static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs - and IGCT. New semiconductor materials for devices – Intelligent power modules- Integrated gate commutated thyristor (IGCT) - Comparison of all power devices.

**UNIT IV FIRING AND PROTECTING CIRCUITS 9**

Necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET, IGBTs and base driving for power BJT. - Over voltage, over current and gate protections; Design of snubbers.

**UNIT V THERMAL PROTECTION 9**

Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phase cooling; Guidance for heat sink selection – Thermal resistance and impedance -Electrical analogy of thermal components, heat sink types and design – Mounting types- switching loss calculation for power device.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to determine the suitable device for the application.
- Ability to design of semiconductor device and its parameters.
- Ability to design of protection circuits and control circuits
- Ability to determine the reliability of the system.

**REFERENCES**

1. B.W Williams ‘Power Electronics Circuit Devices and Applications’..
2. Rashid M.H., " Power Electronics Circuits, Devices and Applications ", Prentice Hall India, Third Edition, New Delhi, 2004
3. MD Singh and K.B Khanchandani, “Power Electronics”, Tata McGraw Hill, 2001.
4. Mohan, Undeland and Robins, “Power Electronics – Concepts, applications and Design, John Wiley and Sons, Singapore, 2000.
5. Joseph Vithayathil, Power Electronics: Principles and Applications, Delhi, Tata McGraw-Hill, 2010.

**PX5151 ANALYSIS OF ELECTRICAL MACHINES L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To provide knowledge about the fundamentals of magnetic circuits, energy, force and torque of multi-excited systems.
- To analyze the steady state and dynamic state operation of DC machine through mathematical modeling and simulation in digital computer.
- To provide the knowledge of theory of transformation of three phase variables to two phase variables.
- To analyze the steady state and dynamic state operation of three-phase induction machines using transformation theory based mathematical modeling and digital computer simulation.
- To analyze the steady state and dynamic state operation of three-phase synchronous machines using transformation theory based mathematical modeling and digital computer simulation.

**UNIT I PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION 9**

Magnetic circuits, permanent magnet, stored magnetic energy, co-energy - force and torque in singly and doubly excited systems – machine windings and air gap mmf - winding inductances and voltage equations.

**UNIT II DC MACHINES 9**

Elementary DC machine and analysis of steady state operation - Voltage and torque equations – dynamic characteristics of permanent magnet and shunt d.c. motors – Time domain block diagrams - solution of dynamic characteristic by Laplace transformation – digital computer simulation of permanent magnet and shunt D.C. machines.

**UNIT III REFERENCE FRAME THEORY 9**

Historical background – phase transformation and commutator transformation – transformation of variables from stationary to arbitrary reference frame - variables observed from several frames of reference.

**UNIT IV INDUCTION MACHINES 9**

Three phase induction machine, equivalent circuit and analysis of steady state operation – free acceleration characteristics – voltage and torque equations in machine variables and arbitrary reference frame variables – analysis of dynamic performance for load torque variations – digital computer simulation.

**UNIT V SYNCHRONOUS MACHINES 9**

Three phase synchronous machine and analysis of steady state operation - voltage and torque equations in machine variables and rotor reference frame variables (Park's equations) – analysis of dynamic performance for load torque variations – Generalized theory of rotating electrical machine and Krons primitive machine.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Ability to understand the various electrical parameters in mathematical form.
- Ability to understand the different types of reference frame theories and transformation relationships.
- Ability to find the electrical machine equivalent circuit parameters and modeling of electrical machines.

**REFERENCES**

1. Paul C.Krause, Oleg Waszczuk, Scott S, Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley, Second Edition, 2010..
2. P S Bimbhra, "Generalized Theory of Electrical Machines", Khanna Publishers, 2008
3. A.E, Fitzgerald, Charles Kingsley, Jr, and Stephan D, Umanx, " Electric Machinery", Tata McGraw Hill, 5th Edition, 1992
4. R. Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, New Delhi, Prentice Hall of India, 2001

**PX5152 ANALYSIS AND DESIGN OF POWER CONVERTERS L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To determine the operation and characteristics of controlled rectifiers.
- To apply switching techniques and basic topologies of DC-DC switching regulators.
- To introduce the design of power converter components.
- To provide an in depth knowledge about resonant converters.
- To comprehend the concepts of AC-AC power converters and their applications.

**UNIT I SINGLE PHASE & THREE PHASE CONVERTERS 9**

Principle of phase controlled converter operation – single-phase full converter and semi-converter (RL,RLE load)- single phase dual converter – Three phase operation full converter and semi-converter (R,RL,RLE load) – reactive power – power factor improvement techniques –PWM rectifiers.

**UNIT II DC-DC CONVERTERS 9**

Limitations of linear power supplies, switched mode power conversion, Non-isolated DC-DC converters: operation and analysis of Buck, Boost, Buck-Boost, Cuk & SEPIC – under continuous and discontinuous operation – Isolated converters: basic operation of Flyback, Forward and Push-pull topologies.

**UNIT III DESIGN OF POWER CONVERTER COMPONENTS 9**

Introduction to magnetic materials- hard and soft magnetic materials –types of cores , copper windings – Design of transformer –Inductor design equations –Examples of inductor design for buck/flyback converter-selection of output filter capacitors – selection of ratings for devices – input filter design.

**UNIT IV RESONANT DC-DC CONVERTERS 9**

Switching loss, hard switching, and basic principles of soft switching- classification of resonant converters- load resonant converters – series and parallel – resonant switch converters – operation and analysis of ZVS, ZCS converters comparison of ZCS/ZVS- Introduction to ZVT/ZCT PWM converters.

**UNIT V AC-AC CONVERTERS 9**

Principle of on-off and phase angle control – single phase ac voltage controller – analysis with R & RL load – Three phase ac voltage controller – principle of operation of cyclo converter – single phase and three phase cyclo converters – Introduction to matrix converters.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

At the end of the course the student will be able to:

- Analyze various single phase and three phase power converters
- Select and design dc-dc converter topologies for a broad range of power conversion applications.
- Develop improved power converters for any stringent application requirements.
- Design ac-ac converters for variable frequency applications.

**TEXT BOOKS:**

- 1 Ned Mohan, T.M. Undeland and W.P. Robbins, "Power Electronics: converters, Application and design" John Wiley and sons. Wiley India edition, 2006.
- 2 Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, Third Edition, New Delhi, 2004.
- 3 P.C. Sen, "Modern Power Electronics", Wheeler Publishing Co, First Edition, New Delhi, 1998.
- 4 P.S. Bimbra, "Power Electronics", Khanna Publishers, Eleventh Edition, 2003
- 5 Simon Ang, Alejandro Oliva, "Power-Switching Converters, Second Edition, CRC Press, Taylor & Francis Group, 2010
- 6 V. Ramanarayanan, "Course material on Switched mode power conversion", 2007
- 7 Alex Van den Bossche and Vencislav Cekov Valchev, "Inductors and Transformers for Power Electronics", CRC Press, Taylor & Francis Group, 2005
- 8 W. G. Hurley and W. H. Wolfle, "Transformers and Inductors for Power Electronics Theory, Design and Applications", 2013 John Wiley & Sons Ltd.
- 9 Marian. K. Kazimierczuk and Dariusz Czarkowski, "Resonant Power Converters", John Wiley & Sons limited, 2011

**OBJECTIVES:**

- To understand the fundamentals of physical systems in terms of its linear and nonlinear models.
- To educate on representing systems in state variable form
- To educate on solving linear and non-linear state equations
- To exploit the properties of linear systems such as controllability and observability
- To educate on stability analysis of systems using Lyapunov's theory
- To educate on modal concepts and design of state and output feedback controllers and estimators

**UNIT I STATE VARIABLE REPRESENTATION 9**  
 Introduction-Concept of State-State equations for Dynamic Systems -Time invariance and linearity- Non uniqueness of state model- Physical Systems and State Assignment - free and forced responses- State Diagrams.

**UNIT II SOLUTION OF STATE EQUATIONS 9**  
 Existence and uniqueness of solutions to Continuous-time state equations - Solution of Nonlinear and Linear Time Varying State equations - State transition matrix and its properties – Evaluation of matrix exponential- System modes- Role of Eigen values and Eigen vectors.

**UNIT III STABILITY ANALYSIS OF LINEAR SYSTEMS 9**  
 Controllability and Observability definitions and Kalman rank conditions -Stabilizability and Detectability-Test for Continuous time Systems- Time varying and Time invariant case-Output Controllability-Reducibility- System Realizations.

**UNIT IV STATE FEEDBACK CONTROL AND STATE ESTIMATOR 9**  
 Introduction-Controllable and Observable Companion Forms-SISO and MIMO Systems- The Effect of State Feedback on Controllability and Observability-Pole Placement by State Feedback for both SISO and MIMO Systems-Full Order and Reduced Order Observers.

**UNIT V LYAPUNOV STABILITY ANALYSIS 9**  
 Introduction-Equilibrium Points- BIBO Stability-Stability of LTI Systems- Stability in the sense of Lyapunov - Equilibrium Stability of Nonlinear Continuous-Time Autonomous Systems-The Direct Method of Lyapunov and the Linear Continuous-Time Autonomous Systems-Finding Lyapunov Functions for Nonlinear Continuous-Time Autonomous Systems – Krasovskil's and Variable-Gradient Method.

**TOTAL : 45+30 = 75 PERIODS**

**OUTCOMES:**

- Ability to represent the time-invariant systems in state space form as well as analyze, whether the system is stabilizable, controllable, observable and detectable.
- Ability to design state feedback controller and state observers
- Ability to classify singular points and construct phase trajectory using delta and isocline methods.
- Use the techniques such as describing function, Lyapunov Stability, Popov's Stability Criterion and Circle Criterion to assess the stability of certain class of non-linear system.
- Ability to describe non-linear behaviors such as Limit cycles, input multiplicity and output multiplicity, Bifurcation and Chaos.

**TEXT BOOKS:**

1. M. Gopal, "Modern Control System Theory", New Age International, 2005.
2. K. Ogatta, "Modern Control Engineering", PHI, 2002.
3. John S. Bay, "Fundamentals of Linear State Space Systems", McGraw-Hill, 1999.
4. D. Roy Choudhury, "Modern Control Systems", New Age International, 2005.
5. John J. D'Azzo, C. H. Houpis and S. N. Sheldon, "Linear Control System Analysis and Design with MATLAB", Taylor Francis, 2003.
6. Z. Bubnicki, "Modern Control Theory", Springer, 2005.
7. C.T. Chen, "Linear Systems Theory and Design" Oxford University Press, 3rd Edition, 1999.
8. M. Vidyasagar, "Nonlinear Systems Analysis", 2nd edition, Prentice Hall, Englewood Cliffs, New Jersey.

**PX5111                      POWER ELECTRONIC CIRCUITS LABORATORY                      L   T   P   C**  
**0   0   4   2**

**OBJECTIVES**

- To provide an insight on the switching behaviours of power electronic switches
- To make the students familiar with the digital tools used in generation of gate pulses for the power electronic switches
- To make the students capable of implementing analog interfacing as well as control circuits used in a closed-loop control for power electronic system
- To make the students acquire knowledge on mathematical modeling of power electronic circuits and implementing the same using simulation tools
- To facilitate the students to design and fabricate a power converter circuits at appreciable voltage/power levels
- To develop skills on PCB design and fabrication among the students

**LIST OF EXPERIMENTS**

1. Study of switching characteristics of Power electronic switches with and without Snubber (i) IGBT (ii) MOSFET
2. Modeling and system simulation of basic electric circuits using MATLAB-SIMULINK/SCILAB
3. DC source fed resistive load and Resistive-inductive load
4. DC source fed RLC load for different damping conditions
5. DC source fed DC motor load
6. Modeling and System simulation of basic power electronic circuits using MATLAB-SIMULINK/SCILAB
7. AC Source with Single Diode fed Resistive and Resistive-Inductive Load
8. AC source with Single SCR fed Resistive and Resistive-Inductive Load
9. Modeling and System Simulation of SCR based full converter with different types of load using MATLAB-Simulink/SCILAB
10. Full converter fed resistive load
11. Full converter fed Resistive-Back Emf (RE) load at different firing angles
12. Full Converter fed Resistive-Inductive Load at different firing angles
13. Full converter fed DC motor load at different firing angles
14. Circuit Simulation of Voltage Source Inverter and study of spectrum analysis with and without filter using MATLAB/SCILAB

15. Single phase square wave inverter
16. Three phase sine PWM inverter
17. Generation of PWM gate pulses with duty cycle control using PWM peripheral of microcontroller ( TI-C2000 family/ PIC18)
18. Duty cycle control from IDE
19. Duty Cycle control using a POT connected to ADC peripheral in a standalone mode
20. Generation of Sine-PWM pulses for a three phase Voltage Source Inverter with control of modulation index using PWM peripheral of microcontroller (TI C2000 family/PIC 18)
21. Design of Driver Circuit using IR2110
22. Design and testing of signal conditioning circuit to interface voltage/current sensor with microcontroller (TI-C2000 family/ PIC18)
23. Interface Hall effect current sensor with microcontroller and display the current waveform in the IDE and validate with actual waveform in DSO
24. Interface Hall effect Voltage sensor with microcontroller and display the current waveform in the IDE and validate with actual waveform in DSO
25. Design of PI controller using OP-AMP
26. Construction and testing of 500 W, 220 V IGBT based Buck converter with control circuit and its performance Evaluation
27. Measurement of Efficiency at different duty cycle with a resistive load
28. Measurement of Efficiency at different duty cycle with a resistive-inductive load
29. PCB design and fabrication of DC power supply using any PCB design software (open source- KiCAD/students version)

**TOTAL: 60 PERIODS**

#### **COURSE OUTCOMES**

- Comprehensive understanding on the switching behaviour of Power Electronic Switches
- Comprehensive understanding on mathematical modeling of power electronic system and ability to implement the same using simulation tools
- Ability of the student to use microcontroller and its associated IDE\* for power electronic applications
- Ability of the student to design and implement analog circuits for Power electronic control applications
- Ability to design and fabricate a power converter circuit at a reasonable power level
- Exposure to PCB designing and fabrication
- \* IDE – Integrate Development Environment (Code Composer Studio for Texas Instrument/MPLAB for PIC microcontrollers etc)



|               |   |          |          |          |          |
|---------------|---|----------|----------|----------|----------|
| <b>PX5201</b> | <b>ANALYSIS AND DESIGN OF INVERTERS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To Provide the electrical circuit concepts behind the different working modes of inverters so as to enable deep understanding of their operation.
- To equip with required skills to derive the criteria for the design of inverters for UPS, drives etc.,
- To analyse and comprehend the various operating modes of different configurations of inverters.
- To design different single phase and three phase inverters.
- To impart knowledge on multilevel inverters and modulation techniques

**UNIT I SINGLE PHASE INVERTERS 9**

Principle of operation of half and full bridge inverters – Performance parameters – Voltage control of single phase inverters using various PWM techniques – various harmonic elimination techniques – forced commutated thyristor inverters

**UNIT II THREE PHASE VOLTAGE SOURCE INVERTERS 9**

180 degree and 120 degree conduction mode inverters with star and delta connected loads – voltage control of three phase inverters: single, multi pulse, sinusoidal, space vector modulation techniques – Application to drive system

**UNIT III CURRENT SOURCE INVERTERS 9**

Operation of six-step thyristor inverter – inverter operation modes – load – commutated inverters – Auto sequential current source inverter (ASCI) – current pulsations – comparison of current source inverter and voltage source inverters – PWM techniques for current source inverters.

**UNIT IV MULTILEVEL & BOOST INVERTERS 9**

Multilevel concept – diode clamped – flying capacitor – cascade type multilevel inverters - Comparison of multilevel inverters - application of multilevel inverters – PWM techniques for MLI – Single phase & Three phase Impedance source inverters .

**UNIT V RESONANT INVERTERS AND POWER CONDITIONERS 9**

Series and parallel resonant inverters - voltage control of resonant inverters – Class E resonant inverter – resonant DC - link inverters.-power line disturbances-power conditioners-UPS: offline UPS, online UPS.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

Students

- Will get expertise in the working modes and operation of inverters
- Will be able to design single phase and three phase inverters
- Will equip skills to formulate and design the inverters for generic loads and machine loads
- Will acquire knowledge on multilevel inverters and modulation techniques

**TEXT BOOKS:**

- 1 Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Prentice Hall India, Third Edition, New Delhi, 2004.
- 2 Jai P.Agrawal, "Power Electronics Systems", Pearson Education, Second Edition, 2002
- 3 BimalK.Bose "Modern Power Electronics and AC Drives", Pearson Education, Second Edition, 2003.



**TOTAL : 45+30 = 75 PERIODS**

**OUTCOMES:**

Students,

- Will be able to formulate, design and analyze power supplies for generic loads and machine loads.
- Will acquire knowledge on the operation of VSI and CSI fed induction motor drives.
- Will get expertise in the field oriented control of Induction motor drives.
- Will be able to formulate the control schemes for synchronous motor drives.

**REFERENCES:**

- 1 P.C Sen "Thyristor DC Drives", John Wiley and sons, New York, 1981
- 2 Gopal K Dubey, "Power Semiconductor controlled Drives", Prentice Hall Inc., New Jersey, 1989
- 3 Gopal K.Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, Second Edition ,2009
- 4 Bimal K Bose, "Modern Power Electronics and AC Drives", Pearson Education Asia 2002.
- 5 R.Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2010.
- 6 VedamSubramanyam, "Electric Drives – Concepts and Applications", Tata McGraw-Hill publishing company Ltd., New Delhi, 2002
- 7 W.L Leonhard, "Control of Electrical Drives", Narosa Publishing House, 1992
- 8 Murphy J.M.D and Turnbull, "Thyristor Control of AC Motors", Pergamon Press, Oxford, 1988.

|               |                                    |          |          |          |          |
|---------------|------------------------------------|----------|----------|----------|----------|
| <b>PX5251</b> | <b>SPECIAL ELECTRICAL MACHINES</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                    | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To review the fundamental concepts of permanent magnets and the operation of permanent magnet brushless DC motors.
- To introduce the concepts of permanent magnet brushless synchronous motors and synchronous reluctance motors.
- To develop the control methods and operating principles of switched reluctance motors.
- To introduce the concepts of stepper motors and its applications.
- To understand the basic concepts of other special machines

**UNIT I PERMANENT MAGNET BRUSHLESS DC MOTORS 9**  
Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis EMF and Torque equations- Characteristics and control

**UNIT II PERMANENT MAGNET SYNCHRONOUS MOTORS 9**  
Principle of operation – EMF and Torque equations - Phasor diagram - Power controllers – Torque speed characteristics – Digital controllers – Constructional features, operating principle and characteristics of synchronous reluctance motor.

**UNIT III SWITCHED RELUCTANCE MOTORS 9**  
Constructional features –Principle of operation- Torque prediction–Characteristics-Power controllers – Control of SRM drive- Sensorless operation of SRM – Applications.

**UNIT IV STEPPER MOTORS 9**

Constructional features –Principle of operation –Types – Torque predictions – Linear and Non-linear analysis – Characteristics – Drive circuits – Closed loop control –Applications.

**UNIT V OTHER SPECIAL MACHINES 9**

Principle of operation and characteristics of Hysteresis motor – AC series motors – Linear motor – Applications.

**TOTAL : 45 PERIODS****OUTCOMES:**

- Understand the open loop and closed loop systems stepper motors.
- Understanding the classifications and characteristics of special machines
- Understanding of the control methods of special motors.
- Ability to select the suitable motor for a certain job under given conditions

**REFERENCES**

1. T.J.E. Miller, 'Brushless magnet and Reluctance motor drives', Claredon press, London, 1989.
2. R.Krishnan, ' Switched Reluctance motor drives' , CRC press, 2001.
3. T.Kenjo, ' Stepping motors and their microprocessor controls', Oxford University press, New Delhi, 2000
4. T.Kenjo and S.Nagamori, 'Permanent magnet and Brushless DC motors', Clarendon press, London, 1988
5. R.Krishnan, ' Electric motor drives' , Prentice hall of India,2002.
6. D.P.Kothari and I.J.Nagrath, ' Electric machines', Tata Mc Graw hill publishing company, New Delhi, Third Edition, 2004.
7. Irving L.Kosow, "Electric Machinery and Transformers" Pearson Education, Second Edition, 2007.

**PX5252****POWER QUALITY****L T P C  
3 0 0 3****OBJECTIVES:**

- To understand the various power quality issues.
- To understand the concept of power and power factor in single phase and three phase systems supplying nonlinear loads.
- To understand the conventional compensation techniques used for power factor correction and load voltage regulation.
- To understand the active compensation techniques used for power factor correction.
- To understand the active compensation techniques used for load voltage regulation.

**UNIT I INTRODUCTION 9**

Introduction – Characterisation of Electric Power Quality: Transients, short duration and long duration voltage variations, Voltage imbalance, waveform distortion, Voltage fluctuations, Power frequency variation, Power acceptability curves – power quality problems: poor load power factor, Non linear and unbalanced loads, DC offset in loads, Notching in load voltage, Disturbance in supply voltage – Power quality standards.

**UNIT II ANALYSIS OF SINGLE PHASE AND THREE PHASE SYSTEM 9**

Single phase sinusoidal, non sinusoidal source supplying linear and nonlinear loads – Three phase Balance system – Three phase unbalanced system – Three phase unbalanced and distorted source supplying non linear loads – Concept of PF – Three phase three wire – Three

phase four wire system.

**UNIT III CONVENTIONAL LOAD COMPENSATION METHODS 9**

Principle of Load compensation and Voltage regulation – Classical load balancing problem : Open loop balancing – Closed loop balancing, Current balancing – Harmonic reduction and voltage sag reduction – Analysis of unbalance – instantaneous real and reactive powers – Extraction of fundamental sequence component.

**UNIT IV LOAD COMPENSATION USING DSTATCOM 9**

Compensating single phase loads – Ideal three phase shunt compensator structure – Generating reference currents using instantaneous PQ theory – Instantaneous symmetrical components theory – Generating reference currents when the source is unbalanced – Realization and control of DSTATCOM – DSTATCOM in Voltage control mode.

**UNIT V SERIES COMPENSATION OF POWER DISTRIBUTION SYSTEM 9**

Rectifier supported Dynamic Voltage Restorer – DC Capacitor supported DVR – DVR Structure – voltage Restoration – Series Active Filter – Unified Power Quality Conditioner.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to formulate, design and simulate power supplies for generic load and machine loads.
- Ability to conduct harmonic analysis and load tests on power supplies and drive systems.
- Ability to understand and design load compensation methods useful for mitigating power quality problems.

**TEXT BOOKS:**

- 1 Arindam Ghosh “Power Quality Enhancement Using Custom Power Devices”, Kluwer Academic Publishers, 2002
- 2 R.C. Duggan, Mark.F.McGranaghan, Surya Santoas and H.Wayne Beaty, “Electrical Power System Quality”, McGraw-Hill, 2004.
- 3 G.T.Heydt, “Electric Power Quality”, Stars in a Circle Publications, 1994.  
Bhim Singh, Ambrish Chandra, Kamal Al-Haddad , “Power Quality: Problems and
- 4 Mitigation Techniques”, John Wiley & Sons, 2015.

**REFERENCES**

- 1 Jos Arrillaga and Neville R. Watson , “ Power system harmonics”, Wiley, 2003.  
Derek A. Paice , “Power Electronics Converter Harmonics : Multipulse Methods for Clean
- 2 Power”, Wiley, 1999.  
Ewald Fuchs, Mohammad A. S. Masoum Power Quality in Power Systems and Electrical
- 3 Machines, Elsevier academic press publications, 2011.

PX5211

**ELECTRICAL DRIVES LABORATORY**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>0</b> | <b>0</b> | <b>4</b> | <b>2</b> |

**OBJECTIVES:**

To impart the theoretical and practical knowledge on

- To design and analyse the various DC and AC drives.
- To generate the firing pulses for converters and inverters using digital processors
- Design of controllers for linear and nonlinear systems
- Implementation of closed loop system using hardware simulation

## LIST OF EXPERIMENTS

1. Speed control of Converter fed DC motor.
2. Speed control of Chopper fed DC motor.
3. V/f control of three-phase induction motor.
4. Micro controller based speed control of Stepper motor.
5. Speed control of BLDC motor.
6. DSP based speed control of SRM motor.
7. Voltage Regulation of three-phase Synchronous Generator.
8. Cycloconverter fed Induction motor drives
9. Single phase Multi Level Inverter based induction motor drive
10. Study of power quality analyzer

**TOTAL: 60 PERIODS**

## OUTCOMES:

- Ability to simulate different types of machines, converters in a system.
- Analyze the performance of various electric drive systems.
- Ability to perform both hardware and software simulation.

**PX5212**

**MINI PROJECT**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 4 | 2 |

## OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

## A project to be developed based on one or more of the following concepts.

1. Rectifiers, DC-DC Converters, Inverters, cycloconverters, DC drives, AC drives, Special Electrical Machines, Renewable Energy Systems, Linear and non-linear control systems, Power supply design for industrial and other applications, AC-DC power factor circuits, micro grid, smart grid and robotics.

**TOTAL: 60 PERIODS**

## OUTCOMES:

- Acquire practical knowledge within the chosen area of technology for project development
- Identify, analyze, formulate and handle programming projects with a comprehensive and systematic approach
- Contribute as an individual or in a team in development of technical projects
- Develop effective communication skills for presentation of project related activities

**IN5091**

**SOFT COMPUTING TECHNIQUES**

|          |          |          |          |
|----------|----------|----------|----------|
| <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To expose the concepts of feed forward neural networks.
- To provide adequate knowledge about feed back neural networks.
- To teach about the concept of fuzziness involved in various systems.
- To expose the ideas about genetic algorithm
- To provide adequate knowledge about of FLC and NN toolbox

**UNIT I INTRODUCTION AND ARTIFICIAL NEURAL NETWORKS 9**

Introduction to intelligent systems- Soft computing techniques- Conventional Computing versus Swarm Computing - Classification of meta-heuristic techniques - Properties of Swarm intelligent Systems - Application domain - Discrete and continuous problems - Single objective and multi-objective problems -Neuron- Nerve structure and synapse- Artificial Neuron and its model- activation functions- Neural network architecture- single layer and multilayer feed forward networks- Mc Culloch Pitts neuron model- perceptron model- Adaline and Madaline- multilayer perception model- back propagation learning methods- effect of learning rule coefficient -back propagation algorithm- factors affecting back propagation training- applications.

**UNIT II ARTIFICIAL NEURAL NETWORKS AND ASSOCIATIVE MEMORY 9**

Counter propagation network- architecture- functioning & characteristics of counter Propagation network- Hopfield/ Recurrent network configuration - stability constraints associative memory and characteristics- limitations and applications- Hopfield v/s Boltzman machine- Adaptive Resonance Theory- Architecture- classifications- Implementation and training - Associative Memory.

**UNIT III FUZZY LOGIC SYSTEM 9**

Introduction to crisp sets and fuzzy sets- basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control- Fuzzification inferencing and defuzzification-Fuzzy knowledge and rule bases-Fuzzy modeling and control schemes for nonlinear systems. Self organizing fuzzy logic control- Fuzzy logic control for nonlinear time delay system.

**UNIT IV GENETIC ALGORITHM 9**

Evolutionary programs – Genetic algorithms, genetic programming and evolutionary programming - Genetic Algorithm versus Conventional Optimization Techniques - Genetic representations and selection mechanisms; Genetic operators- different types of crossover and mutation operators - Optimization problems using GA-discrete and continuous - Single objective and multi-objective problems - Procedures in evolutionary programming.

**UNIT V HYBRID CONTROL SCHEMES 9**

Fuzzification and rule base using ANN–Neuro fuzzy systems-ANFIS – Fuzzy Neuron - Optimization of membership function and rule base using Genetic Algorithm –Introduction to Support Vector Machine- Evolutionary Programming-Particle Swarm Optimization - Case study – Familiarization of NN, FLC and ANFIS Tool Box.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Will be able to know the basic ANN architectures, algorithms and their limitations.
- Also will be able to know the different operations on the fuzzy sets.
- Will be capable of developing ANN based models and control schemes for non-linear

system.

- Will get expertise in the use of different ANN structures and online training algorithm.
- Will be knowledgeable to use Fuzzy logic for modeling and control of non-linear systems.
- Will be competent to use hybrid control schemes and P.S.O and support vector Regressive.

**TEXT BOOKS:**

1. Laurene V. Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms And Applications", Pearson Education.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications" Wiley India, 2008.
3. Zimmermann H.J. "Fuzzy set theory and its Applications" Springer international edition, 2011.
4. David E. Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, 2009.
5. W.T. Miller, R.S. Sutton and P.J. Webrose, "Neural Networks for Control" MIT Press", 1996.
6. T. Ross, "Fuzzy Logic with Engineering Applications", Tata McGraw Hill, New Delhi, 1995.
7. Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation and Machine Learning Series)", MIT Press, 2004.
8. Corinna Cortes and V. Vapnik, " Support - Vector Networks, Machine Learning " 1995.

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|---------------|--|----------|----------|----------|----------|
| <b>PX5001</b> | <b>ELECTROMAGNETIC FIELD COMPUTATION AND MODELLING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To refresh the fundamentals of Electromagnetic Field Theory.
- To provide foundation in formulation and computation of Electromagnetic Fields using analytical and numerical methods.
- To impart in-depth knowledge on Finite Element Method in solving Electromagnetic field problems.
- To introduce the concept of mathematical modeling and design of electrical apparatus.

**UNIT I INTRODUCTION 9**  
Review of basic field theory – Maxwell's equations – Constitutive relationships and Continuity equations – Laplace, Poisson and Helmholtz equation – principle of energy conversion – force/torque calculation.

**UNIT II BASIC SOLUTION METHODS FOR FIELD EQUATIONS 9**  
Limitations of the conventional design procedure, need for the field analysis based design, problem definition, boundary conditions, solution by analytical methods-direct integration method – variable separable method – method of images, solution by numerical methods- Finite Difference Method.

**UNIT III FORMULATION OF FINITE ELEMENT METHOD (FEM) 9**  
Variational Formulation – Energy minimization – Discretization – Shape functions –Stiffness matrix –1D and 2D planar and axial symmetry problems.

**UNIT IV COMPUTATION OF BASIC QUANTITIES USING FEM PACKAGES 9**  
Basic quantities – Energy stored in Electric Field – Capacitance – Magnetic Field – Linked Flux – Inductance – Force – Torque – Skin effect – Resistance.

**UNIT V DESIGN APPLICATIONS 9**



**OUTCOMES:**

- Understand the concepts of electromagnetic.
- Ability to formulate the FEM method and use of the package
- Apply the concepts in the design of rotating machines

**REFERENCES**

1. Matthew. N.O. Sadiku, “Elements of Electromagnetics”, Fourth Edition, Oxford University Press, First Indian Edition 2007
2. K.J.Binns, P.J.Lawrenson, C.W Trowbridge, “The analytical and numerical solution of Electric and magnetic fields”, John Wiley & Sons, 1993.
3. Nicola Biyanchi , “Electrical Machine analysis using Finite Elements”, Taylor and Francis Group, CRC Publishers, 2005. 4
4. Nathan Ida, Joao P.A.Bastos , “Electromagnetics and calculation of fields”, SpringerVerlage, 1992.
5. S.J Salon, “Finite Element Analysis of Electrical Machines” Kluwer Academic Publishers, London, 1995, distributed by TBH Publishers & Distributors, Chennai, India
6. .Silvester and Ferrari, “Finite Elements for Electrical Engineers” Cambridge University press, 1983.

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|---------------|--|----------|----------|----------|----------|
| <b>PX5091</b> | <b>CONTROL SYSTEM DESIGN FOR POWER ELECTRONICS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |  | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To explore conceptual bridges between the fields of Control Systems and Power Electronics
- To Study Control theories and techniques relevant to the design of feedback controllers in Power Electronics

**UNIT I                      MODELLING OF DC-TO-DC POWER CONVERTERS                      9**  
 Modelling of Buck Converter , Boost Converter ,Buck-Boost Converter, Cuk Converter ,Sepic Converter, Zeta Converter, Quadratic Buck Converter ,Double Buck-Boost Converter, Boost-Boost Converter General Mathematical Model for Power Electronics Devices

**UNIT II                      SLIDING MODE CONTROLLER DESIGN                      9**  
 Variable Structure Systems. Single Switch Regulated Systems Sliding Surfaces, Accessibility of the Sliding Surface Sliding Mode Control Implementation of Boost Converter ,Buck-Boost Converter, Cuk Converter ,Sepic Converter, Zeta Converter, Quadratic Buck Converter ,Double Buck-Boost Converter, Boost-Boost Converter

**UNIT III                      APPROXIMATE LINEARIZATION CONTROLLER DESIGN                      9**  
 Linear Feedback Control, Pole Placement by Full State Feedback , Pole Placement Based on Observer Design ,Reduced Order Observers , Generalized Proportional Integral Controllers, Passivity Based Control , Sliding Mode Control Implementation of Buck Converter , Boost Converter ,Buck-Boost Converter

**UNIT IV                      NONLINEAR CONTROLLER DESIGN                      9**  
 Feedback Linearization Isidori’s Canonical Form ,Input-Output Feedback Linearization ,State Feedback Linearization,Passivity Based Control , Full Order Observers , Reduced Order Observers

**UNIT V                    PREDICTIVE CONTROL OF POWER CONVERTERS                    9**  
Basic Concepts, Theory, and Methods, Application of Predictive Control in Power Electronics, AC-DC-AC Converter System, Faults and Diagnosis Systems in Power Converters.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to understand an overview on modern linear and nonlinear control strategies for power electronics devices
- Ability to model modern power electronic converters for industrial applications
- Ability to design appropriate controllers for modern power electronics devices.

**REFERENCES**

1. HeberttSira-Ramírez PhD, Ramón Silva-Ortigoza, “Control Design Techniques in Power Electronics Devices”, Springer 2012
2. Mahesh Patil, PankajRodey, “Control Systems for Power Electronics: A Practical Guide”, Springer India, 2015.
3. Blaabjerg José Rodríguez, “Advanced and Intelligent Control in Power Electronics and Drives” , Springer, 2014
4. Enrique Acha, VassiliosAgelidis, Olimpo Anaya, TJE Miller, “Power Electronic Control in Electrical Systems”, Newnes, 2002
5. Marija D. Aranya Chakraborty, Marija , “Control and Optimization Methods for Electric Smart Grids”, Springer, 2012.

**PX5002                    ANALOG AND DIGITAL CONTROLLERS                    L T P C**  
**3 0 0 3**

**OBJECTIVES**

- To provide a overview of the control system and converter control methodologies
- To provide an insight to the analog controllers generally used in practice
- To introduce Embedded Processers for Digital Control
- To study on the driving techniques, isolation requirements, signal conditioning and protection methods
- To provide a Case Study by implementing an analog and a digital controller on a converter

**UNIT I                    CONTROL SYSTEM - OVERVIEW                    9**  
Feedback and Feed-forward control, Right Half Plane Zero, Gain margin and Phase Margin, Stability, Analysis and Transfer function of PI and PID controllers and its effects. Voltage mode control, Peak Current mode Control, Average Current mode Control for Converters – Need, advantages and disadvantages.

**UNIT II                    ANALOG CONTROLLERS                    9**  
Major components of a controller – Op-Amp based PI and PID controller – Proportional, Integral and Differential gains in terms of Resistance and Capacitance, Error Amplifiers, PWM generator using Ramp or Triangular generator and comparator, and Driver, Voltage mode controller design using UC3524, Peak Current mode controller design using UC3842, Average Current mode controller design using UC3854.

**UNIT III                    DIGITAL CONTROLLERS                    9**  
Micro Controllers and Digital Signal Controllers for Converter Control Application, Interface Modules for Converter Control – A/D, Capture, Compare and PWM, Analog Comparators for

instantaneous over current detection, interrupts, Discrete PI and PID equations, Algorithm for PI and PID implementation, Example Code for PWM generation.

**UNIT IV SIGNAL CONDITIONING, DRIVER, ISOLATION AND PROTECTION 9**

Voltage feedback sensing circuits, Hall effect sensors and Shunts for current feedback sensing, Low offset Op-Amps for signal conditioning, Single and dual supply op-amps, Totem pole drivers, Need for isolated drivers, Optically isolated drivers, low side drivers, high side drivers with bootstrap power supply, Vce sat sensing, CT based Device current sensing and pulse blocking.

**UNIT V CONTROLLER IMPLEMENTATION 9**

Analog and Digital Controller Design for Buck Converter – Power circuit transfer function and bode plot, PI controller bode plot, Combined bode plot with required Gain and Phase margins, Implementation of Analog controller and Digital controller.

**TOTAL : 45 PERIODS**

**REFERENCES**

1. I.J. Nagrath and M. Gopal, “Control Systems Engineering”, New Age International Publishers
2. TI Application notes, Reference Manuals and Data Sheets.
3. Agilent Data Sheets
4. Microchip Application notes, Reference Manuals and Data Sheets.

|               |   |          |          |          |          |
|---------------|---|----------|----------|----------|----------|
| <b>PX5003</b> | <b>FLEXIBLE AC TRANSMISSION SYSTEMS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To emphasize the need for FACTS controllers.
- To learn the characteristics, applications and modelling of series and shunt FACTS controllers.
- To analyze the interaction of different FACTS controller and perform control coordination

**UNIT I INTRODUCTION 9**

Review of basics of power transmission networks-control of power flow in AC transmission line Analysis of uncompensated AC Transmission line- Passive reactive power compensation: Effect of series and shunt compensation at the mid-point of the line on power transfer- Need for FACTS controllers- types of FACTS controllers.

**UNIT II STATIC VAR COMPENSATOR (SVC) 9**

Configuration of SVC- voltage regulation by SVC- Modelling of SVC for load flow analysis Modelling of SVC for stability studies-Design of SVC to regulate the mid-point voltage of a SMIB system- Applications: transient stability enhancement and power oscillation damping of SMIB system with SVC connected at the mid-point of the line.

**UNIT III THYRISTOR AND GTO THYRISTOR CONTROLLED SERIES CAPACITORS (TCSC and GCSC) 9**

Concepts of Controlled Series Compensation – Operation of TCSC and GCSC- Analysis of TCSC-GCSC – Modelling of TCSC and GCSC for load flow studies- modeling TCSC and GCSC for stability studied- Applications of TCSC and GCSC.

**UNIT IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS 9**

Static synchronous compensator(STATCOM)- Static synchronous series compensator(SSSC)-

Operation of STATCOM and SSSC-Power flow control with STATCOM and SSSC- Modelling of STATCOM and SSSC for power flow and transient stability studies –operation of Unified and Interline power flow controllers(UPFC and IPFC)- Modelling of UPFC and IPFC for load flow and transient stability studies- Applications.

**UNIT V CONTROLLERS AND THEIR COORDINATION 9**

FACTS Controller interactions – SVC–SVC interaction - co-ordination of multiple controllers using linear control techniques – Quantitative treatment of control coordination.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Ability to understand the operation of the compensator and its applications in power system.
- Ability to understand the various emerging Facts controllers.
- Ability to know about the genetic algorithm used in Facts controller coordination.

**REFERENCES**

1. A.T.John, “Flexible AC Transmission System”, Institution of Electrical and Electronic Engineers (IEEE), 1999.
2. NarainG.Hingorani, Laszio. Gyugyl, “Understanding FACTS Concepts and Technology of Flexible AC Transmission System”, Standard Publishers, Delhi 2001.
3. V. K.Sood, “HVDC and FACTS controllers- Applications of Static Converters in Power System”, 2004, Kluwer Academic Publishers.
4. Mohan Mathur, R., Rajiv. K. Varma, “Thyristor – Based Facts Controllers for Electrical Transmission Systems”, IEEE press and John Wiley & Sons, Inc.
5. K.R.Padiyar,” FACTS Controllers in Power Transmission and Distribution”, New Age International(P) Ltd., Publishers New Delhi, Reprint 2008,

**PX5004 MODERN RECTIFIERS AND RESONANT CONVERTERS L T P C  
3 0 0 3**

**OBJECTIVES:**

- To gain knowledge about the harmonics standards and operation of rectifiers in CCM & DCM.
- To analyze and design power factor correction rectifiers for UPS applications.
- To know the operation of resonant converters for SMPS applications.
- To carry out dynamic analysis of DC- DC Converters.
- To introduce the source current shaping methods for rectifiers

**UNIT I POWER SYSTEM HARMONICS & LINE COMMUTATED RECTIFIERS 9**

Average power-RMS value of waveform–Effect of Power factor-. current and voltage harmonics – Effect of source and load impedance - AC line current harmonic standards IEC1000-IEEE 519-CCM and DCM operation of single phase full wave rectifier- Behaviour of full wave rectifier for large and small values of capacitance - CCM and DCM operation of three phase full wave rectifier- 12 pulse converters - Harmonic trap filters.

**UNIT II PULSE WIDTH MODULATED RECTIFIERS 9**

Properties of Ideal single phase rectifiers-Realization of nearly ideal rectifier-. Single-phase converter systems incorporating ideal rectifiers - Losses and efficiency in CCM high quality rectifiers -single-phase PWM rectifier -PWM concepts - device selection for rectifiers - IGBT based PWM rectifier, comparison with SCR based converters with respect to harmonic content -applications of rectifiers.

**UNIT III RESONANT CONVERTERS****9**

Soft Switching - classification of resonant converters - Quasi resonant converters- basics of ZVS and ZCS- half wave and full wave operation (qualitative treatment) - multi resonant converters - operation and analysis of ZVS and ZCS multi resonant converter - zero voltage transition PWM converters -zero current transition PWM converters

**UNIT IV DYNAMIC ANALYSIS OF SWITCHING CONVERTERS****9**

Review of linear system analysis-State Space Averaging-Basic State Space Average Model-StateSpace Averaged model for an ideal Buck Converter, ideal Boost Converter, ideal Buck BoostConverter and an ideal Cuk Converter. Pulse Width modulation - Voltage Mode PWM Scheme - Current Mode PWM Scheme - design of PI controller.

**UNIT V SOURCE CURRENT SHAPING OF RECTIFIERS****9**

Need for current shaping - power factor - functions of current shaper - input current shaping methods - passive shaping methods -input inductor filter - resonant input filter - active methods - boost rectifier employing peak current control - average current control - Hysteresis control- Nonlinear carrier control.

**TOTAL 45 PERIODS****OUTCOMES:**

After completion of this course, the student will be able to:

- Apply the concept of various types of rectifiers.
- Simulate and design the operation of resonant converter and its importance.
- Identify the importance of linear system, state space model, PI controller.
- Design the DC power supplies using advanced techniques.
- Understand the standards for supply current harmonics and its significance.

**REFERENCES**

- 1 Robert W. Erickson and Dragon Maksimovic, "Fundamentals of Power Electronics", Second Edition, Springer science and Business media, 2001.
- 2 William Shepherd and Li zhang, "Power Converters Circuits", MarcelDekkerin,C, 2005.
- 3 Simon Ang and Alejandro Oliva, "Power Switching Converters", Taylor & Francis Group, 2010.
- 4 Andrzej M. Trzynadlowski, " Introduction To Modern Power Electronics", John Wiley & Sons, 2016.
- 5 Marian.K.Kazimierczuk and DariuszCzarkowski, "Resonant Power Converters", John Wiley & Sons limited, 2011.
- 6 Keng C .Wu, "Switch Mode Power Converters – Design and Analysis" Elseveir academic press, 2006.
- 7 Abraham I.Pressman, Keith Billings and Taylor Morey, " Switching Power Supply Design" McGraw-Hill ,2009
- 8 V.Ramanarayanan, "Course Material on Switched Mode Power Conversion" IISC, Banglore, 2007.
- 9 Christophe P. Basso, Switch-Mode Power Supplies, McGraw-Hill ,2014

**PX5092****ELECTROMAGNETIC INTERFERENCE AND  
COMPATIBILITY**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To provide fundamental knowledge on electromagnetic interference and electromagnetic compatibility.
- To study the important techniques to control EMI and EMC.

- To expose the knowledge on testing techniques as per Indian and international standards in EMI measurement.

### **UNIT I INTRODUCTION 9**

Definitions of EMI/EMC -Sources of EMI- Intersystems and Intrasystem- Conducted and radiated interference- Characteristics - Designing for electromagnetic compatibility (EMC)- EMC regulation typical noise path- EMI predictions and modeling, Cross talk - Methods of eliminating interferences.

### **UNIT II GROUNDING AND CABLING 9**

Cabling- types of cables, mechanism of EMI emission / coupling in cables –capacitive coupling inductive coupling- shielding to prevent magnetic radiation- shield transfer impedance, Grounding – safety grounds – signal grounds- single point and multipoint ground system hybrid grounds- functional ground layout –grounding of cable shields- -guard shields- isolation, neutralizing transformers, shield grounding at high frequencies, digital grounding- Earth measurement Methods

### **UNIT III BALANCING, FILTERING AND SHIELDING 9**

Power supply decoupling- decoupling filters-amplifier filtering –high frequency filtering- EMI filters characteristics of LPF, HPF, BPF, BEF and power line filter design -Choice of capacitors, inductors, transformers and resistors, EMC design components -shielding – near and far field shielding effectiveness- absorption and reflection loss- magnetic materials as a shield, shield discontinuities, slots and holes, seams and joints, conductive gaskets-windows and coatings - grounding of shields

### **UNIT IV EMI IN ELEMENTS AND CIRCUITS 9**

Electromagnetic emissions, noise from relays and switches, non-linearities in circuits, passive inter modulation, transients in power supply lines, EMI from power electronic equipment, EMI as combination of radiation and conduction

### **UNIT V ELECTROSTATIC DISCHARGE, STANDARDS AND TESTING TECHNIQUES 9**

Static Generation- human body model- static discharges- ESD versus EMC, ESD protection in equipments- standards – FCC requirements – EMI measurements – Open area test site measurements and precautions- Radiated and conducted interference measurements, Control requirements and testing methods

**TOTAL : 45 PERIODS**

#### **OUTCOMES:**

- Recognize the sources of Conducted and radiated EMI in Power Electronic Converters and consumer appliances and suggest remedial measures to mitigate the problems
- Assess the insertion loss and design EMI filters to reduce the loss
- Design EMI filters, common-mode chokes and RC-snobber circuits measures to keep the interference within tolerable limits

#### **REFERENCES**

1. V.P. Kodali, "Engineering Electromagnetic Compatibility", S. Chand, 1996
2. Henry W.Ott, " Noise reduction techniques in electronic systems", John Wiley & Sons, 1989
3. Bernhard Keiser, "Principles of Electro-magnetic Compatibility", Artech House, Inc. (685 canton street, Norwood, MA 02062 USA) 1987
4. Bridges, J.E Milleta J. and Ricketts.L.W., "EMP Radiation and Protective techniques", John Wiley and sons, USA 1976
5. William Duff G., & Donald White R. J, "Series on Electromagnetic Interference and Compatibility", Vol.
6. Weston David A., "Electromagnetic Compatibility, Principles and Applications", 1991.

**COURSE OBJECTIVES**

- To teach the students properties of materials ,microstructure and fabrication methods.
- To teach the design and modeling of Electrostatic sensors and actuators.
- To teach the characterizing thermal sensors and actuators through design and modeling
- To teach the fundamentals of piezoelectric sensors and actuators through exposure to different MEMS and NEMS devices
- To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills

**UNIT I MICRO-FABRICATION, MATERIALS AND ELECTRO-MECHANICAL CONCEPTS 9**

Overview of micro fabrication – Silicon and other material based fabrication processes – Concepts: Conductivity of semiconductors-Crystal planes and orientation-stress and strain-flexural beam bending analysis-torsional deflections-Intrinsic stress- resonant frequency and quality factor.

**UNIT II ELECTROSTATIC SENSORS AND ACTUATION 9**

Principle, material, design and fabrication of parallel plate capacitors as electrostatic sensors and actuators-Applications

**UNIT III THERMAL SENSING AND ACTUATION 9**

Principle, material, design and fabrication of thermal couples, thermal bimorph sensors, thermal resistor sensors-Applications.

**UNIT IV PIEZOELECTRIC SENSING AND ACTUATION 9**

Piezoelectric effect-cantilever piezoelectric actuator model-properties of piezoelectric materials-Applications.

**UNIT V CASE STUDIES 9**

Piezoresistive sensors, Magnetic actuation, Micro fluidics applications, Medical applications, Optical MEMS.-NEMS Devices

Note: Class room discussions and tutorials can include the following guidelines for improved teaching /learning process: Discussions/Exercise/Practice on Workbench: on the basics /device model design aspects of thermal/peizo/resistive sensors etc.

**TOTAL : 45 PERIODS**

**OUTCOMES** : After the completion of this course the student will be able to:

- Understand basics of microfabrication, develop models and simulate electrostatic and electromagnetic sensors and actuators
- Understand material properties important for MEMS system performance, analyze dynamics of resonant micromechanical structures
- The learning process delivers insight onto design of micro sensors, embedded sensors & actuators in power aware systems like grid.
- Understand the design process and validation for MEMS devices and systems, and learn the state of the art in optical microsystems
- Improved Employability and entrepreneurship capacity due to knowledge up gradation on recent trends in embedded systems design.

## REFERENCES

1. Chang Liu, "Foundations of MEMS", Pearson International Edition, 2006.
2. Marc Madou, "Fundamentals of microfabrication", CRC Press, 1997.
3. Boston, "Micromachined Transducers Sourcebook", WCB McGraw Hill, 1998.
4. M.H. Bao "Micromechanical transducers :Pressure sensors, accelerometers and gyroscopes", Elsevier, Newyork, 2000.

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|---------------|---|----------|----------|----------|----------|
| <b>PS5071</b> | <b>DISTRIBUTED GENERATION AND MICROGRID</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

### OBJECTIVES:

- To illustrate the concept of distributed generation
- To analyze the impact of grid integration.
- To study concept of Microgrid and its configuration

### **UNIT I INTRODUCTION 9**

Conventional power generation: advantages and disadvantages, Energy crises, Non-conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

### **UNIT II DISTRIBUTED GENERATIONS (DG) 9**

Concept of distributed generations, topologies, selection of sources, regulatory standards/framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants

### **UNIT III IMPACT OF GRID INTEGRATION 9**

Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.

### **UNIT IV BASICS OF A MICROGRID 9**

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids

### **UNIT V CONTROL AND OPERATION OF MICROGRID 9**

Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.

**TOTAL : 45 PERIODS**

### OUTCOMES:

- Learners will attain knowledge on the various schemes of conventional and nonconventional power generation.
- Learners will have knowledge on the topologies and energy sources of distributed



- generation.
- Learners will learn about the requirements for grid interconnection and its impact with NCE sources
- Learners will understand the fundamental concept of Microgrid.

## REFERENCES

- 1 Amirnaser Yezdani, and Reza Iravani, "Voltage Source Converters in Power Systems: Modeling, Control and Applications", IEEE John Wiley Publications, 2010.
- 2 Dorin Neacsu, "Power Switching Converters: Medium and High Power", CRC Press, Taylor & Francis, 2006
- 3 Chetan Singh Solanki, "Solar Photo Voltaics", PHI learning Pvt. Ltd., New Delhi, 2009
- 4 J.F. Manwell, J.G. McGowan "Wind Energy Explained, theory design and applications", Wiley publication 2010.
- 5 D. D. Hall and R. P. Grover, "Biomass Regenerable Energy", John Wiley, New York, 1987.
- 6 John Twidell and Tony Weir, "Renewable Energy Resources" Tylor and Francis Publications, Second edition 2006.

PX5005

## HIGH VOLTAGE DIRECT CURRENT TRANSMISSION

L T P C  
3 0 0 3

### OBJECTIVES:

- To impart knowledge on operation, modelling and control of HVDC link.
- To perform steady state analysis of AC/DC system.
- To expose various HVDC simulators.

### UNIT I DC POWER TRANSMISSION TECHNOLOGY 9

Introduction - Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system - Planning for HVDC transmission – Modern trends in DC transmission – DC breakers – Cables, VSC based HVDC.

### UNIT II THYRISTOR BASED HVDC CONVERTERS AND HVDC SYSTEM CONTROL 9

Pulse number, choice of converter configuration – Simplified analysis of Graetz circuit - Converter bridge characteristics – characteristics of a twelve pulse converter- detailed analysis of converters. General principles of DC link control – Converter control characteristics – System control hierarchy - Firing angle control – Current and extinction angle control – Generation of harmonics and filtering - power control – Higher level controllers-Valve tests.

### UNIT III MULTITERMINAL DC SYSTEMS 9

Introduction – Potential applications of MTDC systems - Types of MTDC systems - Control and protection of MTDC systems - Study of MTDC systems.

### UNIT IV POWER FLOW ANALYSIS IN AC/DC SYSTEMS 9

Per unit system for DC Quantities - Modelling of DC links - Solution of DC load flow - Solution of AC-DC power flow – Unified, Sequential and Substitution of power injection method

### UNIT V SIMULATION OF HVDC SYSTEMS 9

Introduction – DC LINK Modelling , Converter Modeling and State Space Analysis , Philosophy and tools – HVDC system simulation, Online and OFFline simulators — Dynamic interactions

between DC and AC systems.

**TOTAL : 45 PERIODS**

**REFERENCES**

- 1 P. Kundur, "Power System Stability and Control", McGraw-Hill, 1993
- 2 K.R.Padiyar, , "HVDC Power Transmission Systems", New Age International (P) Ltd., New Delhi, 2002
- 3 J.Arrillaga, , "High Voltage Direct Current Transmission", Peter Pregrinus, London, 1983
- 4 Erich Uhlmann, " Power Transmission by Direct Current", BS Publications, 2004.
- 5 V.K.Sood,HVDC and FACTS controllers – Applications of Static Converters in Power System, APRIL 2004 , Kluwer Academic Publishers

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|---------------|---|----------|----------|----------|----------|
| <b>PS5092</b> | <b>SOLAR AND ENERGY STORAGE SYSTEMS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To Study about solar modules and PV system design and their applications
- To Deal with grid connected PV systems
- To Discuss about different energy storage systems

**UNIT I INTRODUCTION 9**  
 Characteristics of sunlight – semiconductors and P-N junctions –behavior of solar cells – cell properties – PV cell interconnection

**UNIT II STAND ALONE PV SYSTEM 9**  
 Solar modules – storage systems – power conditioning and regulation - MPPT- protection – stand alone PV systems design – sizing

**UNIT III GRID CONNECTED PV SYSTEMS 9**  
 PV systems in buildings – design issues for central power stations – safety – Economic aspect – Efficiency and performance - International PV programs

**UNIT IV ENERGY STORAGE SYSTEMS 9**  
 Impact of intermittent generation – Battery energy storage – solar thermal energy storage – pumped hydroelectric energy storage

**UNIT V APPLICATIONS 9**  
 Water pumping – battery chargers – solar car – direct-drive applications –Space – Telecommunications.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Students will develop more understanding on solar energy storage systems
- Students will develop basic knowledge on standalone PV system
- Students will understand the issues in grid connected PV systems
- Students will study about the modeling of different energy storage systems and their performances
- Students will attain more on different applications of solar energy

**REFERENCES**

- 1 Solanki C.S., "Solar Photovoltaics: Fundamentals, Technologies And Applications", PHI Learning Pvt. Ltd.,2015.

- 2 Stuart R.Wenham, Martin A.Green, Muriel E. Watt and Richard Corkish, "Applied Photovoltaics", 2007,Earthscan, UK.  
Eduardo Lorenzo G. Araujo, "Solar electricity engineering of photovoltaic systems", Progensa,1994.
- 3 Frank S. Barnes & Jonah G. Levine, "Large Energy storage Systems Handbook", CRC Press, 2011.
- 4 McNeils, Frenkel, Desai, "Solar & Wind Energy Technologies", Wiley Eastern, 1990
- 5 S.P. Sukhatme , "Solar Energy", Tata McGraw Hill,1987.

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|---------------|---------------------------------------|----------|----------|----------|----------|
| <b>PX5071</b> | <b>WIND ENERGY CONVERSION SYSTEMS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To learn the design and control principles of Wind turbine.
- To understand the concepts of fixed speed and variable speed, wind energy conversion systems.
- To analyze the grid integration issues.

**UNIT I INTRODUCTION 9**

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory-Power coefficient-Sabinin’s theory-Aerodynamics of Wind turbine.

**UNIT II WIND TURBINES 9**

HAWT-VAWT-Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations-Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control-stall control-Schemes for maximum power extraction.

**UNIT III FIXED SPEED SYSTEMS 9**

Generating Systems- Constant speed constant frequency systems -Choice of Generators-Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor - Drive Train model- Generator model for Steady state and Transient stability analysis.

**UNIT IV VARIABLE SPEED SYSTEMS 9**

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG -Variable speed generators modeling - Variable speed variable frequency schemes.

**UNIT V GRID CONNECTED SYSTEMS 9**

Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modeling issue.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Acquire knowledge on the basic concepts of Wind energy conversion system.
- Understand the mathematical modeling and control of the Wind turbine
- Develop more understanding on the design of Fixed speed system
- Study about the need of Variable speed system and its modeling.
- Able to learn about Grid integration issues and current practices of wind interconnections with power system.

**REFERENCES**

1. L.L.Freris "Wind Energy conversion Systems", Prentice Hall, 1990
2. S.N.Bhadra, D.Kastha,S.Banerjee,"Wind Electrical Sytems",Oxford University Press,2010.
3. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
4. E.W.Golding "The generation of Electricity by wind power", Redwood burn Ltd.,Trowbridge,1976.
5. N. Jenkins," Wind Energy Technology" John Wiley & Sons,1997
6. S.Heir "Grid Integration of WECS", Wiley 1998.

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|---------------|---------------------------------------|----------|----------|----------|----------|
| <b>PS5072</b> | <b>ENERGY MANAGEMENT AND AUDITING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To study the concepts behind economic analysis and Load management.
- To emphasize the energy management on various electrical equipments and metering.
- To illustrate the concept of lighting systems and cogeneration.

**UNIT I INTRODUCTION 9**  
 Need for energy management - energy basics- designing and starting an energy management program – energy accounting -energy monitoring, targeting and reporting-energy audit process.

**UNIT II ENERGY COST AND LOAD MANAGEMENT 9**  
 Important concepts in an economic analysis - Economic models-Time value of money-Utility rate structures- cost of electricity-Loss evaluation- Load management: Demand control techniques-Utility monitoring and control system-HVAC and energy management-Economic justification.

**UNIT III ENERGY MANAGEMENT FOR MOTORS, SYSTEMS, AND ELECTRICAL EQUIPMENT 9**  
 Systems and equipment- Electric motors-Transformers and reactors-Capacitors and synchronous machines.

**UNIT IV METERING FOR ENERGY MANAGEMENT 9**  
 Relationships between parameters-Units of measure-Typical cost factors- Utility meters - Timing of meter disc for kilowatt measurement - Demand meters - Paralleling of current transformers - Instrument transformer burdens-Multitasking solid-state meters - Metering location vs. requirements- Metering techniques and practical examples.

**UNIT V LIGHTING SYSTEMS & COGENERATION 9**  
 Concept of lighting systems - The task and the working space -Light sources - Ballasts - Luminaries - Lighting controls-Optimizing lighting energy - Power factor and effect of harmonics on power quality - Cost analysis techniques-Lighting and energy standards  
 Cogeneration: Forms of cogeneration - feasibility of cogeneration- Electrical interconnection.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Students will develop the ability to learn about the need for energy management and auditing process
- Learners will learn about basic concepts of economic analysis and load management.
- Students will understand the energy management on various electrical equipments.
- Students will have knowledge on the concepts of metering and factors influencing cost

function

- Students will be able to learn about the concept of lighting systems, light sources and various forms of cogeneration

#### REFERENCES

- 1 Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, "Guide to Energy Management", Fifth Edition, The Fairmont Press, Inc., 2006
- 2 Eastop T.D & Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific & Technical, 1990.
- 3 Reay D.A, "Industrial Energy Conservation", 1<sup>st</sup> edition, Pergamon Press, 1977.
- 4 "IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities", IEEE, 1996
- 5 Amit K. Tyagi, "Handbook on Energy Audits and Management", TERI, 2003.

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|---------------|---|----------|----------|----------|----------|
| <b>PS5073</b> | <b>ELECTRIC VEHICLES AND POWER MANAGEMENT</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

#### OBJECTIVES:

- To understand the concept of electrical vehicles and its operations
- To understand the need for energy storage in hybrid vehicles
- To provide knowledge about various possible energy storage technologies that can be used in electric vehicles

|  |  |          |
|--|--|----------|
| <b>UNIT I</b>  | <b>ELECTRIC VEHICLES AND VEHICLE MECHANICS</b>         | <b>9</b> |
| Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings, Comparisons of EV with internal combustion Engine vehicles, Fundamentals of vehicle mechanics.   |  |          |
| <b>UNIT II</b>   | <b>ARCHITECTURE OF EV's AND POWER TRAIN COMPONENTS</b> | <b>9</b> |
| Architecture of EV's and HEV's – Plug-n Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes.  |  |          |
| <b>UNIT III</b>  | <b>CONTROL OF DC AND AC DRIVES</b>                     | <b>9</b> |
| DC/DC chopper based four quadrant operations of DC drives – Inverter based V/f Operation (motoring and braking) of induction motor drive system – Induction motor and permanent motor based vector control operation – Switched reluctance motor (SRM) drives. |  |          |
| <b>UNIT IV</b>   | <b>BATTERY ENERGY STORAGE SYSTEM</b>                   | <b>9</b> |
| Battery Basics, Different types, Battery Parameters, Battery modeling, Traction Batteries.   |  |          |
| <b>UNIT V</b>  | <b>ALTERNATIVE ENERGY STORAGE SYSTEMS</b>              | <b>9</b> |
| Fuel cell – Characteristics- Types – hydrogen Storage Systems and Fuel cell EV – Ultra capacitors.   |  |          |

**TOTAL : 45 PERIODS**

#### OUTCOMES:

- Learners will understand the operation of Electric vehicles and various energy storage technologies for electrical vehicles

#### REFERENCES

- 1 Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Second Edition" CRC Press, Taylor & Francis Group, Second Edition (2011).
- 2 Ali Emadi, Mehrdad Ehsani, John M. Miller, "Vehicular Electric Power Systems", Special Indian Edition, Marcel Dekker, Inc 2010.



PS5091

**SMART GRID**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications

**UNIT I INTRODUCTION TO SMART GRID 9**

Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, National and International Initiatives in Smart Grid.

**UNIT II SMART GRID TECHNOLOGIES 9**

Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV).

**UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE 9**

Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU), Intelligent Electronic Devices (IED) & their application for monitoring & protection.

**UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID 9**

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

**UNIT V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS 9**

Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

- Learners will develop more understanding on the concepts of Smart Grid and its present developments.
- Learners will study about different Smart Grid technologies.
- Learners will acquire knowledge about different smart meters and advanced metering infrastructure.
- Learners will have knowledge on power quality management in Smart Grids
- Learners will develop more understanding on LAN, WAN and Cloud Computing for Smart Grid applications.

**REFERENCES**

- 1 Stuart Borlase "Smart Grid :Infrastructure, Technology and Solutions", CRC Press 2012.
- 2 Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, "Smart Grid: Technology and Applications", Wiley 2012.
- 3 Vehbi C. Güngör, DilanSahin, TaskinKocak, Salih Ergüt, Concettina Buccella, Carlo Cecati, and Gerhard P. Hancke, "Smart Grid Technologies: Communication

Technologies and Standards” IEEE Transactions On Industrial Informatics, Vol. 7, No. 4, November 2011.

- 4 Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang “Smart Grid – The New and Improved Power Grid: A Survey” , IEEE Transaction on Smart Grids, vol. 14, 2012.

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|---------------|---|----------|----------|----------|----------|
| <b>PX5072</b> | <b>POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**OBJECTIVES:**

- To provide knowledge about the stand alone and grid connected renewable energy systems.
- To equip with required skills to derive the criteria for the design of power converters for renewable energy applications.
- To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems.
- To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
- To develop maximum power point tracking algorithms

**UNIT I INTRODUCTION 9**

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) -Qualitative study of different renewable energy resources ocean, Biomass, Hydrogen energy systems : operating principles and characteristics of: Solar PV, Fuel cells, wind electrical systems-control strategy, operating area.

**UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION 9**

Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

**UNIT III POWER ELECTRONICS FOR SOLAR 9**

Block diagram of solar photo voltaic system : line commutated converters (inversion-mode) - Boost and buck-boost converters-selection of inverter, battery sizing, array sizing- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

**UNIT IV POWER ELECTRONICS FOR WIND 9**

Three phase AC voltage controllers-AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, matrix converters- Stand alone operation of fixed and variable speed wind energy conversion systems- Grid connection Issues -Grid integrated PMSG and SCIG Based WECS.

**UNIT V HYBRID RENEWABLE ENERGY SYSTEMS 9**

Need for Hybrid Systems -Range and type of Hybrid systems-Case studies of Wind-PV- Maximum Power Point Tracking (MPPT).

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES**

After completion of this course, the student will be able to:

- Analyze the impacts of renewable energy generation on environment.



- Understand the importance and qualitative analysis of solar and wind energy sources.
- Apply the principle of operation of electrical machines for wind energy conversion and their performance characteristics.
- Design suitable power converters for solar PV and wind energy systems.

## REFERENCES

- 1 S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009.
- 2 Rashid .M. H "power electronics Hand book", Academic press, 2001.
- 3 Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
- 4 Rai. G.D," Solar energy utilization", Khanna publishes, 1993.
- 5 Gray, L. Johnson, "Wind energy system", prentice hall inc, 1995.
- 6 B.H.Khan, " Non-conventional Energy sources", Tata McGraw-hill Publishing Company.
- 7 P.S.Bimbhra,"Power Electronics",Khanna Publishers, 3<sup>rd</sup> Edition,2003.
- 8 Fang Lin Luo Hong Ye, " Renewable Energy systems", Taylor & Francis Group,2013.
- 9 R.Seyezhai and R.Ramaprabha, "Power Electronics for Renewable Energy Systems", Scitech Publications, 2015.

IN5079

ROBOTICS AND CONTROL

L T P C  
3 0 0 3

## COURSE OBJECTIVES

- To introduce robot terminologies and robotic sensors To educate direct and inverse kinematic relations
- To educate on formulation of manipulator Jacobians and introduce path planning techniques
- To educate on robot dynamics
- To introduce robot control techniques

### UNIT I INTRODUCTION AND TERMINOLOGIES

9

Definition-Classification-History- Robots components-Degrees of freedom-Robot joints-coordinates-Reference frames-workspace-Robot languages-actuators-sensors-Position, velocity and acceleration sensors-Torque sensors-tactile and touch sensors-proximity and range sensors-vision system-social issues.

### UNIT II KINEMATICS

9

Mechanism-matrix representation-homogenous transformation-DH representation-Inverse kinematics solution and programming-degeneracy and dexterity

### UNIT III DIFFERENTIAL MOTION AND PATH PLANNING

9

Jacobian-differential motion of frames-Interpretation-calculation of Jacobian-Inverse Jacobian-Robot Path planning

### UNIT IV DYNAMIC MODELLING

9

Lagrangian mechanics- Two-DOF manipulator- Lagrange-Euler formulation – Newton- Euler formulation – Inverse dynamics

### UNIT V ROBOT CONTROL SYSTEM

9

- Linear control schemes- joint actuators- decentralized PID control- computed torque control – force control- hybrid position force control- Impedance/ Torque control

**TOTAL : 45 PERIODS**

## COURSE OUTCOMES:

- Ability to understand the components and basic terminology of Robotics

- Ability to model the motion of Robots and analyze the workspace and trajectory panning of robots
- Ability to develop application based Robots
- Ability to formulate models for the control of mobile robots in various industrial applications

## REFERENCES

1. R.K. Mittal and I J Nagrath, " Robotics and Control", Tata MacGraw Hill, Fourth edition.
2. Saeed B. Niku, "Introduction to Robotics ", Pearson Education, 2002.
3. Fu, Gonzalez and Lee Mcgrahill, "Robotics ", international edition.
4. R.D. Klafter, TA Chmielewski and Michael Negin, "Robotic Engineering, An Integrated approach", Prentice Hall of India, 2003.

PX5007

NON LINEAR CONTROL

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

### OBJECTIVES:

- To impart knowledge on phase plane analysis of non-linear systems.
- To impart knowledge on Describing function based approach to non-linear systems.
- To educate on stability analysis of systems using Lyapunov's theory.
- To educate on stability analysis of systems using Lyapunov's theory.
- To introduce the concept of sliding mode control.

### UNIT I PHASE PLANE ANALYSIS

9

Concepts of phase plane analysis- Phase portraits- singular points- Symmetry in phase plane portraits-Constructing Phase Portraits- Phase plane Analysis of Linear and Nonlinear Systems- Existence of Limit Cycles. simulation of phase portraits in matlab.

### UNIT II DESCRIBING FUNCTION

9

Describing Function Fundamentals-Definitions-Assumptions-Computing Describing Functions- Common Nonlinearities and its Describing Functions-Nyquist Criterion and its Extension- Existence of Limit Cycles-Stability of limit Cycles. simulation of limit cycles in matlab.

### UNIT III LYAPUNOV THEORY

9

Nonlinear Systems and Equilibrium Points-Concepts of Stability-Linearization and Local Stability- Lyapunov's Direct Method-Positive definite Functions and Lyapunov Functions-Equilibrium Point Theorems-Invariant Set Theorems-LTI System Analysis based on Lyapunov's Direct Method- Krasovski's Method-Variable Gradient Method-Physically – Control Design based on Lyapunov's Direct Method.

### UNIT IV FEEDBACK LINEARIZATION

9

Feedback Linearization and the Canonical Form-Mathematical Tools-Input-State Linearization of SISO Systems- input-Output Linearization of SISO Systems-Generating a Linear Input-Output Relation-Normal Forms-The Zero-Dynamics-Stabilization and Tracking-Inverse Dynamics and Non- Minimum-Phase Systems-Feedback Linearization of MIMO Systems Zero-Dynamics and Control Design. Simulation of tracking problems in matlab.

### UNIT V SLIDING MODE CONTROL

9

Sliding Surfaces- Continuous approximations of Switching Control laws-The Modeling/Performance Trade-Offs- MIMO Systems. simulation of sliding mode controller in matlab.

**TOTAL : 45 PERIODS**

### OUTCOMES:

- Understand the concepts of non-linear control system.
- Analyze the stability of the system
- Illustrate the sliding mode control and implementation in MATLAB.

### REFERENCES

1. J A E Slotine and W Li, Applied Nonlinear control, PHI, 1991.
2. K. P. Mohandas, Modern Control Engineering, Sanguine, India, 2006
3. Hasan Khalil, "Nonlinear systems and control", Prentice Hall.
4. S H Zak, "Systems and control", Oxford University Press, 2003.
5. Torkel Glad and Lennart Ljung, "Control Theory – Multivariable and Nonlinear Methods", Taylor & Francis, 2002.
6. G. J. Thaler, "Automatic control systems", Jaico publishers, 2006.



  
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**ANNA UNIVERSITY, CHENNAI**  
**AFFILIATED INSTITUTIONS**  
**REGULATIONS – 2017**  
**CHOICE BASED CREDIT SYSTEM**  
**MASTER OF BUSINESS ADMINISTRATION (GENERAL)**

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) :**

MBA programme curriculum is designed to prepare the post graduate students

- I. To have a thorough understanding of the core aspects of the business.
- II. To provide the learners with the management tools to identify, analyze and create business opportunities as well as solve business problems.
- III. To prepare them to have a holistic approach towards management functions.
- IV. To motivate them for continuous learning.
- V. To inspire and make them practice ethical standards in business.

**PROGRAMME OUTCOMES (POs):**

On successful completion of the programme,

1. Ability to apply the business acumen gained in practice.
2. Ability to understand and solve managerial issues.
3. Ability to communicate and negotiate effectively, to achieve organizational and individual goals.
4. Ability to upgrade their professional and managerial skills in their workplace.
5. Ability to explore and reflect about managerial challenges, develop informed managerial decisions in a dynamically unstable environment.
6. Ability to take up challenging assignments.
7. Ability to understand one's own ability to set achievable targets and complete them.
8. Ability to pursue lifelong learning.
9. To have a fulfilling business career.

| Programme Educational Objectives | Programme Outcomes |     |     |     |     |     |     |     |     |
|----------------------------------|--------------------|-----|-----|-----|-----|-----|-----|-----|-----|
|                                  | PO1                | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
| I                                | ✓                  | ✓   |     |     |     |     | ✓   |     |     |
| II                               |                    |     |     | ✓   | ✓   | ✓   |     |     |     |
| III                              | ✓                  |     | ✓   |     | ✓   | ✓   | ✓   |     |     |
| IV                               |                    |     |     | ✓   |     | ✓   | ✓   | ✓   |     |
| V                                |                    | ✓   | ✓   |     |     |     |     | ✓   | ✓   |



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|                                     |                           |  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |   |
|-------------------------------------|---------------------------|--|-----|-----|-----|-----|-----|-----|-----|-----|-----|---|
| <b>YEAR 1</b>                       | <b>SEM 1</b>              | Principles of Management                   | ✓   | ✓   | ✓   |     | ✓   |     |     |     |     |   |
|                                     |                           | Accounting for Management                  | ✓   |     |     | ✓   |     |     |     |     |     |   |
|                                     |                           | Economic Analysis for Business             | ✓   | ✓   |     |     |     |     |     |     | ✓   | ✓ |
|                                     |                           | Legal Aspects of Business                  | ✓   |     |     |     |     |     |     |     |     |   |
|                                     |                           | Organizational Behaviour                   | ✓   |     | ✓   |     |     |     |     |     |     |   |
|                                     |                           | Statistics for Management                  | ✓   |     |     |     |     |     |     |     |     |   |
|                                     |                           | Total Quality Management                   |     |     |     | ✓   | ✓   |     |     |     |     | ✓ |
|                                     |                           | Spoken and Written Communication           | ✓   |     | ✓   |     |     |     |     |     |     |   |
|                                     | <b>SEM 2</b>              | Applied Operations Research                |     | ✓   |     |     | ✓   |     | ✓   |     |     |   |
|                                     | Business Research Methods |  | ✓   |     |     | ✓   |     | ✓   |     |     |     |   |
|                                     | Financial Management      | ✓  | ✓   |     | ✓   | ✓   |     | ✓   |     | ✓   |     |   |
|                                     | Human Resource Management | ✓  | ✓   |     | ✓   | ✓   |     | ✓   |     | ✓   |     |   |
|                                     | Information Management    | ✓  | ✓   |     | ✓   | ✓   |     | ✓   |     | ✓   |     |   |
|                                     | Operations Management     | ✓  | ✓   |     | ✓   | ✓   |     | ✓   |     | ✓   |     |   |
|                                     | Marketing Management      |  | ✓   |     | ✓   | ✓   |     | ✓   |     |     |     |   |
| Data Analysis and Business Modeling |                           |  |     | ✓   | ✓   | ✓   |     |     | ✓   |     |     |   |
| <b>YEAR 2</b>                       | <b>SEM 3</b>              | International Business Management          |     |     |     | ✓   | ✓   |     |     |     | ✓   |   |
|                                     |                           | Strategic Management                       | ✓   | ✓   |     | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   |   |
|                                     | Elective I                | Given below for each stream/Specialization |     |     |     |     |     |     |     |     |     |   |
|                                     | Elective II               |  |     |     |     |     |     |     |     |     |     |   |
|                                     | Elective III              |  |     |     |     |     |     |     |     |     |     |   |
|                                     | Elective IV               |  |     |     |     |     |     |     |     |     |     |   |
|                                     | Elective V                |  |     |     |     |     |     |     |     |     |     |   |
|                                     | Elective VI               |  |     |     |     |     |     |     |     |     |     |   |
|                                     | Summer Training           | ✓  | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   |     |   |
|                                     | <b>SEM 4</b>              | Project Work                               | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   | ✓   |   |

|  |   | P01 | P02 | P03 | P04 | P05 | P06 | P07 | P08 | P09 |
|--|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|  | <b>Stream/ Specialization : Marketing Management</b>      |     |     |     |     |     |     |     |     |     |
|  | Brand Management  | ✓   |     | ✓   |     | ✓   |     |     | ✓   | ✓   |
|  | Consumer Behaviour  | ✓   |     |     |     | ✓   | ✓   | ✓   | ✓   | ✓   |
|  | Customer Relationship Management                          | ✓   |     |     |     | ✓   | ✓   | ✓   | ✓   | ✓   |
|  | Integrated Marketing Communication                        | ✓   |     | ✓   |     | ✓   |     |     |     | ✓   |
|  | Retail Marketing  | ✓   |     | ✓   |     | ✓   |     |     | ✓   | ✓   |
|  | Services Marketing  | ✓   |     |     |     | ✓   | ✓   | ✓   |     | ✓   |
|  | Social Marketing  | ✓   |     |     |     | ✓   | ✓   | ✓   | ✓   | ✓   |
|  | <b>Stream/ Specialization : Financial Management</b>      |     |     |     |     |     |     |     |     |     |
|  | Banking Financial Services Management                     | ✓   |     | ✓   |     | ✓   |     |     | ✓   | ✓   |
|  | Corporate Finance   | ✓   |     | ✓   | ✓   |     |     |     | ✓   | ✓   |
|  | Derivatives Management                                    | ✓   |     | ✓   |     |     |     | ✓   | ✓   | ✓   |
|  | Merchant Banking and Financial Services                   | ✓   |     | ✓   |     | ✓   |     |     | ✓   | ✓   |
|  | Security Analysis and Portfolio Management                | ✓   |     |     |     | ✓   |     |     |     | ✓   |
|  | Strategic Investment and Financing Decisions              | ✓   |     | ✓   |     |     | ✓   |     | ✓   | ✓   |
|  | International Trade Finance                               | ✓   |     | ✓   |     | ✓   |     |     | ✓   | ✓   |
|  | <b>Stream/ Specialization : Human Resource Management</b> |     |     |     |     |     |     |     |     |     |
|  | Entrepreneurship Development                              | ✓   |     | ✓   |     | ✓   |     |     | ✓   | ✓   |
|  | Industrial Relations and Labour Welfare                   | ✓   |     | ✓   |     | ✓   |     |     | ✓   | ✓   |
|  | Labour Legislations                                       | ✓   |     | ✓   |     |     | ✓   |     |     | ✓   |
|  | Managerial Behaviour and Effectiveness                    |     |     | ✓   |     | ✓   |     |     | ✓   | ✓   |
|  | Organizational Theory, Design and Development             | ✓   |     | ✓   |     | ✓   |     |     | ✓   | ✓   |
|  | Strategic Human Resource Management                       |     |     | ✓   |     |     | ✓   |     |     | ✓   |
|  | <b>Stream/ Specialization : Systems Management</b>        |     |     |     |     |     |     |     |     |     |
|  | Advanced Database Management System                       | ✓   | ✓   | ✓   |     | ✓   | ✓   | ✓   |     | ✓   |
|  | Data mining for Business Intelligence                     | ✓   |     | ✓   |     |     | ✓   |     |     | ✓   |
|  | E-Business Management                                     | ✓   |     |     |     |     | ✓   |     |     | ✓   |

|  |  |   |   |  |   |  |   |  |  |   |
|--|--|---|---|--|---|--|---|--|--|---|
|  |  | Software Project Management and Quality               |   |  |   |  |   |  |  |   |
|  |  | Enterprise Resource Planning                          | ✓ |  |   |  | ✓ |  |  | ✓ |
|  |  | <b>Stream/ Specialization : Operations Management</b> |   |  |   |  |   |  |  |   |
|  |  | Logistics Management                                  | ✓ |  | ✓ |  |   |  |  | ✓ |
|  |  | Materials Management                                  | ✓ |  |   |  | ✓ |  |  | ✓ |
|  |  | Product Design  | ✓ |  | ✓ |  | ✓ |  |  | ✓ |
|  |  | Project Management                                    | ✓ |  | ✓ |  | ✓ |  |  | ✓ |
|  |  | Services Operations Management                        | ✓ |  | ✓ |  | ✓ |  |  | ✓ |
|  |  | Supply Chain Management                               | ✓ |  | ✓ |  | ✓ |  |  | ✓ |

**ANNA UNIVERSITY, CHENNAI**  
**AFFILIATED INSTITUTIONS**  
**REGULATIONS – 2017**  
**CHOICE BASED CREDIT SYSTEM**  
**MASTER OF BUSINESS ADMINISTRATION (FULL TIME)**  
**CURRICULA AND SYLLABI I TO IV SEMESTERS**  
**SEMESTER - I**

| SL. NO.           | COURSE CODE | COURSE TITLE                       | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|------------------------------------|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |                                    |          |                 |           |          |          |           |
| 1.                | BA5101      | Economic Analysis for Business     | PC       | 4               | 4         | 0        | 0        | 4         |
| 2.                | BA5102      | Principles of Management           | PC       | 3               | 3         | 0        | 0        | 3         |
| 3.                | BA5103      | Accounting for Management          | PC       | 4               | 4         | 0        | 0        | 4         |
| 4.                | BA5104      | Legal Aspects of Business          | PC       | 3               | 3         | 0        | 0        | 3         |
| 5.                | BA5105      | Organizational Behaviour           | PC       | 3               | 3         | 0        | 0        | 3         |
| 6.                | BA5106      | Statistics for Management          | PC       | 3               | 3         | 0        | 0        | 3         |
| 7.                | BA5107      | Total Quality Management           | PC       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |                                    |          |                 |           |          |          |           |
| 8                 | BA5111      | Spoken and Written Communication # | EEC      | 4               | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>      |             |                                    |          | <b>27</b>       | <b>23</b> | <b>0</b> | <b>4</b> | <b>25</b> |

# No end semester examination is required for this course.

**SEMESTER - II**

| SL. NO            | COURSE CODE | COURSE TITLE                         | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|--------------------------------------|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |                                      |          |                 |           |          |          |           |
| 1.                | BA5201      | Applied Operations Research          | PC       | 3               | 3         | 0        | 0        | 3         |
| 2.                | BA5202      | Business Research Methods            | PC       | 3               | 3         | 0        | 0        | 3         |
| 3.                | BA5203      | Financial Management                 | PC       | 3               | 3         | 0        | 0        | 3         |
| 4.                | BA5204      | Human Resource Management            | PC       | 3               | 3         | 0        | 0        | 3         |
| 5.                | BA5205      | Information Management               | PC       | 3               | 3         | 0        | 0        | 3         |
| 6.                | BA5206      | Operations Management                | PC       | 3               | 3         | 0        | 0        | 3         |
| 7                 | BA5207      | Marketing Management                 | PC       | 4               | 4         | 0        | 0        | 4         |
| <b>PRACTICALS</b> |             |                                      |          |                 |           |          |          |           |
| 8                 | BA5211      | Data Analysis and Business Modelling | EEC      | 4               | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>      |             |                                      |          | <b>26</b>       | <b>22</b> | <b>0</b> | <b>4</b> | <b>24</b> |

**SUMMER SEMESTER (4 WEEKS)**

**SUMMER TRAINING**

Summer Training – The training report along with the company certificate should be submitted within the two weeks of the reopening date of 3<sup>rd</sup> semester. The training report should be around 40 pages containing the details of training undergone, the departments wherein he was trained with duration (chronological diary), along with the type of managerial skills developed during training. The training report should be sent to the Controller of Examinations by the HOD through the Principal, before the last working day of the 3<sup>rd</sup> Semester.



**SEMESTER - III**

| SL. NO.           | COURSE CODE | COURSE TITLE                      | CATEGORY | CONTACT PERIODS | L         | T        | P        | C         |
|-------------------|-------------|-----------------------------------|----------|-----------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |                                   |          |                 |           |          |          |           |
| 1.                | BA5301      | International Business Management | PC       | 3               | 3         | 0        | 0        | 3         |
| 2                 | BA5302      | Strategic Management              | PC       | 3               | 3         | 0        | 0        | 3         |
| 3                 |             | Professional Elective I ***       | PE       | 3               | 3         | 0        | 0        | 3         |
| 4                 |             | Professional Elective II***       | PE       | 3               | 3         | 0        | 0        | 3         |
| 5                 |             | Professional Elective III***      | PE       | 3               | 3         | 0        | 0        | 3         |
| 6                 |             | Professional Elective IV***       | PE       | 3               | 3         | 0        | 0        | 3         |
| 7                 |             | Professional Elective V***        | PE       | 3               | 3         | 0        | 0        | 3         |
| 8                 |             | Professional Elective VI***       | PE       | 3               | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |                                   |          |                 |           |          |          |           |
| 9                 | BA5311      | Summer Training                   | EEC      | 2               | 0         | 0        | 2        | 1         |
| <b>TOTAL</b>      |             |                                   |          | <b>26</b>       | <b>24</b> | <b>0</b> | <b>2</b> | <b>25</b> |

\*\*\* Chosen electives should be from two streams of management of three electives each.

**SEMESTER - IV**

| SI. NO            | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L        | T         | P         | C  |
|-------------------|-------------|--------------|----------|-----------------|----------|-----------|-----------|----|
| <b>PRACTICALS</b> |             |              |          |                 |          |           |           |    |
| 1.                | BA5411      | Project Work | EEC      | 24              | 0        | 0         | 24        | 12 |
| <b>TOTAL</b>      |             |              |          | <b>0</b>        | <b>0</b> | <b>24</b> | <b>12</b> |    |

**TOTAL NO. OF CREDITS:86**

**PROFESSIONAL CORE (PC)**

| <b>SL. NO.</b> | <b>COURSE CODE</b> | <b>COURSE TITLE</b>               | <b>CATEGORY</b> | <b>CONTACT PERIODS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------|--------------------|-----------------------------------|-----------------|------------------------|----------|----------|----------|----------|
| 1.             |                    | Principles of Management          | PC              | 3                      | 3        | 0        | 0        | 3        |
| 2.             |                    | Accounting for Management         | PC              | 4                      | 4        | 0        | 0        | 4        |
| 3.             |                    | Economic Analysis for Business    | PC              | 4                      | 4        | 0        | 0        | 4        |
| 4.             |                    | Legal Aspects of Business         | PC              | 3                      | 3        | 0        | 0        | 3        |
| 5.             |                    | Organizational Behaviour          | PC              | 3                      | 3        | 0        | 0        | 3        |
| 6.             |                    | Statistics for Management         | PC              | 3                      | 3        | 0        | 0        | 3        |
| 7.             |                    | Marketing Management              | PC              | 4                      | 4        | 0        | 0        | 4        |
| 8.             |                    | Spoken and Written Communication  | PC              | 4                      | 0        | 0        | 4        | 2        |
| 9.             |                    | Applied Operations Research       | PC              | 3                      | 3        | 0        | 0        | 3        |
| 10.            |                    | Business Research Methods         | PC              | 3                      | 3        | 0        | 0        | 3        |
| 11.            |                    | Strategic Management              | PC              | 3                      | 3        | 0        | 0        | 3        |
| 12.            |                    | Financial Management              | PC              | 3                      | 3        | 0        | 0        | 3        |
| 13.            |                    | Human Resource Management         | PC              | 3                      | 3        | 0        | 0        | 3        |
| 14.            |                    | Information Management            | PC              | 3                      | 3        | 0        | 0        | 3        |
| 15.            |                    | Operations Management             | PC              | 3                      | 3        | 0        | 0        | 3        |
| 16.            |                    | International Business Management | PC              | 3                      | 3        | 0        | 0        | 3        |
| 17.            |                    | Total Quality Management          | PC              | 3                      | 3        | 0        | 0        | 3        |

**PROFESSIONAL ELECTIVES (PE)**

**FUNCTIONAL SPECIALIZATIONS**

1. Students can take three elective subjects from two functional specializations
- Or
2. Students can take six elective subjects from any one sectoral specializations

| SL. NO  | COURSE CODE | COURSE TITLE                                 | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|-------------|--|----------|-----------------|---|---|---|---|
| <b>Stream/ Specialization : Marketing Management</b>      |             |  |          |                 |   |   |   |   |
| 1.  | BA5001      | Brand Management                             | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.  | BA5002      | Consumer Behaviour                           | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.  | BA5003      | Customer Relationship Management             | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.  | BA5004      | Integrated Marketing Communication           | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.  | BA5005      | Retail Marketing                             | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.  | BA5006      | Services Marketing                           | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.  | BA5007      | Social Marketing                             | PE       | 3               | 3 | 0 | 0 | 3 |
| <b>Stream/ Specialization : Financial Management</b>      |             |  |          |                 |   |   |   |   |
| 8.  | BA5008      | Banking Financial Services Management        | PE       | 3               | 3 | 0 | 0 | 3 |
| 9.  | BA5009      | Corporate Finance                            | PE       | 3               | 3 | 0 | 0 | 3 |
| 10.   | BA5010      | Derivatives Management                       | PE       | 3               | 3 | 0 | 0 | 3 |
| 11.   | BA5011      | Merchant Banking and Financial Services      | PE       | 3               | 3 | 0 | 0 | 3 |
| 12.   | BA5012      | Security Analysis and Portfolio Management   | PE       | 3               | 3 | 0 | 0 | 3 |
| 13.   | BA5013      | Strategic Investment and Financing Decisions | PE       | 3               | 3 | 0 | 0 | 3 |
| 14.   | BA5031      | International Trade Finance                  | PE       | 3               | 3 | 0 | 0 | 3 |
| <b>Stream/ Specialization : Human Resource Management</b> |             |  |          |                 |   |   |   |   |
| 15.   | BA5014      | Entrepreneurship Development                 | PE       | 3               | 3 | 0 | 0 | 3 |
| 16.   | BA5015      | Industrial Relations and Labour Welfare      | PE       | 3               | 3 | 0 | 0 | 3 |
| 17.   | BA5016      | Labour Legislations                          | PE       | 3               | 3 | 0 | 0 | 3 |
| 18.   | BA5017      | Managerial                                   | PE       | 3               | 3 | 0 | 0 | 3 |

|   |        |   |    |   |   |   |   |   |
|---|--------|---|----|---|---|---|---|---|
|   |        | Behaviour and Effectiveness                   |    |   |   |   |   |   |
| 19.   | BA5018 | Organizational Theory, Design and Development | PE | 3 | 3 | 0 | 0 | 3 |
| 20.   | BA5019 | Strategic Human Resource Management           | PE | 3 | 3 | 0 | 0 | 3 |
| <b>Stream/ Specialization : Systems Management</b>    |        |   |    |   |   |   |   |   |
| 21.   | BA5020 | Advanced Database Management System           | PE | 3 | 3 | 0 | 0 | 3 |
| 22.   | BA5021 | Datamining for Business Intelligence          | PE | 3 | 3 | 0 | 0 | 3 |
| 23.   | BA5022 | Enterprise Resource Planning                  | PE | 3 | 3 | 0 | 0 | 3 |
| 24.   | BA5023 | Software Project Management and Quality       | PE | 3 | 3 | 0 | 0 | 3 |
| 25.   | BA5024 | E-Business Management                         | PE | 3 | 3 | 0 | 0 | 3 |
| <b>Stream/ Specialization : Operations Management</b> |        |   |    |   |   |   |   |   |
| 26.   | BA5025 | Logistics Management                          | PE | 3 | 3 | 0 | 0 | 3 |
| 27.   | BA5026 | Materials Management                          | PE | 3 | 3 | 0 | 0 | 3 |
| 28.   | BA5027 | Product Design                                | PE | 3 | 3 | 0 | 0 | 3 |
| 29.   | BA5028 | Project Management                            | PE | 3 | 3 | 0 | 0 | 3 |
| 30.   | BA5029 | Services Operations Management                | PE | 3 | 3 | 0 | 0 | 3 |
| 31.   | BA5030 | Supply Chain Management                       | PE | 3 | 3 | 0 | 0 | 3 |

## SECTORAL SPECIALIZATIONS

1. Students can take three electives subjects from two functional specializations  
or
2. Students can take six elective subjects from any one sectoral specializations

| SL. NO  | COURSE CODE | COURSE TITLE  | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|-------------|---|----------|-----------------|---|---|---|---|
| <b>Sectoral Specialization : Logistics and Supply Chain Management</b>    |             |   |          |                 |   |   |   |   |
| 1.  | BA5051      | Supply Chain Concepts and Planning                            | PE       | 3               | 3 | 0 | 0 | 3 |
| 2.  | BA5052      | Sourcing and Supply Management                                | PE       | 3               | 3 | 0 | 0 | 3 |
| 3.  | BA5053      | Supply Chain Inventory Management                             | PE       | 3               | 3 | 0 | 0 | 3 |
| 4.  | BA5054      | Supply Chain Information System                               | PE       | 3               | 3 | 0 | 0 | 3 |
| 5.  | BA5055      | Warehouse Management  | PE       | 3               | 3 | 0 | 0 | 3 |
| 6.  | BA5056      | Transportation and Distribution Management                    | PE       | 3               | 3 | 0 | 0 | 3 |
| 7.  | BA5057      | Reverse and Contract Logistics                                | PE       | 3               | 3 | 0 | 0 | 3 |
| 8.  | BA5058      | Air Cargo Management  | PE       | 3               | 3 | 0 | 0 | 3 |
| 9.  | BA5059      | Containerization and Allied Business                          | PE       | 3               | 3 | 0 | 0 | 3 |
| 10.   | BA5060      | Exim Management   | PE       | 3               | 3 | 0 | 0 | 3 |
| 11.   | BA5061      | Fundamentals of Shipping                                      | PE       | 3               | 3 | 0 | 0 | 3 |
| 12.   | BA5062      | Port and Terminal Management                                  | PE       | 3               | 3 | 0 | 0 | 3 |
| <b>Sectoral Specialization :Infrastructure and Real Estate Management</b> |             |   |          |                 |   |   |   |   |
| 13.   | BA5063      | Infrastructure Planning Scheduling and Control                | PE       | 3               | 3 | 0 | 0 | 3 |
| 14.   | BA5064      | Contracts and Arbitration                                     | PE       | 3               | 3 | 0 | 0 | 3 |
| 15.   | BA5065      | Project Management for Infrastructure                         | PE       | 3               | 3 | 0 | 0 | 3 |
| 16.   | BA5066      | Management of Human Resources, Safety and Quality             | PE       | 3               | 3 | 0 | 0 | 3 |
| 17.   | BA5067      | Disaster Mitigation and Management                            | PE       | 3               | 3 | 0 | 0 | 3 |
| 18.   | BA5068      | Economics and Financial Management in Construction            | PE       | 3               | 3 | 0 | 0 | 3 |
| 19.   | BA5069      | Urban Environmental Management                                | PE       | 3               | 3 | 0 | 0 | 3 |
| 20.   | BA5070      | Smart Materials, Techniques and Equipments for Infrastructure | PE       | 3               | 3 | 0 | 0 | 3 |
| 21.   | BA5071      | Strategic Airport Infrastructure Management                   | PE       | 3               | 3 | 0 | 0 | 3 |
| 22.   | BA5072      | Real Estate Marketing and Management                          | PE       | 3               | 3 | 0 | 0 | 3 |
| 23.   | BA5073      | Infrastructure and Real Estate Entrepreneurship               | PE       | 3               | 3 | 0 | 0 | 3 |
| 24.   | BA5074      | Valuation of Real Estate and Infrastructure Assets            | PE       | 3               | 3 | 0 | 0 | 3 |

**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

| <b>SL. NO.</b> | <b>COURSE CODE</b> | <b>COURSE TITLE</b>                 | <b>CATEGORY</b> | <b>CONTACT PERIODS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------|--------------------|-------------------------------------|-----------------|------------------------|----------|----------|----------|----------|
| 1.             | BA5111             | Spoken and Written Communication #  | EEC             | 4                      | 0        | 0        | 4        | 2        |
| 2.             | BA5211             | Data Analysis and Business Modeling | EEC             | 4                      | 0        | 0        | 4        | 2        |
| 3.             | BA5311             | Summer Training                     | EEC             | 2                      | 0        | 0        | 2        | 1        |
| 4.             | BA5411             | Project Work                        | EEC             | 24                     | 0        | 0        | 24       | 12       |

**OBJECTIVES:**

- To introduce the concepts of scarcity and efficiency; to explain principles of micro economics relevant to managing an organization; to describe principles of macro economics to have the understanding of economic environment of business.

**UNIT I INTRODUCTION****8**

The themes of economics – scarcity and efficiency – three fundamental economic problems – society’s capability – Production possibility frontiers (PPF) – Productive efficiency Vs economic efficiency – economic growth & stability – Micro economies and Macro economies – the role of markets and government – Positive Vs negative externalities.

**UNIT II CONSUMER AND PRODUCER BEHAVIOUR****13**

Market – Demand and Supply – Determinants – Market equilibrium – elasticity of demand and supply – consumer behaviour – consumer equilibrium – Approaches to consumer behaviour – Production – Short-run and long-run Production Function – Returns to scale – economies Vs diseconomies of scale – Analysis of cost – Short-run and long-run cost function – Relation between Production and cost function.

**UNIT III PRODUCT AND FACTOR MARKET****13**

Product market – perfect and imperfect market – different market structures – Firm’s equilibrium and supply – Market efficiency – Economic costs of imperfect competition – factor market – Land, Labour and capital – Demand and supply – determination of factor price – Interaction of product and factor market – General equilibrium and efficiency of competitive markets.

**UNIT IV PERFORMANCE OF AN ECONOMY – MACRO ECONOMICS****13**

Macro-economic aggregates – circular flow of macroeconomic activity – National income determination – Aggregate demand and supply – Macroeconomic equilibrium – Components of aggregate demand and national income – multiplier effect – Demand side management – Fiscal policy in theory.

**UNIT V AGGREGATE SUPPLY AND THE ROLE OF MONEY****13**

Short-run and Long-run supply curve – Unemployment and its impact – Okun’s law – Inflation and the impact – reasons for inflation – Demand Vs Supply factors – Inflation Vs Unemployment tradeoff – Phillips curve – short- run and long-run – Supply side Policy and management- Money market- Demand and supply of money – money-market equilibrium and national income – the role of monetary policy.

**TOTAL: 60 PERIODS****OUTCOMES:**

- Students are expected to become familiar with both principles of micro and macro economics. They would also become familiar with application of these principles to appreciate the functioning of both product and input markets as well as the economy.

**REFERENCES :**

- Paul A. Samuelson, William D. Nordhaus, Sudip Chaudhuri and Anindya Sen, Economics, 19<sup>th</sup> edition, Tata McGraw Hill, New Delhi, 2010.
- William Boyes and Michael Melvin, Textbook of economics, Biztantra, 9<sup>th</sup> Edition, 2012.
- N. Gregory Mankiw, Principles of Economics, 7<sup>th</sup> edition, Cengage, New Delhi, 2014
- Richard Lipsey and Alec Charystal, Economics, 12<sup>th</sup> edition, Oxford, University Press, New Delhi, 2011.
- Karl E. Case and Ray C. Fair, Principles of Economics, 12<sup>th</sup> edition, Pearson, Education Asia, New Delhi, 2014.

**OBJECTIVES:**

- To familiarize the students to the basic concepts of management in order to aid in understanding how an organization functions, and in understanding the complexity and wide variety of issues managers face in today's business firms.

**UNIT I INTRODUCTION TO MANAGEMENT 9**

Organization- Management- Role of managers- Evolution of management thought- Organization and the environmental factors- Managing globally- Strategies for International business.

**UNIT II PLANNING 9**

Nature and purpose of planning- Planning process- Types of plans- Objectives- Managing by Objective (MBO) strategies- Types of strategies – Policies – Decision Making- Types of decision- Decision making process- Rational decision making process- Decision making under different conditions.

**UNIT III ORGANISING 9**

Nature and purpose of organizing- Organization structure- Line and staff authority- Departmentation- Span of control- Centralization and decentralization- Delegation of authority- Staffing- Selection and Recruitment- Career development- Career stages- Training- Performance appraisal

**UNIT IV DIRECTING 9**

Managing people- Communication- Hurdles to effective communication- Organization culture-Elements and types of culture- Managing cultural diversity.

**UNIT V CONTROLLING 9**

Process of controlling- Types of control- Budgetary and non-budgetary control techniques - Managing productivity- Cost control- Purchase control- Maintenance control- Quality control- Planning operations.

**TOTAL: 45 PERIODS****OUTCOMES:**

- The students should be able to describe and discuss the elements of effective management,
- discuss and apply the planning, organizing and control processes,
- describe various theories related to the development of leadership skills, motivation techniques, team work and effective communication,
- communicate effectively through both oral and written presentation.

**REFERENCES:**

- Andrew J. Dubrin, Essentials of Management, Thomson Southwestern, 9<sup>th</sup> edition, 2012.
- Samuel C. Certo and Tervis Certo, Modern management: concepts and skills, Pearson education, 12<sup>th</sup> edition, 2012.
- Harold Koontz and Heinz Weihrich, Essentials of management: An International & Leadership Perspective, 9<sup>th</sup> edition, Tata McGraw-Hill Education, 2012.
- Don Hellriegel, Susan E. Jackson and John W. Slocum, Management- A competency-based approach, Thompson South Western, 11<sup>th</sup> edition, 2008.
- Heinz Weihrich, Mark V Cannice and Harold Koontz, Management- A global entrepreneurial perspective, Tata McGraw Hill, 13<sup>th</sup> edition, 2010.
- Stephen P. Robbins, David A. De Cenzo and Mary Coulter, Fundamentals of Management, Prentice Hall of India, 2012.



**OBJECTIVES :**

- Acquire a reasonable knowledge in accounts
- Analysis and evaluate financial statements

**UNIT I FINANCIAL ACCOUNTING 12**

Introduction to Financial, Cost and Management Accounting- Generally accepted accounting principles, Conventions and Concepts-Balance sheet and related concepts- Profit and Loss account and related concepts - Introduction to inflation accounting- Introduction to human resources accounting.

**UNIT II COMPANY ACCOUNTS 12**

Meaning of Company -Maintenance of Books of Account-Statutory Books- Profit or Loss Prior to incorporation- Final Accounts of Company- Alteration of share capital- Preferential allotment, Employees stock option- Buyback of securities.

**UNIT III ANALYSIS OF FINANCIAL STATEMENTS 12**

Analysis of financial statements – Financial ratio analysis, cash flow (as per Accounting Standard 3) and funds flow statement analysis.

**UNIT IV COST ACCOUNTING 12**

Cost Accounts - Classification of manufacturing costs - Accounting for manufacturing costs. Cost Accounting Systems: Job order costing - Process costing- Activity Based Costing- Costing and the value chain- Target costing- Marginal costing including decision making- Budgetary Control & Variance Analysis - Standard cost system.

**UNIT V ACCOUNTING IN COMPUTERISED ENVIRONMENT 12**

Significance of Computerised Accounting System- Codification and Grouping of Accounts-Maintaining the hierarchy of ledgers- Prepackaged Accounting software.

**TOTAL: 45+15 = 60 PERIODS****OUTCOME**

- Possess a managerial outlook at accounts.

**REFERENCES :**

1. M.Y.Khan & P.K.Jain, Management Accounting, Tata McGraw Hill, 2011.
2. R.Narayanaswamy, Financial Accounting – A managerial perspective, PHI Learning, New Delhi, 2011.
3. Jan Williams, Financial and Managerial Accounting – The basis for business Decisions, 15<sup>th</sup> edition, Tata McGraw Hill Publishers, 2010.
4. Horngren, Surdem, Stratton, Burgstahler, Schatzberg, Introduction to Management Accounting, PHI Learning, 2011.
5. Stice & Stice, Financial Accounting Reporting and Analysis, 8<sup>th</sup> edition, Cengage, 2010.
6. Singhvi Bodhanwala, Management Accounting -Text and cases, PHI Learning, 2009.
7. Ashish K. Battacharya, Introduction to Financial Statement Analysis, Elsevier, 2009.
8. Sawyers, Jackson, Jenkins, Arora, Managerial Accounting, 2<sup>nd</sup> edition, Cengage, 2011
9. Godwin, Alderman, Sanyal , Financial Accounting, 2<sup>nd</sup> edition, Cengage, 2011
10. Narashiman.M.S, Financial statement analysis, Cengage, 2016.

**OBJECTIVE:**

- To create the knowledge of Legal perspective and its practices to improvise the business.

**UNIT I COMMERCIAL LAW 9****THE INDIAN CONTRACT ACT 1872**

Definition of contract, essentials elements and types of a contract, Formation of a contract, performance of contracts, breach of contract and its remedies, Quasi contracts - Contract Of Agency: Nature of agency, Creation and types of agents, Authority and liability of Agent and principal: Rights and duties of principal and agents, termination of agency.

**THE SALE OF GOODS ACT 1930**

Nature of Sales contract, Documents of title, risk of loss, Guarantees and Warranties, performance of sales contracts, conditional sales and rights of an unpaid seller - Negotiable Instruments Act 1881: Nature and requisites of negotiable instruments. Types of negotiable instruments, liability of parties, holder in due course, special rules for Cheque and drafts, discharge of negotiable instruments-GST

**UNIT II COMPANY LAW 2013 (amended on 03.05.18) 9**

Major principles – Nature and types of companies, Formation, Memorandum and Articles of Association, Prospectus, Power, duties and liabilities of Directors, winding up of companies, Corporate Governance. Amendments of Companies Act, 2013

**UNIT III INDUSTRIAL LAW 9**

An Overview of Factories Act - Payment of Wages Act - Payment of Bonus Act - Industrial Disputes Act.

**UNIT IV CORPORATE TAX AND GST (amended on 03.05.18) 9**

Corporate Tax planning, Income Tax, Goods and Services Tax – Introduction, Objective, Classification and practical implications of GST

**UNIT V CONSUMER PROTECTION ACT AND INTRODUCTION OF CYBER LAWS 9**

Consumer Protection Act – Consumer rights, Procedures for Consumer grievances redressal, Types of consumer Redressal Mechanism and Forums- Competition Act 2002 - Cyber crimes, IT Act 2000 and 2002, Cyber Laws, Introduction of IPR – Copy rights, Trade marks, Patent Act.

**TOTAL: 45 PERIODS****OUTCOME:**

- Legal insight will be established in the business practices according to the situation of changing environment.

**TEXT BOOKS**

1. Kapoor, N. D.; Elements of Mercanlite Law, 30th edition, Sultan Chand & Sons, NewDelhi,2015
2. P. K. Goel, Business Law for Managers, Biztantatara Publishers, India, 2008.
3. Akhileshwar Pathack, Legal Aspects of Business, 4th Edition, Tata McGraw Hill, 2009.
4. P. P. S. Gogna, Mercantile Law, S. Chand & Co. Ltd., India, 11th Edition, 2015
5. Maheshwari, S.N. and S.K. Maheshwari; A Manual of Business Law, 6th Edition, Himalaya Publishing House, 2015.
6. V.S.Datey, GST Ready Reckoner, Taxmann Publishing, July 2017.

**OBJECTIVE:**

- To provide an overview of theories and practices in organizational behavior in individual, group and organizational level.

**UNIT I FOCUS AND PURPOSE****5**

Definition, need and importance of organizational behaviour – Nature and scope – Frame work – Organizational behaviour models.

**UNIT II INDIVIDUAL BEHAVIOUR****12**

Personality – types – Factors influencing personality – Theories – Learning – Types of learners – The learning process – Learning theories – Organizational behaviour modification.  
Misbehaviour – Types – Management Intervention. Emotions - Emotional Labour – Emotional Intelligence – Theories. Attitudes – Characteristics – Components – Formation – Measurement-Values. Perceptions – Importance – Factors influencing perception – Interpersonal perception-Impression Management. Motivation – Importance – Types – Effects on work behavior.

**UNIT III GROUP BEHAVIOUR****10**

Organization structure – Formation – Groups in organizations – Influence – Group dynamics – Emergence of informal leaders and working norms – Group decision making techniques – **Team building** - Interpersonal relations – Communication – Control.

**UNIT IV LEADERSHIP AND POWER****8**

Meaning – Importance – Leadership styles – Theories – Leaders Vs Managers – Sources of power – Power centers – Power and Politics.

**UNIT V DYNAMICS OF ORGANIZATIONAL BEHAVIOUR****10**

Organizational culture and climate – Factors affecting organizational climate – Importance. Job satisfaction – Determinants – Measurements – Influence on behavior. Organizational change – Importance – Stability Vs Change – Proactive Vs Reaction change – the change process – Resistance to change – Managing change. Stress – Work Stressors – Prevention and Management of stress – Balancing work and Life. Organizational development – Characteristics – objectives –. Organizational effectiveness Developing Gender sensitive workplace

**TOTAL: 45 PERIODS****OUTCOME:**

- Students will have a better understanding of human behavior in organization. They will know the framework for managing individual and group performance.

**REFERENCES :**

- Stephen P. Robins, Organisational Behavior, PHI Learning / Pearson Education, Edition 17, 2016 (Global edition)
- Fred Luthans, Organisational Behavior, McGraw Hill, 12<sup>th</sup> Edition,
- Mc Shane & Von Glinov, Organisational Behaviour, 4<sup>th</sup> Edition, Tata Mc Graw Hill, 2007.
- Nelson, Quick, Khandelwal. ORGB – An innovative approach to learning and teaching. Cengage, 2<sup>nd</sup> edition. 2012
- Ivancevich, Konopaske & Maheson, Oranisational Behaviour & Management, 7<sup>th</sup> edition, Tata McGraw Hill, 2008.
- Udai Pareek, Understanding Organisational Behaviour, 3<sup>rd</sup> Edition, Oxford Higher Education, 2011.
- Jerald Greenberg, Behaviour in Organization, PHI Learning. 10<sup>th</sup> edition. 2011

**OBJECTIVE:**

- To learn the applications of statistics in business decision making.

**UNIT I INTRODUCTION 9**

Basic definitions and rules for probability, conditional probability independence of events, Baye's theorem, and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

**UNIT II SAMPLING DISTRIBUTION AND ESTIMATION 9**

Introduction to sampling distributions, sampling distribution of mean and proportion, application of central limit theorem, sampling techniques. Estimation: Point and Interval estimates for population parameters of large sample and small samples, determining the sample size.

**UNIT III TESTING OF HYPOTHESIS - PARAMETIRC TESTS 9**

Hypothesis testing: one sample and two sample tests for means and proportions of large samples (z-test), one sample and two sample tests for means of small samples (t-test), F-test for two sample standard deviations. ANOVA one and two way.

**UNIT IV NON-PARAMETRIC TESTS 9**

Chi-square test for single sample standard deviation. Chi-square tests for independence of attributes and goodness of fit. Sign test for paired data. Rank sum test. Kolmogorov-Smirnov – test for goodness of fit, comparing two populations. Mann – Whitney U test and Kruskal Wallis test. One sample run test.

**UNIT V CORRELATION AND REGRESSION 9**

Correlation – Coefficient of Determination – Rank Correlation – Regression – Estimation of Regression line – Method of Least Squares – Standard Error of estimate.

**TOTAL: 45 PERIODS****OUTCOME:**

To facilitate objective solutions in business decision making under subjective conditions.

**REFERENCES:**

1. Richard I. Levin, David S. Rubin, Sanjay Rastogi Masood Husain Siddiqui, Statistics for Management, Pearson Education, 7th Edition, 2016.
2. Prem.S.Mann, Introductory Statistics, 7th Edition, Wiley India, 2016.
3. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer, 2016.
4. Aczel A.D. and Sounderpandian J., "Complete Business Statistics", 6th edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2012.
5. Anderson D.R., Sweeney D.J. and Williams T.A., Statistics for business and economics, 11th edition, Thomson (South – Western) Asia, Singapore, 2012.
6. N. D. Vohra, Business Statistics, Tata McGraw Hill, 2012.
7. Ken Black, Applied Business Statistics, 7th Edition, Wiley India Edition, 2012.

**OBJECTIVE:**

- To learn the quality philosophies and tools in the managerial perspective.

**UNIT I INTRODUCTION 9**

Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.

**UNIT II PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT 9**

Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle, Japanese 5S principles and 8D methodology.

**UNIT III STATISTICAL PROCESS CONTROL 9**

Meaning and significance of statistical process control (SPC) – construction of control charts for variables and attributed. Process capability – meaning, significance and measurement – Six sigma - concepts of process capability. Reliability concepts – definitions, reliability in series and parallel, product life characteristics curve. Total productive maintenance (TMP), Terotechnology. Business process Improvement (BPI) – principles, applications, reengineering process, benefits and limitations.

**UNIT IV TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT 9**

Quality functions development (QFD) – Benefits, Voice of customer, information organization, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation. Seven Tools (old & new). Bench marking and POKA YOKE.

**UNIT V QUALITY SYSTEMS ORGANIZING AND IMPLEMENTATION 9**

Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward - TQM framework, benefits, awareness and obstacles.

**TOTAL: 45 PERIODS****OUTCOME:**

- To apply quality philosophies and tools to facilitate continuous improvement and ensure customer delight.

**REFERENCES :**

- Dale H. Besterfield, Carol Besterfield – Michna, Glen H. Besterfield, Mary Besterfield – Sacre, Hermant – Urdhwareshe, Rashmi Urdhwareshe, Total Quality Management, Revised Third edition, Pearson Education, 2011
- Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, II Edition 2010
- Douglas C. Montgomery, Introduction to Statistical Quality Control, Wiley Student Edition, 4<sup>th</sup> Edition, Wiley India Pvt Limited, 2008.
- James R. Evans and William M. Lindsay, The Management and Control of Quality, Sixth Edition, Thomson, 2005.
- Poornima M. Charantimath, Total Quality Management, Pearson Education, Second Edition, 2011
- Indian standard – quality management systems – Guidelines for performance improvement (Fifth Revision), Bureau of Indian standards, New Delhi.

**OBJECTIVES :**

- To familiarize learners with the mechanics of writing
- To enable learners to write in English precisely and effectively.
- To enable learners to speak fluently and flawlessly in all kinds of communicative contexts with all nationalities.

**UNIT I PERSONAL COMMUNICATION 12**

Day-to-day conversation with family members, neighbours, relatives, friends on various topics, context specific - Journal writing, mails/emails, SMS, greeting cards, situation based – accepting/declining invitations, congratulating, consoling, conveying information, oral reports, extempore.

**UNIT II EMPLOYABILITY SKILLS 12**

Interview skills – HR and technical – Types of interview, preparation for interview, mock interview, Group Discussion – Communication skills in Group Discussion, Structure of GD, GD process, successful GD techniques. Time management and effective planning – identifying barriers to effective time management, time management techniques, relationship between time management and stress management.

**UNIT III WORK PLACE COMMUNICATION 12**

e-mails, minutes, reports of different kinds – annual report, status report, survey report, proposals, memorandums, presentations, interviews, profile of institutions, speeches, responding to enquiries, complaints, resumes, applications, summarizing, strategies for writing.

**UNIT IV RESEARCH WRITING 12**

Articles for publication (Journals), developing questionnaire, writing abstract, dissertation, qualities of research writing, data (charts, tables) analysis, documentation.

**UNIT V WRITING FOR MEDIA AND CREATIVE WRITING 12**

Features for publication (Newspapers, magazines, newsletters, notice-board), case studies, short stories, travelogues, writing for children, translation, techniques of writing.

**TOTAL: 60 PERIODS**

Note: It is an activity based course. Student individually or as a group can organize event(s), present term papers etc. This will be evaluated by the faculty member(s) handling the course and the consolidated marks can be taken as the final mark.

No end semester examination is required for this course.

**OUTCOMES :****Learners should be able to**

- Get into the habit of writing regularly.
- Express themselves in different genres of writing from creative to critical to factual writing.
- Take part in print and online media communication
- Read quite widely to acquire a style of writing and
- Identify their area of strengths and weaknesses in writing.
- Speak confidently with any speakers of English, including native speakers.
- Speak effortlessly in different contexts – informal and formal.

## REFERENCES :

1. Raymond V Lesikar, John D Pettit, and Mary E Flatly, 2009. Lesikar's Basic Business Communication, 11<sup>th</sup> ed. Tata McGraw-Hill, New Delhi.
2. E.H. McGrath, S.J. 2012, Basic Managerial Skills for All. 9<sup>th</sup> ed. Prentice-Hall of India, New Delhi.

### Management books

Robin Sharma - The greatness guide  
Steven Covey - 7 Habits of Effective people  
Arindham Chaudhuri- Count your chickens before they hatch  
Ramadurai - TCS Story

Blogs : Seth Godwin, Guy Kawasaki, Kiruba Shankar

Review : Harvard Business review

Reports : Deloitte Netsis

Magazines : Bloomberg Businessweek, Economist

3. Richard Denny, 'Communication to Win; Kogan Page India Pvt. Ltd., New Delhi, 2008.

**BA5201**

**APPLIED OPERATIONS RESEARCH**

**L T P C**

**3 0 0 3**

### OBJECTIVE:

- To learn the concepts of operations research applied in business decision making.

### **UNIT I INTRODUCTION TO LINEAR PROGRAMMING (LP) 9**

Introduction to applications of operations research in functional areas of management. Linear Programming-formulation, solution by graphical and simplex methods (Primal - Penalty, Two Phase), Special cases. Dual simplex method. Principles of Duality. Sensitivity Analysis.

### **UNIT II LINEAR PROGRAMMING EXTENSIONS 9**

Transportation Models (Minimising and Maximising Problems) – Balanced and unbalanced Problems – Initial Basic feasible solution by N-W Corner Rule, Least cost and Vogel's approximation methods. Check for optimality. Solution by MODI / Stepping Stone method. Case of Degeneracy. Transshipment Models. Assignment Models (Minimising and Maximising Problems) – Balanced and Unbalanced Problems. Solution by Hungarian and Branch and Bound Algorithms. Travelling Salesman problem. Crew Assignment Models.

### **UNIT III INTEGER PROGRAMMING AND GAME THEORY 9**

Solution to pure and mixed integer programming problem by Branch and Bound and cutting plane algorithms. Game Theory-Two person Zero sum games-Saddle point, Dominance Rule, Convex Linear Combination (Averages), methods of matrices, graphical and LP solutions.

### **UNIT IV INVENTORY MODELS, SIMULATION AND DECISION THEORY 9**

Inventory Models – EOQ and EBQ Models (With and without shortages), Quantity Discount Models. Decision making under risk – Decision trees – Decision making under uncertainty. Monte-carlo simulation.

### **UNIT V QUEUING THEORY AND REPLACEMENT MODELS 9**

Queuing Theory - single and Multi-channel models – infinite number of customers and infinite calling source. Replacement Models-Individuals replacement Models (With and without time value of money) – Group Replacement Models.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- To facilitate quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.

**REFERENCES :**

1. Paneerselvam R., Operations Research, Prentice Hall of India, Fourth Print, 2008.
2. N. D Vohra, Quantitative Techniques in Management, Tata Mcgraw Hill, 2010.
3. Hamdy A Taha, Introduction to Operations Research, Prentice Hall India, Ninth Edition, 2010.
4. Anderson , Sweeney Williams Solutions Manual to Accompany An Introduction to Management Science Quantitative Approaches To Decision, Cengage , 12<sup>th</sup> edition , 2012
5. G. Srinivasan, Operations Research – Principles and Applications, II edition , PHI, 2010.
6. Bernard W.Taylor ,Introduction to Management Science , 12 th edition, 2012

**BA5202****BUSINESS RESEARCH METHODS****L T P C  
3 0 0 3****OBJECTIVE:**

- To familiarise the students to the principles of scientific methodology in business enquiry; to develop analytical skills of business research; to develop the skills for scientific communications.

**UNIT I INTRODUCTION****9**

Business Research – Definition and Significance – the research process – Types of Research – Exploratory and causal Research – Theoretical and empirical Research – Cross –Sectional and time – series Research – Research questions / Problems – Research objectives – Research hypotheses – characteristics – Research in an evolutionary perspective – the role of theory in research.

**UNIT II RESEARCH DESIGN AND MEASUREMENT****9**

Research design – Definition – types of research design – exploratory and causal research design – Descriptive and experimental design – different types of experimental design – Validity of findings – internal and external validity – Variables in Research – Measurement and scaling – Different scales – Construction of instrument – Validity and Reliability of instrument.

**UNIT III DATA COLLECTION****9**

Types of data – Primary Vs Secondary data – Methods of primary data collection – Survey Vs Observation – Experiments – Construction of questionnaire and instrument – Validation of questionnaire – Sampling plan – Sample size – determinants optimal sample size – sampling techniques –Probability Vs Non–probability sampling methods.

**UNIT IV DATA PREPARATION AND ANALYSIS****9**

Data Preparation – editing – Coding –Data entry – Validity of data – Qualitative Vs Quantitative data analyses – Bivariate and Multivariate statistical techniques – Factor analysis – Discriminant analysis – cluster analysis – multiple regression and correlation – multidimensional scaling – Conjoint Analysis - Application of statistical software for data analysis.

**UNIT V REPORT DESIGN, WRITING AND ETHICS IN BUSINESS RESEARCH****9**

Research report – Different types – Contents of report – need of executive summary – chapterization – contents of chapter – report writing – the role of audience – readability – comprehension – tone – final proof – report format – title of the report – ethics in research – ethical behaviour of research – subjectivity and objectivity in research.

**TOTAL: 45 PERIODS**



## OUTCOME:

- Students would become acquainted with the scientific methodology in business domain. They would also become analytically skillful. They would become familiar with the nuances of scientific communications.

## REFERENCES :

1. Donald R. Cooper, Pamela S. Schindler and J K Sharma, Business Research methods, 11<sup>th</sup> Edition, Tata Mc Graw Hill, New Delhi, 2012.
2. Alan Bryman and Emma Bell, Business Research methods, 3<sup>rd</sup> Edition, Oxford University Press, New Delhi, 2011.
3. Uma Sekaran and Roger Bougie, Research methods for Business, 5<sup>th</sup> Edition, Wiley India, New Delhi, 2012.
4. William G Zikmund, Barry J Babin, Jon C.Carr, Atanu Adhikari, Mitch Griffin, Business Research methods, A South Asian Perspective, 8<sup>th</sup> Edition, Cengage Learning, New Delhi, 2012.

**BA5203**

**FINANCIAL MANAGEMENT**

**L T P C**  
**4 0 0 4**

## OBJECTIVES:

Facilitate student to

- Understand the operational nuances of a Finance Manager
- Comprehend the technique of making decisions related to finance function

### **UNIT I FOUNDATIONS OF FINANCE:**

**9**

Introduction to finance- Financial Management – Nature, scope and functions of Finance, organization of financial functions, objectives of Financial management, Major financial decisions – Time value of money – features and valuation of shares and bonds – Concept of risk and return – single asset and of a portfolio.

### **UNIT II INVESTMENT DECISIONS:**

**9**

Capital Budgeting: Principles and techniques - Nature of capital budgeting- Identifying relevant cash flows - Evaluation Techniques: Payback, Accounting rate of return, Net Present Value, Internal Rate of Return, Profitability Index - Comparison of DCF techniques Concept and measurement of cost of capital - Specific cost and overall cost of capital.

### **UNIT III FINANCING AND DIVIDEND DECISION:**

**9**

Leverages - Operating and Financial leverage – measurement of leverages – degree of Operating & Financial leverage – Combined leverage, EBIT – EPS Analysis- Indifference point.

Capital structure – Theories – Net Income Approach, Net Operating Income Approach, MM Approach – Determinants of Capital structure.

Dividend decision- Issues in dividend decisions, Importance, Relevance & Irrelevance theories – Walter"s – Model, Gordon"s model and MM model. – Factors determining dividend policy – Types of dividend policies – forms of dividend

### **UNIT IV WORKING CAPITAL MANAGEMENT:**

**9**

Principles of working capital: Concepts, Needs, Determinants, issues and estimation of working capital - Accounts Receivables Management and factoring - Inventory management - Cash management - Working capital finance : Trade credit, Bank finance and Commercial paper.

**UNIT V LONG TERM SOURCES OF FINANCE: 9**  
 Indian capital and stock market, New issues market Long term finance: Shares, debentures and term loans, lease, hire purchase, venture capital financing, Private Equity.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- Possess the techniques of managing finance in an organization

**REFERENCES :**

1. M.Y. Khan and P.K.Jain Financial management, Text, Problems and cases Tata McGraw Hill, 6<sup>th</sup> edition, 2011.
2. M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd., 10<sup>th</sup> edition, 2012.
3. Aswat Damodaran, Corporate Finance Theory and practice, John Wiley & Sons, 2011.
4. James C. Vanhorne –Fundamentals of Financial Management– PHI Learning, 11<sup>th</sup> Edition, 2012.
5. Prasanna Chandra, Financial Management, 9<sup>th</sup> edition, Tata McGraw Hill, 2012.
6. G.Sudersena Reddy, Financial Management- Principles & Practices, Himalaya Publishing House, 2nd Edition, 2010
7. Srivatsava, Mishra, Financial Management, Oxford University Press, 2011
8. Parasuraman.N.R, Financial Management, Cengage, 2014.
9. William R.Lasher, Financial Management, 7<sup>th</sup> Edition, Cengage, 2014 .
10. Brigham and Ehrhardt, Financial Management, 14<sup>th</sup> edition, Cengage, 2015.

**BA5204**

**HUMAN RESOURCE MANAGEMENT**

**L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- To provide knowledge about management issues related to staffing, training, performance, compensation, human factors consideration and compliance with human resource requirements.

**UNIT I PERSPECTIVES IN HUMAN RESOURCE MANAGEMENT 5**

Evolution of human resource management – The importance of the human factor – Challenges – Inclusive growth and affirmative action -Role of human resource manager – Human resource policies – Computer applications in human resource management – Human resource accounting and audit.

**UNIT II THE CONCEPT OF BEST FIT EMPLOYEE 8**

Importance of Human Resource Planning – Forecasting human resource requirement –matching supply and demand - Internal and External sources. Recruitment - Selection – induction –Socialization benefits.

**UNIT III TRAINING AND EXECUTIVE DEVELOPMENT 10**

Types of training methods –purpose- benefits- resistance. Executive development programmes – Common practices - Benefits – Self development – Knowledge management.

**UNIT IV SUSTAINING EMPLOYEE INTEREST 12**

Compensation plan – Reward – Motivation – Application of theories of motivation – Career management – Development of mentor – Protégé relationships.

**UNIT V PERFORMANCE EVALUATION AND CONTROL PROCESS 10**

Method of performance evaluation – Feedback – Industry practices. Promotion, Demotion, Transfer and Separation – Implication of job change. The control process – Importance – Methods – Requirement of effective control systems grievances – Causes – Implications – Redressal methods.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- Students will gain knowledge and skills needed for success as a human resources professional

**REFERENCES :**

1. Dessler Human Resource Management, Pearson Education Limited, 14th Edition, 2015.
2. Decenzo and Robbins, Fundamentals of Human Resource Management, Wiley, 11<sup>th</sup> Edition, 2013.
3. Luis R.Gomez-Mejia, David B.Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012
4. Bernadin , Human Resource Management ,Tata Mcgraw Hill ,8<sup>th</sup> edition 2012.
5. Wayne Cascio, Managing Human Resource, McGraw Hill, 2007.
6. Ivancevich, Human Resource Management, McGraw Hill 2012.
7. Uday Kumar Haldar, Juthika Sarkar. Human Resource management. Oxford. 2012

**BA5205****INFORMATION MANAGEMENT****L T P C  
3 0 0 3****OBJECTIVES :**

- To understand the importance of information in business
- To know the technologies and methods used for effective decision making in an organization.

**UNIT I INTRODUCTION****10**

Data, Information, Intelligence, Information Technology, Information System, evolution, types based on functions and hierarchy, System development methodologies, Functional Information Systems, DSS, EIS, KMS, GIS, International Information System.

**UNIT II SYSTEM ANALYSIS AND DESIGN****10**

Case tools - System flow chart, Decision table, Data flow Diagram (DFD), Entity Relationship (ER), Object Oriented Analysis and Design(OOAD), UML diagram.

**UNIT III DATABASE MANAGEMENT SYSTEMS****9**

DBMS – HDBMS, NDBMS, RDBMS, OODBMS, Query Processing, SQL, Concurrency Management, Data warehousing and Data Mart

**UNIT IV SECURITY, CONTROL AND REPORTING****8**

Security, Testing, Error detection, Controls, IS Vulnerability, Disaster Management, Computer Crimes, Securing the Web, Intranets and Wireless Networks, Software Audit, Ethics in IT, User Interface and reporting.

**UNIT V NEW IT INITIATIVES****8**

Role of information management in ERP, e-business, e-governance, Data Mining, Business Intelligence, Pervasive Computing, Cloud computing, CMM.

**TOTAL: 45 PERIODS****OUTCOME**

- Gains knowledge on effective applications of information systems in business

**REFERENCES :**

1. Robert Schultheis and Mary Summer, Management Information Systems – The Managers View, Tata McGraw Hill, 2008.

2. Kenneth C. Laudon and Jane Price Laudon, Management Information Systems – Managing the digital firm, PHI Learning / Pearson Education, PHI, Asia, 2012.
3. Rahul de, MIS in Business, Government and Society, Wiley India Pvt Ltd, 2012
4. Gordon Davis, Management Information System : Conceptual Foundations, Structure and Development, Tata McGraw Hill, 21<sup>st</sup> Reprint 2008.
5. Haag, Cummings and Mc Cubbrey, Management Information Systems for the Information Age, McGraw Hill, 2005. 9<sup>th</sup> edition, 2013.
6. Turban, McLean and Wetherbe, Information Technology for Management –Transforming Organisations in the Digital Economy, John Wiley, 6<sup>th</sup> Edition, 2008.
7. Raymond McLeod and Jr. George P. Schell, Management Information Systems, Pearson Education, 2007.
8. James O Brien, Management Information Systems – Managing Information Technology in the E-business enterprise, Tata McGraw Hill, 2004.
9. Ralph Stair and George Reynolds, Information Systems, Cengage Learning, 10<sup>th</sup> Edition, 2012
10. Corey Schou and Dan Shoemaker, Information Assurance for the Enterprise – A Roadmap to Information Security, Tata McGraw Hill, 2007.
11. Frederick Gallegor, Sandra Senft, Daniel P. Manson and Carol Gonzales, Information Technology Control and Audit, Auerbach Publications, 4<sup>th</sup> Edition, 2013.

**BA5206**

**OPERATIONS MANAGEMENT**

**L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- To provide a broad introduction to the field of operations management and explain the concepts, strategies , tools and techniques for managing the transformation process that can lead to competitive advantage.

**UNIT I INTRODUCTION TO OPERATIONS MANAGEMENT 9**

Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends; Operations Strategy – Strategic fit , framework; Supply Chain Management

**UNIT II FORECASTING, CAPACITY AND FACILITY DESIGN 9**

Demand Forecasting – Need, Types, Objectives and Steps. Overview of Qualitative and Quantitative methods. Capacity Planning – Long range, Types, Developing capacity alternatives. Overview of sales and operations planning. Overview of MRP, MRP II and ERP. Facility Location – Theories, Steps in Selection, Location Models. Facility Layout – Principles, Types, Planning tools and techniques.

**UNIT III DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS 9**

Product Design – Influencing factors, Approaches, Legal, Ethical and Environmental issues. Process – Planning, Selection, Strategy, Major Decisions. Work Study – Objectives, Procedure. Method Study and Motion Study. Work Measurement and Productivity – Measuring Productivity and Methods to improve productivity.

**UNIT IV MATERIALS MANAGEMENT 9**

Materials Management – Objectives, Planning, Budgeting and Control. Purchasing – Objectives, Functions, Policies, Vendor rating and Value Analysis. Stores Management – Nature, Layout, Classification and Coding. Inventory – Objectives, Costs and control techniques. Overview of JIT.

**UNIT V SCHEDULING AND PROJECT MANAGEMENT 9**

Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shop floor control; Flow shop scheduling – Johnson's Algorithm – Gantt charts; personnel scheduling in services.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- Understanding of the strategic and operational decisions in managing manufacturing and service organizations and appreciation of the role of operations management function in an organization.

**REFERENCES :**

1. Richard B. Chase, Ravi Shankar, F. Robert Jacobs, Nicholas J. Aquilano, Operations and Supply Management, Tata McGraw Hill, 12<sup>th</sup> Edition, 2010.
2. Norman Gaither and Gregory Frazier, Operations Management, South Western Cengage, 2002.
3. William J Stevenson, Operations Management, Tata McGraw Hill, 11<sup>th</sup> Edition, 2015.
4. Russel and Taylor, Operations Management, Wiley, 8th Edition, 2015.
5. Kanishka Bedi, Production and Operations Management, Oxford University, 3<sup>rd</sup> Edition, 2013.
6. Chary S. N, Production and Operations Management, Tata McGraw Hill, 5<sup>th</sup> Edition, 2013.
7. Aswathappa K and Shridhara Bhat K, Production and Operations Management, Himalaya Publishing House, Revised Second Edition, 2008.
8. Mahadevan B, Operations Management Theory and practice, Pearson Education, 3<sup>rd</sup> Edition, 2015
9. Pannerselvam R, Production and Operations Management, Prentice Hall India, Second Edition, 2008.

**BA5207**

**MARKETING MANAGEMENT**

**L T P C  
4 0 0 4**

**OBJECTIVES:**

- Developing an understanding of ideas and nuances of modern marketing
- Describe the process to formulate and manage the B2B marketing strategy including all key components.
- Explain the techniques to conduct market analysis practices including market segmentation and targeting.
- Compare and contrast different perspectives that characterize the study of consumer behavior.
- Explain the role of IMC in the overall marketing program.

**UNIT I INTRODUCTION 12**

Marketing – Definitions - Conceptual frame work – Marketing environment : Internal and External - Marketing interface with other functional areas – Production, Finance, Human Relations Management, Information System. Marketing in global environment – Prospects and Challenges.

**UNIT II MARKETING STRATEGY 12**

Marketing strategy formulations – Key Drivers of Marketing Strategies - Strategies for Industrial Marketing – Consumer Marketing — Services marketing – Competitor analysis - Analysis of consumer and industrial markets – Strategic Marketing Mix components.

**UNIT III MARKETING MIX DECISIONS 12**

Product planning and development – Product life cycle – New product Development and Management – Market Segmentation – Targeting and Positioning – Channel Management – Advertising and sales promotions – Pricing Objectives, Policies and methods.

**UNIT IV BUYER BEHAVIOUR****12**

Understanding industrial and individual buyer behavior - Influencing factors – Buyer Behaviour Models – Online buyer behaviour - Building and measuring customer satisfaction – Customer relationships management – Customer acquisition, Retaining, Defection.

**UNIT V MARKETING RESEARCH & TRENDS IN MARKETING****12**

Marketing Information System – Research Process – Concepts and applications : Product –Advertising – Promotion – Consumer Behaviour – Retail research – Customer driven organizations -Cause related marketing - Ethics in marketing –Online marketing trends.

**TOTAL: 60 PERIODS****OUTCOMES:**

- knowledge of analytical skills in solving marketing related problems
- awareness of marketing management process

**REFERENCES :**

1. Philip Kotler and Kevin Lane Keller, Marketing Management, PHI 14<sup>th</sup> Edition, 2012
2. KS Chandrasekar, "Marketing management-Text and Cases", Tata McGraw Hill, First edition,2010
3. Lamb, hair, Sharma, Mc Daniel– Marketing – An Innovative approach to learning and teaching-A south Asian perspective, Cengage Learning — 2012
4. Paul Baines, Chris Fill and Kelly Page, Marketing, Oxford University Press, 2<sup>nd</sup> Edition,2011.
5. Micheal R.Czinkota & Masaaki Kotabe, Marketing Management, Cengage, 2000.

**BA5211****DATA ANALYSIS AND BUSINESS MODELING****L T P C  
0 0 4 2****OBJECTIVE :**

- to have hands-on experience on decision modeling.

[Business models studied in theory to be practiced using Spreadsheet / Analysis Software]

| S.No. | Exp. No. | Details of experiments               | Duration |
|-------|----------|--------------------------------------|----------|
|       |          | Name                                 |          |
| 1     | 1        | Descriptive Statistics               | 4        |
| 2     | 2        | Hypothesis - Parametric              | 4        |
| 3     | 3        | Hypothesis – Non-parametric          | 4        |
| 4     | 4        | Correlation & Regression             | 4        |
| 5     | 5        | Forecasting                          | 4        |
| 6     | -        | Extended experiment – 1              | 4        |
| 7     | 6        | Portfolio Selection                  | 4        |
| 8     | 7        | Risk Analysis & Sensitivity Analysis | 4        |
| 9     | 8        | Revenue Management                   | 4        |
| 10    | -        | Extended experiment – 2              | 4        |
| 11    | 9        | Transportation & Assignment          | 4        |
| 12    | 10       | Networking Models                    | 4        |
| 13    | 11       | Queuing Theory                       | 4        |
| 14    | 12       | Inventory Models                     | 4        |
| 15    | -        | Extended experiments – 3             | 4        |

- Spreadsheet Software and
- Data Analysis Tools

**TOTAL: 60 PERIODS**

## OUTCOME

- Knowledge of spreadsheets and data analysis software for business modeling.

## TEXTBOOKS

1. David M. Levine et al, "Statistics for Managers using MS Excel" (6<sup>th</sup> Edition) Pearson, 2010
2. David R. Anderson, et al, 'An Introduction to Management Sciences: Quantitative approaches to Decision Making, (13<sup>th</sup> edition) South-Western College Pub, 2011.
3. Hansa Lysander Manohar , " Data Analysis and Business Modelling using MS Excel ", PHI Learning private Ltd, 2017.
4. William J. Stevenson, Ceyhun Ozgur, 'Introduction to Management Science with Spreadsheet', Tata McGraw Hill, 2009.
5. Wayne L. Winston, Microsoft Excel 2010: Data Analysis & Business Modeling, 3<sup>rd</sup> edition, Microsoft Press, 2011.
6. Vikas Gupta, Comdex Business Accounting with Ms Excel, 2010 and Tally ERP 9.0 Course Kit, Wiley India, 2012
7. Kiran Pandya and Smriti Bulsari, SPSS in simple steps, Dreamtech, 2011.

**BA5301**

**INTERNATIONAL BUSINESS MANAGEMENT**

**L T P C**  
**3 0 0 3**

## OBJECTIVE:

- To familiarize the students to the basic concepts of international business management.

### **UNIT I INTRODUCTION**

**6**

International Business –Definition – Internationalizing business-Advantages – factors causing globalization of business- international business environment – country attractiveness –Political, economic and cultural environment – Protection Vs liberalization of global business environment.

### **UNIT II INTERNATIONAL TRADE AND INVESTMENT**

**11**

Promotion of global business – the role of GATT/WTO – multilateral trade negotiation and agreements – VIII & IX, round discussions and agreements – Challenges for global business – global trade and investment – theories of international trade and theories of international investment – Need for global competitiveness – Regional trade block – Types – Advantages and disadvantages – RTBs across the globe – brief history.

### **UNIT III INTERNATIONAL STRATEGIC MANAGEMENT**

**11**

Strategic compulsions-Standardization Vs Differentiation – Strategic options – Global portfolio management- global entry strategy – different forms of international business – advantages - organizational issues of international business – organizational structures – controlling of international business – approaches to control – performance of global business- performance evaluation system.

### **UNIT IV PRODUCTION, MARKETING, FINANCIAL AND HUMAN RESOURCE MANAGEMENT OF GLOBAL BUSINESS**

**11**

Global production –Location –scale of operations- cost of production – Make or Buy decisions – global supply chain issues – Quality considerations- Globalization of markets, marketing strategy – Challenges in product development , pricing, production and channel management- Investment decisions – economic- Political risk – sources of fund- exchange –rate risk and management –strategic orientation – selection of expatriate managers- Training and development – compensation.

**UNIT V CONFLICT MANAGEMENT AND ETHICS IN INTERNATIONAL BUSINESS MANAGEMENT**

**6**

Disadvantages of international business – Conflict in international business- Sources and types of conflict – Conflict resolutions – Negotiation – the role of international agencies –Ethical issues in international business – Ethical decision-making.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- Students would be familiar with global business environment, global strategic management practices and get acquainted with functional domain practices. They would be familiar with conflicts situations and ethical issues in global business.

**REFERENCES :**

1. Charles W.I. Hill and Arun Kumar Jain, International Business, 6<sup>th</sup> edition, Tata McGraw Hill, New Delhi, 2010.
2. John D. Daniels and Lee H. Radebaugh, International Business, Pearson Education Asia, 12th Edition, New Delhi, 2010
3. K. Aswathappa, International Business, 6<sup>th</sup> Edition, Tata Mc Graw Hill, New Delhi, 2015.
4. Michael R. Czinkota, Ilkka A. Ronkainen and Michael H. Moffet, International Business, 7<sup>th</sup> Edition, Cengage Learning, New Delhi, 2010.
5. Rakesh Mohan Joshi, International Business, Oxford University Press, New Delhi, 2009.
6. Vyuptakesh Sharan, International Business, 3<sup>rd</sup> Edition, Pearson Education in South Asia, New Delhi, 2011.

**BA5302**

**STRATEGIC MANAGEMENT**

**L T P C  
3 0 0 3**

**OBJECTIVE:**

- To learn the major initiatives taken by a company's top management on behalf of corporates, involving resources and performance in external environments. It entails specifying the organization's mission, vision and objectives, developing policies and plan to understand the analysis and implementation of strategic management in strategic business units.

**UNIT I STRATEGY AND PROCESS**

**9**

Conceptual framework for strategic management, the Concept of Strategy and the Strategy Formation Process – Stakeholders in business – Vision, Mission and Purpose – Business definition, Objectives and Goals - Corporate Governance and Social responsibility-case study.

**UNIT II COMPETITIVE ADVANTAGE**

**9**

External Environment - Porter's Five Forces Model-Strategic Groups Competitive Changes during Industry Evolution-Globalisation and Industry Structure - National Context and Competitive advantage Resources- Capabilities and competencies–core competencies-Low cost and differentiation Generic Building Blocks of Competitive Advantage- Distinctive Competencies-Resources and Capabilities durability of competitive Advantage- Avoiding failures and sustaining competitive advantage-Case study.

**UNIT III STRATEGIES**

**10**

The generic strategic alternatives – Stability, Expansion, Retrenchment and Combination strategies - Business level strategy- Strategy in the Global Environment-Corporate Strategy-Vertical Integration-Diversification and Strategic Alliances- Building and Restructuring the corporation- Strategic analysis and choice - Environmental Threat and Opportunity Profile (ETOP) - Organizational Capability Profile - Strategic Advantage Profile - Corporate Portfolio Analysis - SWOT Analysis - GAP Analysis - Mc



Kinsey's 7s Framework - GE 9 Cell Model - Distinctive competitiveness - Selection of matrix - Balance Score Card-case study.

**UNIT IV STRATEGY IMPLEMENTATION & EVALUATION 9**

The implementation process, Resource allocation, Designing organisational structure-Designing Strategic Control Systems- Matching structure and control to strategy-Implementing Strategic change-Politics-Power and Conflict-Techniques of strategic evaluation & control-case study.

**UNIT V OTHER STRATEGIC ISSUES 8**

Managing Technology and Innovation-Strategic issues for Non Profit organisations. New Business Models and strategies for Internet Economy-case study

**TOTAL: 45 PERIODS**

**OUTCOME :**

- This Course will create knowledge and understanding of management concepts principles and skills from a people, finance, marketing and organisational perspectives the development of appropriate organisational policies and strategies within a changing context to meet stakeholder interests information systems to learn from failure key tools and techniques for the analysis and design of information systems, including their human and organisational as well as technical aspects.

**REFERENCES :**

1. Hill. Strategic Management : An Integrated approach, 2009 Edition Wiley (2012).
2. John A.Parnell. Strategic Management, Theory and practice Biztantra (2012).
3. Azhar Kazmi, Strategic Management and Business Policy, 3<sup>rd</sup> Edition, Tata McGraw Hill,2008
4. Adriaue Haberberg and Alison Rieple, Strategic Management Theory & Application, Oxford University Press, 2008.
5. Gupta, Gollakota and Srinivasan, Business Policy and Strategic Management – Concepts and Application, Prentice Hall of India, 2005.
6. Dr.Dharma Bir Singh, Strategic Management & Business Policy, KoGent Learning Solutions Inc., Wiley, 2012.
7. John Pearce, Richard Robinson and Amitha Mittal, Strategic Management, McGraw Hill, 12<sup>th</sup> Edition, 2012

## FUNCTIONAL SPECIALIZATIONS

**BA5001**

**BRAND MANAGEMENT**

**L T P C**  
**3 0 0 3**

### **OBJECTIVES :**

- To understand the basic Principles of branding.
- To understand the key issues in crafting and evaluating brand strategies
- To improve the skills in delivering persuasive brand presentations.
- To evaluate brand extension and its contribution to parent brand
- To develop an understanding of brand equity and a range of performance related outcomes.

**UNIT I INTRODUCTION 8**  
Basics Understanding of Brands – Definitions - Branding Concepts – Functions of Brand - Significance of Brands – Different Types of Brands – Co branding – Store brands.

**UNIT II BRAND STRATEGIES 10**  
Strategic Brand Management process – Building a strong brand – Brand positioning – Establishing Brand values – Brand vision – Brand Elements – Branding for Global Markets – Competing with foreign brands.

**UNIT III BRAND COMMUNICATIONS 8**  
Brand image Building – Brand Loyalty programmes – Brand Promotion Methods – Role of Brand ambassadors, celebrities – On line Brand Promotions.

**UNIT IV BRAND EXTENSION 9**  
Brand Adoption Practices – Different type of brand extension – Factors influencing Decision for extension – Re-branding and re-launching.

**UNIT V BRAND PERFORMANCE 10**  
Measuring Brand Performance – Brand Equity Management - Global Branding strategies - Brand Audit – Brand Equity Measurement – Brand Leverage -Role of Brand Managers– Branding challenges & opportunities.

**TOTAL: 45 PERIODS**

### **OUTCOMES :**

- Have a solid understanding of the key ‘branding’ concepts, methods and tools used by marketing practitioners.
- Be able to more confidently engage in and contribute to ‘brand building’ projects, developments, and discussions.

### **REFERENCES :**

1. Kevin Lane Keller, Strategic Brand Management: Building, Measuring and Managing Brand Equity, Pearson, 4th Edition, 2013.
2. Aker, David, Building Strong Brands, Simon and Schuster, 1995
3. Kapferer J.N, Strategic Brand Management, 4th edition, Kogan Press, 2008
4. Moorthi YLR, Brand Management – I edition, Vikas Publishing House 2001.

**OBJECTIVES :**

- To understand the concepts of consumer behaviour and its application in purchase decisions.
- To Analyse of the reasons and motives for consumer buying behaviour
- To analyse the relationship between psychological social and cultural drivers behind consumer behaviour and marketing
- To identify the dynamics of human behaviour and the basic factors that influence the consumers decision process.

**UNIT I INTRODUCTION 9**

Concepts – Significance – Dimensions of Consumer Behavior – Application of knowledge of Consumer Behaviour in marketing decisions.

**UNIT II CONSUMER BEHAVIOR MODELS 9**

Industrial and individual consumer behaviour models - Howard- Sheth, Engel – Kollat, Webster and wind Consumer Behaviour Models – Implications of the models on marketing decisions.

**UNIT III INTERNAL INFLUENCES 9**

Psychological Influences on consumer behavior – motivation – perception – personality Learning and Attitude- Self Image and Life styles – Consumer expectation and satisfaction.

**UNIT IV EXTERNAL INFLUENCES 9**

Socio-Cultural, Cross Culture - Family group – Reference group – Communication - Influences on Consumer behavior

**UNIT V PURCHASE DECISION PROCESS 9**

High and low involvement - Pre-purchase and post-purchase behavior – Online purchase decision process – Diffusion of Innovation – Managing Dissonance - Emerging Issues.

**TOTAL: 45 PERIODS****OUTCOMES :**

- Identify the major individual, social and cultural factors that affect consumers' decision making process;
- Explain and analyze the major stages which consumers usually go through when making a consumption-related decision
- Understand the essence of how consumers make decisions and assess the relevant implications for marketing practitioners

**REFERENCES :**

1. Leon G Schiffman, Joseph Wisembit, S Ramesh Kumar , Consumer Behaviour, 11th edition, Pearson, 2015
2. Barry J.Babin, Eric G.Harris, Ashutosh Mohan, Consumer Behavior: A South Asian Perspective, Cengage Learning, Indian Edition, 6th Edition, 2016
3. P.C.Jain and Monika Bhatt., Consumer Behavior in Indian Context, S.Chand & Company, 2013.
4. Srabanti Mukherjee, Consumer behavior, Cengage Learning, 2012.
5. Assael, Consumer Behavior - A Strategic Approach, Biztranza, 2008
6. Dinesh kumar ,Consumer Behaviour, Oxford University Press,2015.

**OBJECTIVE:**

- To understand the need and importance of maintaining a good customer relationship.

|  |  |          |
|--|--|----------|
| <b>UNIT I</b>  | <b>INTRODUCTION</b>                    | <b>9</b> |
| Definitions - Concepts and Context of relationship Management – Evolution - Transactional Vs Relationship Approach – CRM as a strategic marketing tool – CRM significance to the stakeholders.   |  |          |
| <b>UNIT II</b>   | <b>UNDERSTANDING CUSTOMERS</b>         | <b>9</b> |
| Customer information Database – Customer Profile Analysis - Customer perception, Expectations analysis – Customer behavior in relationship perspectives; individual and group customer's - Customer life time value – Selection of Profitable customer segments. |  |          |
| <b>UNIT III</b>  | <b>CRM STRUCTURES</b>                  | <b>9</b> |
| Elements of CRM – CRM Process – Strategies for Customer acquisition – Retention and Prevention of defection – Models of CRM – CRM road map for business applications.  |  |          |
| <b>UNIT IV</b>   | <b>CRM PLANNING AND IMPLEMENTATION</b> | <b>9</b> |
| Strategic CRM planning process – Implementation issues – CRM Tools- Analytical CRM – Operational CRM – Call center management – Role of CRM Managers.  |  |          |
| <b>UNIT V</b>  | <b>TRENDS IN CRM</b>                   | <b>9</b> |
| e- CRM Solutions – Data Warehousing – Data mining for CRM – an introduction to CRM software packages.  |  |          |

**TOTAL: 45 PERIODS****OUTCOME :**

- To use strategic customer acquisition and retention techniques in CRM.

**REFERENCES :**

- G.Shainesh, Jagdish, N.Sheth, Customer Relationship Management A Strategic Prespective, Macmillan 2010
- Alok Kumar et al, Customer Relationship Management : Concepts and applications, Biztantra, 2008
- H.Peeru Mohamed and A.Sahadevan, Customer Relation Management, Vikas Publishing 2005.
- Jim Catheart, The Eight Competencies of Relationship selling, Macmillan India, 2005.
- Assel, Consumer Behavior, Cengage, 6<sup>th</sup> Edition.
- Kumar, Customer Relationship Management - A Database Approach, Wiley India, 2007.
- Francis Buttle, Customer Relationship Management : Concepts & Tools, Elsevier, 2004.
- Zikmund. Customer Relationship Management, Wiley 2012 ..

**OBJECTIVE:**

- This course introduces students to the basic concepts of advertising and sales promotion and how business organizations and other institutions carry out such activities.

**UNIT I INTRODUCTION TO ADVERTISEMENT 9**

Concept –definition-scope-Objectives-functions-principles of advertisement – Social, Economic and Legal Implications of advertisements – setting advertisement objectives – Advertisement Agencies – Selection and remuneration – Advertisement campaigns – case studies.

**UNIT II ADVERTISEMENT MEDIA 9**

Media plan – Type and choice criteria – Reach and frequency of advertisements – Cost of advertisements - related to sales – Media strategy and scheduling. design and execution of advertisements -Message development – Different types of advertisements – Layout – Design appeal – Copy structure – Advertisement production – Print – Radio. T.V. and Web advertisements – Media Research – Testing validity and Reliability of ads – Measuring impact of advertisements – case studies.

**UNIT III SALES PROMOTION 9**

Scope and role of sale promotion – Definition – Objectives of sales promotion - sales promotion techniques – Trade oriented and consumer oriented. Sales promotion – Requirement identification – Designing of sales promotion campaign – Involvement of salesmen and dealers – Out sourcing sales promotion national and international promotion strategies – Integrated promotion – Coordination within the various promotion techniques – Online sales promotions- case studies.

**UNIT IV PERSONAL SELLING 9**

Introduction – Meaning – Functions- Personal selling process – Evaluation – Compensation – Motivation- Territory Management – Sales Report Preparation and Presentation- Ethical Issues

**UNIT V PUBLICITY AND PUBLIC RELATIONS 9**

Introduction – Meaning – Objectives –Scope-Functions-integrating PR in to Promotional Mix-Marketing Public Relation function- Process of Public Relations-advantages and disadvantages of PR-Measuring the Effectiveness of PR- PR tools and techniques. Difference between Marketing, PR and Publicity -- Social publicity – Web Publicity and Social media – Publicity Campaigns

**TOTAL: 45 PERIODS****OUTCOME :**

- Insight into the importance of advertising and sales promotion campaigns planning and objective setting in relation to consumer decision making processes.

**REFERENCES :**

1. George E Belch and Michel A Belch, Advertising & Promotion, Tata McGraw Hill, 10th edition, 2014
2. Wells, Moriarty & Burnett, Advertising, Principles & Practice, Pearson Education, 7th Edition, 2007.
3. Kenneth Clow. Donald Baack, Integrated Advertisements, Promotion and Marketing communication, Prentice Hall of India, New Delhi, 3rd Edition, 2006.
4. Terence A. Shimp and J.Craig Andrews, Advertising Promotion and other aspects of Integrated Marketing Communications, CENGAGE Learning, 9th edition, 2016
5. S. H. H. Kazmi and Satish K Batra, Advertising & Sales Promotion, Excel Books, New Delhi, 3rd Revised edition edition, 2008.
6. Julian Cummings, Sales Promotion: How to Create, Implement and Integrate Campaigns that Really Work, Kogan Page, London, Fifth Edition Edition ,2010.
7. Jaishri Jephwaney, Advertising Management, Oxford University Press, 2nd Edition, 2013.

**OBJECTIVE:**

- To understand the concepts of effective retailing

**UNIT I INTRODUCTION 9**

An overview of Global Retailing – Challenges and opportunities – Retail trends in India – Socio economic and technological Influences on retail management – Government of India policy implications on retails.

**UNIT II RETAIL FORMATS 9**

Organized and unorganized formats – Different organized retail formats – Characteristics of each format – Emerging trends in retail formats – MNC's role in organized retail formats.

**UNIT III RETAILING DECISIONS 9**

Choice of retail locations - internal and external atmospheric – Positioning of retail shops – Building retail store Image - Retail service quality management – Retail Supply Chain Management – Retail Pricing Decisions. Mercandising and category management – buying.

**UNIT IV RETAIL SHOP MANAGEMENT 9**

Visual Merchandise Management – Space Management – Retail Inventory Management – Retail accounting and audits - Retail store brands – Retail advertising and promotions – Retail Management Information Systems - Online retail – Emerging trends .

**UNIT V RETAIL SHOPPER BEHAVIOUR 9**

Understanding of Retail shopper behavior – Shopper Profile Analysis – Shopping Decision Process - Factors influencing retail shopper behavior – Complaints Management - Retail sales force Management – Challenges in Retailing in India.

**TOTAL: 45 PERIODS****OUTCOME:**

- To manage the retail chains and understand the retail customer's behavior

**REFERENCES :**

1. Michael Havy ,Baston, Aweitz and Ajay Pandit, Retail Management, Tata Mcgraw Hill, Sixth Edition, 2007
2. J K Nayak, Prakash C.Dash, Retail Management, Cengage, 2017
3. Dr.Harjit Singh, Retail Management A Global Perspective, S.Chand Publishing, 3rd Edition,2014
4. Patrick M. Dunne and Robert F Lusch, Retailing, Cengage, 8th edition, 2013.
5. Chetan Bajaj, Rajnish Tow and Nidhi V. Srivatsava, Retail Management, Oxford University Press, 3rd Edition 2016.
6. Swapna Pradhan, Retail Management -Text and Cases, Tata McGraw Hill, 4th Edition, 2012.
7. Ramkrishnan and Y.R.Srinivasan, Indian Retailing Text and Cases, Oxford University Press, 2008

**BA5006**

**SERVICES MARKETING**

**L T P C**

**3 0 0 3**

**OBJECTIVE:**

- To understand the meaning of services and the significance of marketing the services.

**UNIT I INTRODUCTION 9**

Definition – Service Economy – Evolution and growth of service sector – Nature and Scope of Services – Unique characteristics of services - Challenges and issues in Services Marketing.

**UNIT II SERVICE MARKETING OPPORTUNITIES 9**

Assessing service market potential - Classification of services – Expanded marketing mix – Service marketing – Environment and trends – Service market segmentation, targeting and positioning.

**UNIT III SERVICE DESIGN AND DEVELOPMENT 9**

Service Life Cycle – New service development – Service Blue Printing – GAP model of service quality – Measuring service quality – SERVQUAL – Service Quality function development.

**UNIT IV SERVICE DELIVERY AND PROMOTION 9**

Positioning of services – Designing service delivery System, Service Channel – Pricing of services, methods – Service marketing triangle - Integrated Service marketing communication.

**UNIT V SERVICE STRATEGIES 9**

Service Marketing Strategies for health – Hospitality – Tourism – Financial – Logistics - Educational – Entertainment & public utility Information technique Services

**TOTAL: 45 PERIODS**

**OUTCOME:**

- Will be able to apply the concepts of services marketing in promoting services.

**REFERENCES :**

1. Chiristopher H.Lovelock and Jochen Wirtz, Services Marketing, Pearson Education, New Delhi, 7<sup>th</sup> edition, 2011.
2. Hoffman, Marketing of Services, Cengage, 4<sup>th</sup> Edition, 2010.
3. Kenneth E Clow, et al, Services Marketing Operation Management and Strategy, Biztantra, 2<sup>nd</sup> Edition, New Delhi, 2004.
4. Valarie Zeithaml et al, Services Marketing, 5<sup>th</sup> International Edition, Tata McGraw Hill, 2007.
5. Gronroos, Service Management and Marketing –Wiley India, 3<sup>rd</sup> Edition, 2009.

**BA5007**

**SOCIAL MARKETING**

**L T P C**

**3 0 0 3**

**OBJECTIVE:**

- To enhance Competiveness in Social Marketing by ethical values and social media in Marketing.

**UNIT I INTRODUCTION 9**

Social marketing - Definition - Scope and concept - Evolution of Social marketing - Need for Social marketing - A comparative study between Commercial and Social marketing - Use of market research - social change tools - Factors influencing Social marketing - Challenges and opportunities.

## **UNIT II SOCIAL MARKETING PROCESS AND PLANNING 9**

Introduction - Environment Monitoring - Social Class and self-efficacy - social capital - Social ecology - Advocacy - A global phenomenon - Social marketing Process - Stages - Ethical considerations. Planning - Formative Research in Social marketing. Analysis - Problem - Environment - Resource.

Segmentation - Motives and benefits - Sheth's and Frazier's attitude - behavior segmentation - Stage approach to segmentation - Selecting target audiences - Cross cultural targeting - cultural and individual tailoring.

## **UNIT III SOCIAL MARKETING MIX 9**

Social marketing mix - policy - product - place - price - promotion - people - partnership. Rating & Reviews - Virtual world - Using media in social marketing - Importance - effectiveness of mass media in social marketing - Practical model for media use in social marketing - Advertisement - Publicity - Edutainment - Civic or Public - Choosing media & methods.

Role of media in social marketing campaigns - planning and developing Social media campaigning – Campaign vs Programme - Programme planning models – conceptual model Lawrence Green's PRECEDE-PROCEED model.

## **UNIT IV ETHICAL ISSUES AND CHALLENGES 9**

Ethical principles - Codes of behaviour - Critics of social marketing - Critic of power imbalance in social marketing - Criticism of unintended consequences - Competition in social marketing- Definition - monitoring - countering competition - competition and principle of differential advantage - Internal competition.

## **UNIT V TRENDS IN SOCIAL MARKETING 9**

Future of Social marketing - setting priorities in social marketing - Repositioning strategies- Future of Public sector – NGO – Private sector social marketing.

Social Media marketing - Importance - Big Brands & Small business - E mail marketing -Social Media Tools –Marketing with Social network sites, blogging, micro blogging, podcasting with Podomatic

**TOTAL: 45 PERIODS**

### **OUTCOME:**

- Applying Ethical Principles in Social Marketing through advanced marketing medias

### **REFERENCES :**

1. Rob Donovan & Nadine Henley. (2011). Principles and Practice of Social Marketing-an international perspective. Cambridge University Press.
2. Kotler, P., Roberto, N., & Lee, N. (2008). Social Marketing – Influencing Behaviors for Good. (3rd ed.). Thousand Oaks, CA: Sage Publications, Inc.
3. French, J., Blair-Stevens, C., McVey, D., & Merritt, R. Social Marketing and Public Health. Oxford, UK: University Press 2010.
4. Hastings, G. Social Marketing: Why should the Devil Have All the Best Tunes, Routledge 2013
5. Social marketing in the 21<sup>st</sup> Century- Alan R. Andreasen- sage Publication, 2012



**OBJECTIVES:**

- Grasp how banks raise their sources and how they deploy it and manage the associated risks
- Understand e-banking and the threats that go with it.

**UNIT I OVERVIEW OF INDIAN BANKING SYSTEM 9**

Overview of Indian Banking System, Functions of banks, key Acts governing the functioning of Indian banking system – RBI Act 1934, Negotiable Instruments Act 1881, Banking Regulations Act 1948 – Rights and obligations of a banker, Overview of Financial statement of banks – Balance sheet and Income Statement.

**UNIT II SOURCES AND APPLICATION OF BANK FUNDS 9**

Capital adequacy, Deposits and non-deposit sources, Designing of deposit schemes and pricing of deposit services, application of bank funds – Investments and Lending functions, Types of lending – Fund based, non-fund based, asset based – Different types of loans and their features, Major components of a typical loan policy document, Steps involved in Credit analysis, Credit delivery and administration, Pricing of loans, Customer profitability analysis.

**UNIT II CREDIT MONITORING AND RISK MANAGEMENT 9**

Need for credit monitoring, Signals of borrowers' financial sickness, Financial distress prediction models – Rehabilitation process, Risk management – Interest rate, liquidity, forex, credit, market, operational and solvency risks – risk measurement process and mitigation, Basic understanding of NPAs and ALM.

**UNIT IV MERGERS, DIVERSIFICATION AND PERFORMANCE EVALUATION 9**

Mergers and Diversification of banks into securities market, underwriting, Mutual funds and Insurance business, Risks associated therewith. Performance analysis of banks – background factors, ratio analysis and CAMELS.

**UNIT V HIGH TECH E-BANKING 9**

Payment system in India – Paper based, e-payments – Electronic banking – advantages – Plastic money, E-money – Forecasting of cash demand at ATMs – Security threats in e-banking and RBI's initiatives.

**TOTAL: 45 PERIODS****OUTCOME:**

- Price various types of loans proposed by banks to various prospective borrowers with different risk profiles and evaluate the performance of banks

**REFERENCES :**

1. Padmalatha Suresh and Justin Paul, "Management of Banking and Financial Services, Pearson, Delhi, 2012.
2. Meera Sharma, "Management of Financial Institutions – with emphasis on Bank and Risk Management", PHI Learning Pvt. Ltd., New Delhi 2010.
3. Peter S. Rose and Sylvia C. and Hudgins, "Bank Management and Financial Services", Tata McGraw Hill, New Delhi, 2012.
4. Madura, Financial Institutions & Markets, 10<sup>th</sup> edition, Cengage, 2016.

**OBJECTIVES :**

Student will acquire

- Nuances involved in short term corporate financing
- Good ethical practices

**UNIT I INDUSTRIAL FINANCE****9**

Indian Capital Market – Basic problem of Industrial Finance in India. Equity – Debenture financing – Guidelines from SEBI, advantages and disadvantages and cost of various sources of Finance – Finance from international sources, financing of exports – role of EXIM bank and commercial banks.– Finance for rehabilitation of sick units.

**UNIT II SHORT TERM-WORKING CAPITAL FINANCE****6**

Estimating working capital requirements – Approach adopted by Commercial banks, Commercial paper- Public deposits and inter corporate investments.

**UNIT III ADVANCED FINANCIAL MANAGEMENT****12**

Appraisal of Risky Investments - certainty equivalent of cash flows and risk adjusted discount rate -risk analysis in the context of DCF methods using Probability information - nature of cash flows - Sensitivity analysis - Simulation and investment decision, Decision tree approach in investment decisions.

**UNIT IV FINANCING DECISION****10**

Simulation and financing decision - cash inadequacy and cash insolvency - determining the probability of cash insolvency- Financing decision in the Context of option pricing model and agency costs- Inter-dependence of investment- financing and Dividend decisions.

**UNIT V CORPORATE GOVERNANCE****8**

Corporate Governance - SEBI Guidelines- Corporate Disasters and Ethics-Corporate Social Responsibility- Stakeholders and Ethics- Ethics, Managers and Professionalism.

**TOTAL: 45 PERIODS****OUTCOME :**

- Good ethical corporate manager

**REFERENCES :**

1. Richard A.Brealey, Stewart C.Myers and Mohanthy, Principles of Corporate Finance, Tata McGraw Hill, 9<sup>th</sup> Edition, 2011
2. I.M.Pandey, Financial Management, Vikas Publishing House Pvt., Ltd., 12<sup>th</sup> Edition, 2012.
3. Brigham and Ehrhardt, Corporate Finance - A focused Approach, Cengage Learning, 2nd Edition, 2011.
4. M.Y Khan, Indian Financial System, Tata McGraw Hill, 6<sup>th</sup> Edition, 2011
5. Smart, Megginson, and Gitman, Corporate Finance, 2nd Edition, 2011.
6. Krishnamurthy and Viswanathan, Advanced Corporate Finance, PHI Learning, 2011.
7. Website of SEBI
8. Besley, Brigham, Parasuraman, Corporate Finance, Cengage Learning, 2015
9. Michael C.Ehrhardt, Eugene F.Brigham, Corporate Finance – A focused approach, Cengage Learning, 2011.
10. Madura, International Corporate Finance, 10<sup>th</sup> edition, Cengage Learning, 2014.

**OBJECTIVE :**

- To understand the nuances involved in derivatives and to understand the basic operational mechanisms in derivatives.

|  |                             |          |
|--|-----------------------------|----------|
| <b>UNIT I</b>  | <b>INTRODUCTION</b>         | <b>9</b> |
| Derivatives – Definition – Types – Forward Contracts – Futures Contracts – Options – Swaps – Differences between Cash and Future Markets – Types of Traders – OTC and Exchange Traded Securities – Types of Settlement – Uses and Advantages of Derivatives – Risks in Derivatives.  |                             |          |
| <b>UNIT II</b>   | <b>FUTURES CONTRACT</b>     | <b>9</b> |
| Specifications of Futures Contract - Margin Requirements – Marking to Market – Hedging uses Futures – Types of Futures Contracts – Securities, Stock Index Futures, Currencies and Commodities – Delivery Options – Relationship between Future Prices, Forward Prices and Spot Prices.  |                             |          |
| <b>UNIT III</b>  | <b>OPTIONS</b>              | <b>9</b> |
| Definition – Exchange Traded Options, OTC Options – Specifications of Options – Call and Put Options – American and European Options – Intrinsic Value and Time Value of Options – Option payoff, options on Securities, Stock Indices, Currencies and Futures – Options pricing models – Differences between future and Option contracts.                                 |                             |          |
| <b>UNIT IV</b>   | <b>SWAPS</b>                | <b>9</b> |
| Definition of SWAP – Interest Rate SWAP – Currency SWAP – Role of Financial Intermediary – Warehousing – Valuation of Interest rate SWAPs and Currency SWAPs Bonds and FRNs – Credit Risk.   |                             |          |
| <b>UNIT V</b>  | <b>DERIVATIVES IN INDIA</b> | <b>9</b> |
| Evolution of Derivatives Market in India – Regulations - Framework – Exchange Trading in Derivatives – Commodity Futures – Contract Terminology and Specifications for Stock Options and Index Options in NSE – Contract Terminology and specifications for stock futures and Index futures in NSE –Contract Terminology and Specifications for Interest Rate Derivatives. |                             |          |

**TOTAL: 45 PERIODS****OUTCOME :**

- This course aims at providing an in-depth understanding of financial derivatives in terms of concepts, structure, instruments and trading strategies for profit and risk management.

**REFERENCES :**

- David Dubofsky – ‘Option and Financial Futures – Valuation and Uses, McGraw Hill International Edition.
- Don M. Chance, Robert Brooks, An Introduction to Derivatives and Risk Management, 9<sup>th</sup> edition, Cengage, 2015.
- John. C. Hull, Options, Futures and Other Derivative Securities’, PHI Learning, 9th Edition, 2012
- Keith Redhead, ‘Financial Derivatives – An Introduction to Futures, Forwards, Options and SWAPs’,– PHI Learning, 2011.
- S. L. Gupta, Financial Derivatives- Theory, Concepts and Practice, Prentice Hall of India, 2011.
- Stulz, Risk Management and Derivatives, Cengage, 2nd Edition, 2011.
- Varma, Derivatives and Risk Management, 2<sup>nd</sup> Edition, 2011.
- Website of NSE, BSE.

**OBJECTIVES :**

To enable student

- Understand the modes of issuing securities
- Acquire financial evaluation technique of leasing and hire purchase

**UNIT I MERCHANT BANKING 5**

Introduction – An Over view of Indian Financial System – Merchant Banking in India – Recent Developments and Challenges ahead – merchant banking services offered by banks – NBFC'S offering merchant banking – Banking system – types of banks – payment banking -Legal and Regulatory Framework – Relevant Provisions of Companies Act- SERA- SEBI guidelines- FEMA, etc. - Relation with Stock Exchanges and OTCEI.

**UNIT II ISSUE MANAGEMENT 12**

Role of Merchant Banker in Appraisal of Projects, Designing Capital Structure and Instruments – Issue Pricing – Book Building – Preparation of Prospectus Selection of Bankers, Advertising Consultants, etc. - Role of Registrars –Bankers to the Issue, Underwriters, and Brokers. – Offer for Sale – Green Shoe Option – E-IPO, Private Placement – Bought out Deals – Placement with FIs, MFs, FII, etc. Off - Shore Issues. – Issue Marketing – Advertising Strategies – NRI Marketing – Post Issue Activities.

**UNIT III OTHER FEE BASED SERVICES 10**

Mergers and Acquisitions – Portfolio Management Services – Credit Syndication – Credit Rating – Mutual Funds - Business Valuation.

**UNIT IV FUND BASED FINANCIAL SERVICES 10**

Leasing and Hire Purchasing – Basics of Leasing and Hire purchasing – Financial Evaluation.

**UNIT V OTHER FUND BASED FINANCIAL SERVICES 8**

Consumer Credit – Credit Cards – Real Estate Financing – Bills Discounting – factoring and Forfeiting – Venture Capital - venture debt funds – start up financing.

**TOTAL: 45 PERIODS****OUTCOME**

- Good knowledge on merchant banking activities

**REFERENCES :**

1. M.Y.Khan, Financial Services, Tata McGraw-Hill, 12<sup>th</sup> Edition, 2012
2. Nalini Prava Tripathy, Financial Services, PHI Learning, 2011.
3. Machiraju, Indian Financial System, Vikas Publishing House, 2nd Edition, 2010.
4. J.C.Verma, A Manual of Merchant Banking, Bharath Publishing House, New Delhi,
5. Varshney P.N. & Mittal D.K., Indian Financial System, Sultan Chand & Sons, New Delhi.
6. Sasidharan, Financial Services and System, Tata Mcgraw Hill, New Delhi, 2nd Edition, 2011.
7. Website of SEBI
8. Madura, Financial Institutions & Markets, 10<sup>th</sup> edition, Cengage, 2016.

**OBJECTIVES :**

Enables student to

- Understand the nuances of stock market operations.
- Understand the techniques involved in deciding upon purchase or sale of securities.

**UNIT I INVESTMENT SETTING 8**

Financial and economic meaning of Investment – Characteristics and objectives of Investment – Types of Investment – Investment alternatives – Choice and Evaluation – Risk and return concepts.

**UNIT II SECURITIES MARKETS 10**

Financial Market - Segments – Types - - Participants in financial Market – Regulatory Environment, Primary Market – Methods of floating new issues, Book building – Role of primary market – Regulation of primary market, Stock exchanges in India – BSE, OTCEI , NSE, ISE, and Regulations of stock exchanges – Trading system in stock exchanges –SEBI.

**UNIT III FUNDAMENTAL ANALYSIS 9**

Economic Analysis – Economic forecasting and stock Investment Decisions – Forecasting techniques. Industry Analysis : Industry classification, Industry life cycle – Company Analysis Measuring Earnings – Forecasting Earnings – Applied Valuation Techniques – Graham and Dodds investor ratios.

**UNIT IV TECHNICAL ANALYSIS 9**

Fundamental Analysis Vs Technical Analysis – Charting methods – Market Indicators. Trend – Trend reversals – Patterns - Moving Average – Exponential moving Average – Oscillators – Market Indicators – Efficient Market theory.

**UNIT V PORTFOLIO MANAGEMENT 9**

Portfolio analysis – Portfolio Selection –Capital Asset Pricing model – Portfolio Revision Portfolio Evaluation – Mutual Funds.

**TOTAL: 45 PERIODS****OUTCOME**

- Become a good investment analyst

**REFERENCES :**

1. Donald E.Fischer & Ronald J.Jordan, Security Analysis & Portfolio Management, PHI Learning., New Delhi, 8<sup>th</sup> edition, 2011.
2. Prasannachandra, Investment analysis and Portfolio Management, Tata McGraw Hill, 2011.
3. Reilly & Brown, Investment Analysis and Portfolio Management, Cengage, 10<sup>th</sup> edition, 2016.
4. S. Kevin , Securities Analysis and Portfolio Management , PHI Learning , 2012.

**OBJECTIVE :**

- Enable students to acquire techniques of evaluating strategic investment decisions understand the causes of prediction modes of financial distress.

**UNIT I INVESTMENT DECISIONS****9**

Project Investment Management Vs Project Management – Introduction to profitable projects – evaluation of Investment opportunities – Investment decisions under conditions of uncertainty – Risk analysis in Investment decision – Types of investments and disinvestments.

**UNIT II CRITICAL ANALYSIS OF APPRAISAL TECHNIQUES****10**

Significance of Information and data bank in project selections – Investment decisions under capital constraints – capital rationing, Portfolio – Portfolio risk and diversified projects.

**UNIT III STRATEGIC ANALYSIS OF SELECTED INVESTMENT DECISIONS****10**

Lease financing – Lease Vs Buy decision – Hire Purchase and installment decision – Hire Purchase Vs Lease Decision – Mergers and acquisition – Cash Vs Equity for mergers.

**UNIT IV FINANCING DECISIONS****8**

Capital Structure – Capital structure theories – Capital structure Planning in Practice.

**UNIT V FINANCIAL DISTRESS****8**

Consequences, Issues, Bankruptcy, Settlements, reorganization and Liquidation in bankruptcy.

**TOTAL: 45 PERIODS****OUTCOME :**

- Possess good knowledge in techniques for making strategic investment decision and tackling financial distress

**REFERENCES:**

1. Prasanna Chandra, Financial Management, Tata McGraw Hill, 9th Edition, 2012.
2. Prasanna Chandra, Projects : Planning, Analysis, Financing Implementation and Review, TMH, New Delhi, 2011.
3. Bodie, Kane, Marcus: Investment, Tata McGraw Hill, New Delhi, 2010.
4. Brigham E. F & Houston J.F. Financial Management, Thomson Publications, 9 th edition, 2010.
5. M. Pandey, Financial Management, Vikas Publishing House, 10th edition, 2010.
6. M. Y. Khan and P. K. Jain, Financial Management Text and Problems, Tata McGraw Hill Publishing Co, 2011.
7. Website of IDBI Related to Project Finance.

**OBJECTIVES :**

To enable student

- Understand export import finance and forex management
- Understand the documentation involved in international trade

**UNIT I INTERNATIONAL TRADE 9**  
International Trade – Meaning and Benefits – Basis of International Trade –Foreign Trade and Economic Growth – Balance of Trade – Balance of Payment – Current Trends in India – Barriers to International Trade – WTO – Indian EXIM Policy.

**UNIT II EXPORT AND IMPORT FINANCE 9**  
Special need for Finance in International Trade – INCO Terms (FOB, CIF, etc.,) – Payment Terms – Letters of Credit – Pre Shipment and Post Shipment Finance – Forfaiting – Deferred Payment Terms – EXIM Bank – ECGC and its schemes Import Licensing – Financing methods for import of Capital goods

**UNIT III FOREX MANAGEMENT 9**  
Foreign Exchange Markets – Spot Prices and Forward Prices – Factors influencing Exchange rates – The effects of Exchange rates in Foreign Trade – Tools for hedging against Exchange rate variations – Forward, Futures and Currency options – FEMA – Determination of Foreign Exchange rate and Forecasting.

**UNIT IV DOCUMENTATION IN INTERNATIONAL TRADE 9**  
Export Trade Documents: Financial Documents – Bill of Exchange- Type- Commercial Documents - Proforma, Commercial, Consular, Customs, Legalized Invoice, Certificate of Origin Certificate Value, Packing List, Weight Certificate, Certificate of Analysis and Quality, Certificate of Inspection, Health certificate. Transport Documents -Bill of Lading, Airway Bill, Postal Receipt, Multimodal Transport Document. Risk Covering Document: Insurance Policy, Insurance Cover Note. Official Document: Export Declaration Forms, GR Form, PP Form, COD Form, Softer Forms, Export Certification, GSPS – UPCDC Norms.

**UNIT V EXPORT PROMOTION SCHEMES 9**  
Government Organizations Promoting Exports – Export Incentives : Duty Exemption – IT Concession – Marketing Assistance – EPCG, DEPB – Advance License – Other efforts I Export Promotion – EPZ – EQU – SEZ and Export House.

**TOTAL: 45 PERIODS**

#### **OUTCOME**

- Possess good knowledge on international trade and the documentation involved in it.

#### **TEXT BOOKS**

1. Apte P.G., International Financial Management, Tata McGraw Hill, 2011.
2. Jeff Madura, International Corporate Finance, Cengage Learning, 9th Edition, 2011.

#### **REFERENCES**

1. Alan C. Shapiro, Multinational Financial Management, PHI Learning, 5th Edition, 2010.
2. Eun and Resnik, International Financial Management, Tata Mcgraw Hill, 5th Edition, 2011.
3. Website of Indian Government on EXIM policy

**OBJECTIVE:**

- To develop and strengthen entrepreneurial quality and motivation in students. To impart basic entrepreneurial skills and understandings to run a business efficiently and effectively.

**UNIT I ENTREPRENEURIAL COMPETENCE 6**  
 Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful, Entrepreneur – Knowledge and Skills of Entrepreneur.

**UNIT II ENTREPRENEURIAL ENVIRONMENT 12**  
 Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organisational Services - Central and State Government Industrial Policies and Regulations - International Business.

**UNIT III BUSINESS PLAN PREPARATION 12**  
 Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product - Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria.

**UNIT IV LAUNCHING OF SMALL BUSINESS 10**  
 Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching – Incubation, Venture capital, IT startups.

**UNIT V MANAGEMENT OF SMALL BUSINESS 5**  
 Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business.

**TOTAL: 45 PERIODS****OUTCOME:**

- Students will gain knowledge and skills needed to run a business.

**REFERENCES:**

- Hisrich, Entrepreneurship, Edition 9, Tata McGraw Hill, New Delhi, 2014
- S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, (Revised Edition) 2013.
- Mathew Manimala, Entrepreneurship Theory at the Crossroads, Paradigms & Praxis, Biztrantra, 2<sup>nd</sup> Edition, 2005
- Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill, 1996.
- P.Saravanel, Entrepreneurial Development, Ess Pee kay Publishing House, Chennai
- 1997.
- Arya Kumar. Entrepreneurship. Pearson, 2012.
- Donald F Kuratko, T.V Rao. Entrepreneurship: A South Asian perspective. Cengage, 2012



**OBJECTIVE:**

- To explore contemporary knowledge and gain a conceptual understanding of industrial relations.

**UNIT I INDUSTRIAL RELATIONS 7**

Concepts – Importance – Industrial Relations problems in the Public Sector – Growth of Trade Unions – Codes of conduct.

**UNIT II INDUSTRIAL CONFLICTS 12**

Disputes – Impact – Causes – Strikes – Prevention – Industrial Peace – Government Machinery – Conciliation – Arbitration – Adjudication.

**UNIT III LABOUR WELFARE 8**

Concept – Objectives – Scope – Need – Voluntary Welfare Measures – Statutory Welfare Measures – Labour – Welfare Funds – Education and Training Schemes.

**UNIT IV INDUSTRIAL SAFETY 9**

Causes of Accidents – Prevention – Safety Provisions – Industrial Health and Hygiene – Importance – Problems – Occupational Hazards – Diseases – Psychological problems – Counseling – Statutory Provisions.

**UNIT V WELFARE OF SPECIAL CATEGORIES OF LABOUR 9**

Child Labour – Female Labour – Contract Labour – Construction Labour – Agricultural Labour – Differently abled Labour – BPO & KPO Labour - Social Assistance – Social Security – Implications.

**TOTAL: 45 PERIODS****OUTCOME:**

- Students will know how to resolve industrial relations and human relations problems and promote welfare of industrial labour.

**REFERENCES :**

- Mamoria C.B., Sathish Mamoria, Gankar, Dynamics of Industrial Relations, Himalaya Publishing House, New Delhi, 2012.
- Arun Monappa, Ranjeet Nambudiri, Patturaja Selvaraj. Industrial relations & Labour Laws. Tata McGraw Hill. 2012.
- Ratna Sen, Industrial Relations in India, Shifting Paradigms, Macmillan India Ltd., New Delhi, 2007.
- C.S.Venkata Ratnam, Globalisation and Labour Management Relations, Response Books, 2007.
- Srivastava, Industrial Relations and Labour laws, Vikas, 2007.
- P.N.Singh, Neeraj Kumar. Employee relations Management. Pearson. 2011.
- P.R.N Sinha, Indu Bala Sinha, Seema Priyardarshini Shekhar. Industrial Relations, Trade Unions and Labour Legislation. Pearson. 2004

**OBJECTIVE:**

- To have a broad understanding of the legal principles governing the employment relationship at individual and collective level.
- To familiarise the students to the practical problems inherent in the implementation of labour statutes.

Contained in the following acts are to be studied.

|   | Periods |
|---|---------|
| 1. The Factories Act, 1948                                | 3       |
| 2. The Trade Unions Act, 1926                             | 4       |
| 3. The Payment of Wages Act, 1936                         | 3       |
| 4. The Minimum Wages Act, 1948                            | 2       |
| 5. The Industrial Disputes Act, 1947                      | 5       |
| 6. The Workmen's Compensation Act, 1923                   | 2       |
| 7. The Payment of Gratuity Act, 1972                      | 3       |
| 8. The Payment of Bonus Act, 1965                         | 3       |
| 9. The Employee's Provident Fund & Misc. Act, 1952        | 3       |
| 10. The Employees State Insurance Act, 1948               | 4       |
| 11. The Industrial Employment (Standing Orders) Act, 1946 | 3       |
| 12. The Apprentices Act, 1961                             | 2       |
| 13. The Equal Remuneration Act, 1976                      | 2       |
| 14. The Maternity Benefit Act, 1961                       | 2       |
| 15. Contract Labour Regulations and Abolition Act, 1970   | 2       |
| 16. The Child Labour Prevention and Regulation Act, 1986  | 2       |

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- To appreciate the application of labour laws.
- Legal Provision relating to
  - a) Wages
  - b) Working Conditions and Labour Welfare
  - c) Industrial Relations
  - d) Social Security

**REFERENCES :**

1. P.K. Padhi, Industrial Laws, PHI, 2008.
2. Kapoor N. D , Elements of Mercantile Law, Sultan Chand, 2008
3. Tax Mann, Labour Laws, 2008.
4. D. R. N. Sinha, Indu Balasinha & Semma Priyadarshini Shekar, Industrial Relation, Trade unions and Labour Legislation, 2004.
5. Arun Monappa, Ranjeet Nambudiri, Patturaja Selvaraj. Industrial relations & Labour Laws. Tata McGraw Hill. 2012
6. Srivastava, Industrial Relations and Labour laws, Vikas, 2007.
7. Respective Bare Acts.

**OBJECTIVE:**

- To examine managerial styles in terms of concern for production and concern for people. To assess different systems of management and relate these systems to organisational characteristics.

|   |   |           |
|---|---|-----------|
| <b>UNIT I</b>   | <b>DEFINING THE MANAGERIAL JOB</b>                      | <b>8</b>  |
| Descriptive Dimensions of Managerial Jobs – Methods – Model – Time Dimensions in Managerial Jobs – Effective and Ineffective Job behaviour – Functional and level differences in Managerial Job behaviour.  |   |           |
| <b>UNIT II</b>  | <b>DESIGNING THE MANAGERIAL JOB</b>                     | <b>12</b> |
| Identifying Managerial Talent – Selection and Recruitment – Managerial Skills Development – Pay and Rewards – Managerial Motivation – Effective Management Criteria – Performance Appraisal Measures – Balanced Scorecard - Feedback – Career Management – Current Practices. |   |           |
| <b>UNIT III</b>   | <b>THE CONCEPT OF MANAGERIAL EFFECTIVENESS</b>          | <b>7</b>  |
| Definition – The person, process, product approaches – Bridging the Gap – Measuring Managerial Effectiveness – Current Industrial and Government practices in the Management of Managerial Effectiveness- the Effective Manager as an Optimizer.                              |   |           |
| <b>UNIT IV</b>  | <b>ENVIRONMENTAL ISSUES IN MANAGERIAL EFFECTIVENESS</b> | <b>8</b>  |
| Organisational Processes – Organisational Climate – Leader – Group Influences – Job Challenge – Competition – Managerial Styles.  |   |           |
| <b>UNIT V</b>   | <b>DEVELOPING THE WINNING EDGE</b>                      | <b>10</b> |
| Organisational and Managerial Efforts – Self Development – Negotiation Skills – Development of the Competitive Spirit – Knowledge Management – Fostering Creativity and innovation.   |   |           |

**TOTAL:45 PERIODS****OUTCOME:**

- Students will gain knowledge about appropriate style of managerial behaviour.

**REFERENCES:**

1. Peter Drucker, Management, Harper Row, 2006.
2. Milkovich and Newman, Compensation, McGraw-Hill International, 2013.
3. Blanchard and Thacker, Effective Training Systems, Strategies and Practices Pearson 2012.
4. Dubrin, Leadership, Research Findings, Practices & Skills, Biztantra, 2015.
5. Joe Tidd , John Bessant, Keith Pavitt , Managing Innovation ,Wiley 3<sup>rd</sup> edition,2006.
6. T.V.Rao,Appraising and Developing Managerial Performance, Excel Books,2002.
7. R.M.Omkar, Personality Development and Career Management, S.Chand 1<sup>st</sup>edition,2008.
8. Richard L.Daft, Leadership, Cengage, 1 st Indian Reprint 2008.

**OBJECTIVE:**

- To learn how an organization can be designed and developed to deal with the challenges from environment, technology, and its own processes.

**UNIT I ORGANISATION & ITS ENVIRONMENT 8**  
Meaning of Organisation – Need for existence - Organisational Effectiveness – Creation of Value – Measuring Organisational Effectiveness – External Resources Approach, Internal Systems Approach and Technical approach - HR implications.

**UNIT II ORGANIZATIONAL DESIGN 15**  
Organizational Design – Determinants – Components – Types - Basic Challenges of design – Differentiation, Integration, Centralization, Decentralization, Standardization, Mutual adjustment- Mechanistic and Organic Structures- Technological and Environmental Impacts on Design-Importance of Design – Success and Failures in design - Implications for Managers.

**UNIT III ORGANISATIONAL CULTURE 6**  
Understanding Culture – Strong and Weak Cultures – Types of Cultures – Importance of Culture - Creating and Sustaining Culture - Culture and Strategy - Implications for practicing Managers.

**UNIT IV ORGANISATIONAL CHANGE 6**  
Meaning – Forces for Change - Resistance to Change – Types and forms of change – Evolutionary and Revolutionary change – Change process -Organisation Development – HR functions and Strategic Change Management - Implications for practicing Managers.

**UNIT V ORGANISATION EVOLUTION AND SUSTENANCE 10**  
Organizational life cycle – Models of transformation – Models of Organizational Decision making – Organizational Learning – Innovation, Intrapreneurship and Creativity-HR implications.

**TOTAL: 45 PERIODS****OUTCOME:**

- Students will be able to analyze organizations more accurately and deeply by applying organization theory.

**REFERENCES:**

1. Thomson G. Cummings and Christopher G. Worley, Organisational development and Change, Cengage, 9<sup>th</sup> edition 2011
2. Robbins Organisation Theory; Structure Design & Applications, Prentice Hall of India, 2009.
3. Bhupen Srivastava, Organisational Design and Development: Concepts application, Biztantra , 2010.
4. Robert A Paton, James Mc Calman, Change Management, A guide to effective implementation, Response Books, 2012.
5. Adrian Thorn Hill, Phil Lewis, Mike Mill more and Mark Saunders, Managing Change -A Human Resource Strategy Approach, Wiley, 2010.
6. Gareth R.Jones, Organisational Theory, Design & Change, Pearson Education, 6<sup>th</sup> Edition 2011.
7. Richard L. Daft, Understanding theory & Design of Organisations, Cengage, Western, 10<sup>th</sup> Edition 2012.

**OBJECTIVE:**

- To help students understand the transformation in the role of HR functions from being a support function to strategic function.

**UNIT I HUMAN RESOURCE DEVELOPMENT 10**

Meaning – Strategic framework for HRM and HRD – Vision, Mission and Values – Importance – Challenges to Organisations – HRD Functions - Roles of HRD Professionals - HRD Needs Assessment - HRD practices – Measures of HRD performance – Links to HR, Strategy and Business Goals – HRD Program Implementation and Evaluation – Recent trends – Strategic Capability , Bench Marking and HRD Audit.

**UNIT II E-HRM 6**

e- Employee profile– e- selection and recruitment - Virtual learning and Orientation – e - training and development – e- Performance management and Compensation design – Development and Implementation of HRIS – Designing HR portals – Issues in employee privacy – Employee surveys online.

**UNIT III CROSS CULTURAL HRM 7**

Domestic Vs International HRM - Cultural Dynamics - Culture Assessment - Cross Cultural Education and Training Programs – Leadership and Strategic HR Issues in International Assignments - Current challenges in Outsourcing, Cross border Mergers and Acquisitions - Repatriation etc - Building Multicultural Organisation - International Compensation.

**UNIT IV CAREER & COMPETENCY DEVELOPMENT 10**

Career Concepts – Roles – Career stages – Career planning and Process – Career development Models– Career Motivation and Enrichment –Managing Career plateaus- Designing Effective Career Development Systems – Competencies and Career Management – Competency Mapping Models – Equity and Competency based Compensation.

**UNIT V EMPLOYEE COACHING & COUNSELING 12**

Need for Coaching – Role of HR in coaching – Coaching and Performance – Skills for Effective Coaching – Coaching Effectiveness– Need for Counseling – Role of HR in Counseling - Components of Counseling Programs – Counseling Effectiveness – Employee Health and Welfare Programs – Work Stress – Sources - Consequences – Stress Management Techniques.- Eastern and Western Practices - Self Management and Emotional Intelligence.

**TOTAL: 45 PERIODS****OUTCOME:**

- Students will have a better understanding of the tools and techniques used by organizations to meet current challenges.

**REFERENCES :**

- Randy L. Desimone, Jon M. Werner – David M. Mathis, Human Resource Development, Cengage Learning, Edition 6, 2012.
- Paul Boselie. Strategic Human Resource Management. Tata McGraw Hill. 2012.
- Jeffrey A Mello, Strategic Human Resource Management, Cengage, Southwestern 2007.
- Robert L. Mathis and John H. Jackson, Human Resource Management, Cengage, 2007.
- Monir Tayeb. International Human Resource Management. Oxford. 2007
- Randall S Schuler and Susan E Jackson. Strategic Human Resource Management. Wiley India. 2<sup>nd</sup> edition
- McLeod. The Counsellor's workbook. Tata McGraw Hill. 2011

**OBJECTIVES :**

- To understand the various advanced databases used in the organization
- To be aware of recent trends in database management.

**UNIT I INTRODUCTION 9**

DBMS Models - Multimedia Databases, Parallel Databases, embedded, web, spatial, temporal databases, Virtualization, Active Databases - Embedded databases - Web databases.

**UNIT II DATABASE IMPLEMENTATION 9**

Query Processing basics and optimization – Heuristic Optimization – Transactions Models – Concurrency Control – Recovery – Security and Authorization – Storage – Indexing and Hashing – ISAM – B-Trees – Kd Trees – X Trees – Dynamic Hashing.

**UNIT III DISTRIBUTED DATABASES 9**

Distributed Databases – Queries – Optimization Access Strategies – Distributed Transactions Management – Concurrency Control – Reliability

**UNIT IV OBJECT ORIENTED DATABASES 9**

Object Oriented Concepts – Data Object Models – Object Oriented Databases – Issues in OODBMS - Object Oriented Relational Databases – Object Definition Languages – Object Query Languages

**UNIT V EMERGING TRENDS 9**

Data Mining – Data warehousing – Star, Snowflake, Fact Constellation; open source database systems, Scripting Language, JDBC, ODBC

**TOTAL: 45 PERIODS****OUTCOMES :**

- Awareness of database models
- Knowledge of database technologies

**REFERENCES :**

1. Peter Rob, Carlos Coronel, Database System and Design, Implementation and Management, 8<sup>th</sup> edition, Cengage,
2. Ramez Elmasri and Shamkant B. Navathe, Fundamentals of Database Systems, 7<sup>th</sup> edition, Pearson Education, 2015.
3. Jeffrey A Hoffer et al, Modern Database Management, 12<sup>th</sup> Edition, Pearson Education, 2016,
4. Abraham Silberchatz, Henry F. Korth and S.Sudarsan, Database System Concepts, 6<sup>th</sup> Edition, McGraw-Hill, 2015.
5. Thomas M. Connolly and Carolyn E. Begg, Database Systems – A Practical Approach to Design, Implementation and Management, 6<sup>th</sup> edition, Pearson Education, 2015.
6. Jeffrey D. Ullman and Jennifer Widom, A First Course in Database Systems, 3<sup>rd</sup> edition, Pearson Education Asia, 2013.
7. Stefano Ceri and Giuseppe Pelagatti, Distributed Databases Principles and Systems, McGraw-Hill International Editions, 2008.
8. Rajesh Narang, Object Oriented Interfaces and Databases, 1<sup>st</sup> edition, Prentice Hall of India, 2004.
9. Mark L. Gillenson & el, Introduction to database management, 2<sup>nd</sup> edition, Wiley India Pvt. Ltd, 2012
10. Charkrabarti, Advanced Database Management Systems, Wiley India Pvt Ltd, 2011

**OBJECTIVES :**

- To know how to derive meaning form huge volume of data and information
- To understand how knowledge discovering process is used in business decision making

**UNIT I INTRODUCTION 9**  
Data mining, Text mining, Web mining, Spatial mining, Process mining, BI process- Private and Public intelligence, Strategic assessment of implementing BI

**UNIT II DATA WAREHOUSING 9**  
Data ware house – characteristics and view - OLTP and OLAP - Design and development of data warehouse, Meta data models, Extract/ Transform / Load (ETL) design

**UNIT III DATA MINING TOOLS, METHODS AND TECHNIQUES 9**  
Regression and correlation; Classification- Decision trees; clustering –Neural networks; Market basket analysis- Association rules-Genetic algorithms and link analysis, Support Vector Machine, Ant Colony Optimization

**UNIT IV MODERN INFORMATION TECHNOLOGY AND ITS BUSINESS OPPORTUNITIES 9**  
Business intelligence software, BI on web, Ethical and legal limits, Industrial espionage, modern techniques of crypto analysis, managing and organizing for an effective BI Team.

**UNIT V BI AND DATA MINING APPLICATIONS 9**  
Applications in various sectors – Retailing, CRM, Banking, Stock Pricing, Production, Crime, Genetics, Medical, Pharmaceutical.

**TOTAL: 45 PERIODS****OUTCOMES :**

- Big Data Management
- Appreciate the techniques of knowledge discovery for business applications

**REFERENCES :**

1. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 3 rd edition, 2011
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, 3<sup>rd</sup> edition, Prentice Hall, 2014.
3. W.H.Inmon, Building the Data Warehouse, fourth edition Wiley India Pvt. Ltd. 2005.
4. Ralph Kimball and Richard Merz, The data warehouse toolkit, John Wiley, 2005.
5. Michel Berry and Gordon Linoff, Mastering Data mining, John Wiley and Sons Inc, 3<sup>rd</sup> Edition, 2011
6. Michel Berry and Gordon Linoff, Data mining techniques for Marketing, Sales and Customer support, John Wiley, 3 rd edition 2011
7. G. K. Gupta, Introduction to Data mining with Case Studies, Prentice hall of India, 2014.
8. Giudici, Applied Data mining – Statistical Methods for Business and Industry, John Wiley. 2009
9. Elizabeth Vitt, Michael Luckevich Stacia Misner, Business Intelligence, Microsoft, 2011
10. Michalewicz Z., Schmidt M. Michalewicz M and Chiriack C, Adaptive Business Intelligence, Springer – Verlag, edition 2016
11. Galit Shmueli, Nitin R. Patel and Peter C. Bruce, Data Mining for Business Intelligence – Concepts, Techniques and Applications Wiley, India ,3rd edition, 2016

**OBJECTIVES :**

- To understand the business process of an enterprise
- To grasp the activities of erp project management cycle
- To understand the emerging trends in erp developments

**UNIT I INTRODUCTION 8**  
Overview of enterprise systems – Evolution - Risks and benefits - Fundamental technology - Issues to be consider in planning design and implementation of cross functional integrated ERP systems.

**UNIT II ERP SOLUTIONS AND FUNCTIONAL MODULES 10**  
Overview of ERP software solutions- Small, medium and large enterprise vendor solutions, BPR, and best business practices - Business process Management, Functional modules.

**UNIT III ERP IMPLEMENTATION 10**  
Planning Evaluation and selection of ERP systems - Implementation life cycle - ERP implementation, Methodology and Frame work- Training – Data Migration. People Organization in implementation- Consultants, Vendors and Employees.

**UNIT IV POST IMPLEMENTATION 8**  
Maintenance of ERP- Organizational and Industrial impact; Success and Failure factors of ERP Implementation.

**UNIT V EMERGING TRENDS ON ERP 9**  
Extended ERP systems and ERP add-ons -CRM, SCM, Business analytics- Future trends in ERP systems-web enabled, Wireless technologies, cloud computing.

**TOTAL: 45 PERIODS**

**OUTCOMES**

- Knowledge of ERP implementation cycle
- Awareness of core and extended modules of ERP

**REFERENCES :**

1. Alexis Leon, ERP demystified, second Edition Tata McGraw-Hill, 2008.
2. Sinha P. Magal and Jeffery Word, Essentials of Business Process and Information System, Wiley India, 2012
3. Jagan Nathan Vaman, ERP in Practice, Tata McGraw-Hill, 2008
4. Alexis Leon, Enterprise Resource Planning, third edition, Tata McGraw-Hill, 2014.
5. Mahadeo Jaiswal and Ganesh Vanapalli, first edition,ERP Macmillan India, 2013
6. Vinod Kumar Grag and N.K. Venkitakrishnan, ERP- Concepts and Practice, second edition Prentice Hall of India, 2009.
7. Summer, ERP, Pearson Education, 2016



**OBJECTIVES:**

- To understand the various project management phases – Initiation, Planning, Tracking and Closure
- To study various project estimation methodologies, process models and risk management
- To understand quality assurance in software development

**UNIT I PROJECT MANAGEMENT OVERVIEW 8**

What is Project and Project Management, Various phase of Project Management, Project Stakeholders, Project Management Organisation (PMO); Roles and Responsibilities of Project Manager. Brief introduction to various process models - Waterfall, RAD, V, Spiral, Incremental, Prototyping, Agile– SCRUM, Extreme Programming (XP) and Kanban **Project Initiation** - Project Charter; Statement of Work (SoW)

**UNIT II PROJECT PLANNING 10**

Project Planning Activities- Project Scope, Work Breakdown Structures (WBS), Software estimation methodologies - COCOMO Model and Function Point

**Project Scheduling Techniques** – Program Evaluation and Review Technique (PERT), Gantt Chart and Critical Path Method (CPM)

**UNIT III PROJECT TRACKING 10**

Monitoring and Control, Project Status Reporting; Project Metrics; Earned Value Analysis (EVA); Project Communication Plan & Techniques; Steps for Process Improvement.

**Risk Management:** Concepts of Risks and Risk Management; Risk Management Activities; Effective Risk Management; Risk Categories; Aids for Risk Identification; Potential Risk Treatments; Risk Components and Drivers; Risk Prioritization.

**UNIT IV PROJECT CLOSURE 8**

Project Closure Analysis, Lesson Learnt

**Software Quality Assurance**-Software Quality Assurance Activities; Software Qualities; Software Quality Standards – ISO Standards for Software Organization, Capability Maturity Model (CMM), Comparison between ISO 9001 & SEI CMM, Other Standards.

**UNIT V AGILE PROJECT MANAGEMENT WITH SCRUM 9**

Agile Manifesto and Agile Principles

**Agile Scrum** - Purpose, Values, Scrum Framework, Scrum Roles – Product Owner, Scrum Master & Team, Scrum Events – Sprint Planning, Daily Scrum/Stand-up Meeting, Sprint Review, Sprint Retrospective, Scrum Artefacts – Product Backlog, Sprint Backlog, Increment and Definition of Done (DoD), Agile estimation – Story Point

**TOTAL:45 PERIODS****OUTCOMES:**

At the end of this course, student should be able to:

- Manage different phases of Software Project Management
- Identify Risk and create risk mitigation plan
- Apply software quality assurance for better quality software delivery

**REFERENCES:**

- Bob Hughes and Mike Cotterell, Software Project Management, Tata McGraw Hill, 5<sup>th</sup> Edition
- Jalote, "Software Project Management in Practice", Pearson Education
- Ramesh, Gopalaswamy, "Managing Global Projects", Tata McGraw Hill
- Ken Schwaber, Agile Project Management with Scrum, Microsoft Press
- Mike Cohn, Agile Estimating & Planning, Pearson
- Royce, "Software Project Management", Pearson Education, 1999.

## ONLINE RESOURCES:

- <http://agilemanifesto.org/>
- <https://www.scrum.org/Resources/What-is-Scrum>
- <http://www.scrumguides.org/scrum-guide.html#purpose>

BA5024

E- BUSINESS MANAGEMENT

L T P C  
3 0 0 3

## OBJECTIVES:

- To understand the practices and technology to start an online business

### UNIT I INTRODUCTION TO e-BUSINESS

8

e-business, e-business vs e-commerce, Economic forces – advantages – myths – e-business models, design, develop and manage business, Web 2.0 and Social Networking, Mobile Commerce, S-commerce.

### UNIT II TECHNOLOGY INFRASTRUCTURE

10

Internet and World Wide Web, internet protocols- FTP, intranet and extranet, Cloud Service Models – SAAS, PAAS, IAAS, Cloud Deployment Models – Public Cloud, Private Cloud, Hybrid Cloud, Auto-Scaling in the Cloud, Internet information publishing technology- basics of web server hardware and software

### UNIT III BUSINESS APPLICATIONS

10

Consumer oriented e-business – e-tailing and models – Marketing on web – advertising, e-mail marketing, affiliated programs - e-CRM; online services, Business oriented e-business, e- governance, EDI on the internet, Delivery management system, Web Auctions, Virtual communities and Web portals – social media marketing

### UNIT IV e-BUSINESS PAYMENTS AND SECURITY

9

E-payments - Characteristics of payment of systems, protocols, e-cash, e-cheque, e-Wallets and Micro payment systems- internet security – cryptography – security protocols – network security.

### UNIT V LEGAL AND PRIVACY ISSUES

8

Legal, Ethics and privacy issues – Protection needs and methodology – consumer protection, cyber laws, contracts and warranties, Taxation and encryption policies.

**TOTAL: 45 PERIODS**

## OUTCOMES:

At the end of this course, student should be able to know how to build and manage an e-business

## REFERENCES

1. Harvey M. Deitel, Paul J. Deitel, Kate Steinbuhler, e-business and e-commerce for managers, Pearson, 2011.
2. Efraim Turban, Jae K. Lee, David King, Ting Peng Liang, Deborah Turban, Electronic Commerce – A managerial perspective, Pearson Education Asia, 2010.
3. Kelly Goetsch - e Commerce in the Cloud, O Reilly Media, 2014.
4. Parag Kulkarni, Sunita Jahirabad kao, Pradeep Chande, e-business, Oxford University Press, 2012.
5. Henry Chan & el, E-Commerce – fundamentals and Applications, Wiley India Pvt Ltd, 2007.
6. Gary P. Schneider, Electronic commerce, Thomson course technology, Fourth annual edition, 2007
7. Bharat Bhasker, Electronic Commerce, Framework technologies and Applications, 3<sup>rd</sup> Edition. Tata McGraw Hill Publications, 2009
8. Kamlesh K. Bajaj and Debjani Nag, Ecommerce- the cutting edge of Business, Tata McGraw Hill Publications, 7<sup>th</sup> reprint, 2009.

9. Kalakota et al, Frontiers of Electronic Commerce, Addison Wesley, 2004
10. Micheal Papaloelon and Peter Robert, e-business, Wiley India, 2006.
11. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, 2009

**BA5025**

**LOGISTICS MANAGEMENT**

**L T P C**  
**3 0 0 3**

**OBJECTIVE :**

- To learn the need and importance of logistics in product flow.

**UNIT I INTRODUCTION**

**9**

Definition and Scope of Logistics – Functions & Objectives – Customer Value Chain – Service Phases and attributes – Value added logistics services – Role of logistics in Competitive strategy – Customer Service

**UNIT II DISTRIBUTION CHANNELS AND OUTSOURCING LOGISTICS**

**9**

Distribution channel structure - channel members, channel strategy, role of logistics and support in distribution channels. Logistics requirements of channel members. Logistics outsourcing – catalysts, benefits, value proposition. Third and fourth party logistics. Selection of service provider.

**UNIT III TRANSPORTATION AND PACKAGING**

**9**

Transportation System – Evolution, Infrastructure and Networks. Freight Management – Vehicle Routing – Containerization. Modal Characteristics, Inter-modal Operators and Transport Economies. Packaging- Design considerations, Material and Cost. Packaging as Unitisation. Consumer and Industrial Packaging.

**UNIT IV PERFORMANCE MEASUREMENT AND COSTS**

**9**

Performance Measurement – Need, System, Levels and Dimensions. Internal and External Performance Measurement. Logistics Audit. Total Logistics Cost – Concept, Accounting Methods. Cost – Identification, Time Frame and Formatting.

**UNIT V CURRENT TRENDS**

**9**

Logistics Information Systems – Need, Characteristics and Design. E-Logistics – Structure and Operation. Logistics Resource Management eLRM. Automatic Identification Technologies. Reverse Logistics – Scope, design and as a competitive tool. Global Logistics – Operational and Strategic Issues, ocean and air transportation. Strategic logistics planning. Green Logistics

**TOTAL: 45 PERIODS**

**OUTCOME :**

- To enable an efficient method of moving products with optimization of time and cost.

**REFERENCES :**

1. Bowersox Donald J, Logistics Management – The Integrated Supply Chain Process, Tata McGraw Hill, 3<sup>rd</sup> edition 2016
2. Sople Vinod V, Logistics Management – The Supply Chain Imperative, Pearson Education, 3<sup>rd</sup> Edition, 2012.
3. Coyle et al., The Management of Business Logistics, Cengage Learning, 7<sup>th</sup> Edition, 2004.
4. Ailawadi C Sathish & Rakesh Singh, Logistics Management, PHI, 2011.
5. Bloomberg David J et al., Logistics, Prentice Hall India, 2005.
6. Ronald H. Ballou, Business Logistics and Supply Chain Management, Pearson Education, 5<sup>th</sup> Edition, 2007.

**OBJECTIVE :**

- Understand how material management should be considered for profitability

**UNIT I INTRODUCTION 9**

Operating environment-aggregate planning-role, need, strategies, costs techniques, approaches-master scheduling-manufacturing planning and control system-manufacturing resource planning-enterprise resource planning-making the production plan

**UNIT II MATERIALS PLANNING 9**

Materials requirements planning-bill of materials-resource requirement planning-manufacturing resource planning-capacity management-scheduling orders-production activity control-codification.

**UNIT III INVENTORY MANAGEMENT 9**

Policy Decisions-objectives-control -Retail Discounting Model, Newsvendor Model; EOQ and EBQ models for uniform and variable demand With and without shortages -Quantity discount models. Probabilistic inventory models.

**UNIT IV PURCHASING MANAGEMENT 9**

Establishing specifications-selecting suppliers-price determination-forward buying-mixed buying strategy-price forecasting-buying seasonal commodities-purchasing under uncertainty-demand management-price forecasting-purchasing under uncertainty-purchasing of capital equipment-international purchasing

**UNIT V WAREHOUSE MANAGEMENT 9**

Warehousing functions – types - Stores management-stores systems and procedures-incoming materials control-stores accounting and stock verification-Obsolete, surplus and scrap-value analysis-material handling-transportation and traffic management -operational efficiency-productivity-cost effectiveness-performance measurement

**TOTAL: 45 PERIODS****OUTCOME :**

- Student gains knowledge on effective utilisation of materials in manufacturing and service organisation

**REFERENCES :**

1. J.R.Tony Arnold, Stephen N. Chapman, Lloyd M. Clive, Materials Management, Pearson, 2012.
2. P. Gopalakrishnan, Purchasing and Materials Management, Tata McGraw Hill, 2012
3. A.K.Chitale and R.C.Gupta, Materials Management, Text and Cases, PHI Learning, 2<sup>nd</sup> Edition, 2006
4. A.K.Datla, Materials Management, Procedure, Text and Cases, PHI Learning, 2<sup>nd</sup> Edition, 2006
5. Ajay K Garg, Production and Operations Management, Tata McGraw Hill , 2012
6. Ronald H. Ballou and Samir K. Srivastava, Business Logistics and Supply Chain Management, Pearson education, Fifth Edition
7. S. N. Chary, Production and Operations Management, Tata McGraw Hill , 2012

**OBJECTIVE:**

- Understand the application of structured methods to develop a product.

**UNIT I INTRODUCTION****9**

Defining Product, Types of products. Product development – characteristics, duration and cost, challenges. Development Process: Generic Process- Adapting to product types. Evaluation – decay curve – cost expenditure curve.

**UNIT II PRODUCT PLANNING****9**

Product Planning Process – Steps. Opportunity identification – breakdown structure- product development charter. Product Life Cycle. Technology Life Cycle - Understanding Customer Needs - Disruptive Technologies- Product Specification - Concept Generation – Activity- Steps- Techniques.

**UNIT III PRODUCT CONCEPT****9**

Concept Selection – Importance, Methodology, concept Screening, Concept Scoring. Concept Testing. Product Architecture- Definition, Modularity, implication, Establishment, Delayed Differentiation, Platform Planning.

**UNIT IV INDUSTRIAL DESIGN AND DESIGN TOOLS****9**

Industrial Design, Design for Manufacturing-Value Engineering-Ergonomics-Prototyping-Robust Design- Design for X-failure rate curve-product use testing-Collaborative Product development- Product development economics-scoring model- financial analysis.

**UNIT V PATENTS****9**

Defining Intellectual Property and Patents, Patent Searches and Application, Patent Ownership and Transfer, Patent Infringement, New Developments and International Patent Law.

**TOTAL: 45 PERIODS****OUTCOME**

- Student gains knowledge on how a product is designed based on the needs of a customer.

**REFERENCES :**

1. Karl T. Ulrich, Steven D. Eppinger, Anita Goyal Product Design and Development, Tata McGraw – Hill, Fourth Edition, reprint 2009.
2. Kenneth B.Kahn, New Product Planning, Sage, 2<sup>nd</sup> Edition 2011.
3. A.K. Chitale and R.C. Gupta, Product Design and Manufacturing, PHI, 2008.
4. Deborah E. Bouchoux, Intellectual Property Rights, Delmar, Cengage Learning, 2005.
5. Anil Mital. Anoop Desai, Anand Subramanian, Aashi Mital, Product Development, Elsevier, 2009.
6. Michael Grieves, Product Life Cycle Management, Tata McGraw Hill , 2006.
7. Kerber, Ronald L, Laseter, Timothy M., Strategic Product Creation, Tata-McGraw Hill, 2007.

**BA5028**

**PROJECT MANAGEMENT**

**L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- To learn the concepts of managing projects.

**UNIT I INTRODUCTION TO PROJECT MANAGEMENT 9**

Project Management – Definition –Goal - Lifecycles. Project Selection Methods. Project Portfolio Process – Project Formulation. Project Manager – Roles- Responsibilities and Selection – Project Teams.

**UNIT II PLANNING AND BUDGETING 9**

The Planning Process – Work Break down Structure – Role of Multidisciplinary teams. Budget the Project – Methods. Cost Estimating and Improvement. Budget uncertainty and risk management.

**UNIT III SCHEDULING & RESOURCE ALLOCATION 9**

PERT & CPM Networks - Crashing – Project Uncertainty and Risk Management – Simulation – Gantt Charts – Expediting a project – Resource loading and leveling. Allocating scarce resources – Goldratt's Critical Chain.

**UNIT IV CONTROL AND COMPLETION 9**

The Plan-Monitor-Control cycle – Data Collecting and reporting – Project Control – Designing the control system. Project Evaluation, Auditing and Termination.

**UNIT V PROJECT ORGANISATION & CONFLICT MANAGEMENT 9**

Formal Organisation Structure – Organisation Design – Types of project organizations. Conflict – Origin & Consequences. Managing conflict – Team methods for resolving conflict.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- To apply project management principles in business situations to optimize resource utilization and time optimisation.

**REFERENCES :**

1. Clifford Gray and Erik Larson, Project Management, Tata McGraw Hill Edition, 6e,2014.
2. John M. Nicholas, Project Management for Business and Technology - Principles and Practice, Second Edition, Pearson Education,5<sup>th</sup> Edition 2016
3. Gido and Clements, Successful Project Management, sixth Edition, Cengage, 2015.
4. Harvey Maylor, Project Management, Fourth Edition, Pearson Education, 2010

**BA5029**

**SERVICES OPERATIONS MANAGEMENT**

**L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- To help understand how service performance can be improved by studying services operations management

**UNIT I INTRODUCTION 9**

Services – Importance, role in economy, service sector – growth; Nature of services -Service classification , Service Package, distinctive characteristics , open-systems view; Service Strategy – Strategic service vision, competitive environment, generic strategies, winning customers; Role of information technology; stages in service firm competitiveness; Internet strategies - Environmental strategies.

**UNIT II SERVICE DESIGN 9**  
 New Service Development – Design elements – Service Blue-printing - process structure – generic approaches –Value to customer; Retail design strategies – store size – Network configuration ; Managing Service Experience –experience economy, key dimensions ; Vehicle Routing and Scheduling

**UNIT III SERVICE QUALITY 9**  
 Service Quality- Dimensions, Service Quality Gap Model; Measuring Service Quality –SERVQUAL - Walk-through Audit; Quality service by design - Service Recovery - Service Guarantees; Service Encounter – triad, creating service orientation, service profit chain; Front-office Back-office Interface – service decoupling.

**UNIT IV SERVICE FACILITY 9**  
 Services capes – behaviour - environmental dimensions – framework; Facility design – nature, objectives, process analysis – process flow diagram, process steps, simulation; Service facility layout; Service Facility Location – considerations, facility location techniques – metropolitan metric, Euclidean, centre of gravity, retail outlet location , location set covering problem

**UNIT V MANAGING CAPACITY AND DEMAND 9**  
 Managing Demand – strategies; Managing capacity – basic strategies, supply management tactics, operations planning and control; Yield management; Inventory Management in Services– Retail Discounting Model, Newsvendor Model; Managing Waiting Lines –Queuing systems, psychology of waiting; Managing for growth- expansion strategies, franchising , globalization.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- To design and operate a service business using the concepts, tools and techniques of service operations management.

**REFERENCES :**

1. James A. Fitzsimmons, Service Management – Operations, Strategy, Information Technology, Tata McGraw-Hill – 7<sup>th</sup> Edition 2013.
2. Richard Metters, Kathryn King-Metters, Madeleine Pullman, Steve Walton Successful Service Operations Management, South-Western, Cengage Learning, 2<sup>nd</sup> Edition ,2012
3. Cengiz Haksever, Barry Render, Roberta S. Russell, Rebert G. Murdick, Service Management and Operations, Pearson Education – Second Edition.
4. Robert Johnston, Graham Clark, Service Operations Management, Pearson Education, 2<sup>nd</sup> Edition, 2005.
5. Bill Hollins and Sadie Shinkins, Managing Service Operations, Sage, 2006
6. J.Nevan Wright and Peter Race, The management of service operations, Cengage, 2<sup>nd</sup> Edition, 2004

**BA5030**

**SUPPLY CHAIN MANAGEMENT**

**L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- To help understand the importance of and major decisions in supply chain management for gaining competitive advantage.

**UNIT I INTRODUCTION 9**

Supply Chain – Fundamentals –Evolution- Role in Economy - Importance - Decision Phases - Supplier-Manufacturer-Customer chain. - Enablers/ Drivers of Supply Chain Performance. Supply chain strategy - Supply Chain Performance Measures.







**OBJECTIVES**

- To provide understanding of the framework.
- To illustrate current practices in industries.
- To provide knowledge on certain tools & techniques

**UNIT - I INTRODUCTION TO PURCHASING AND SUPPLY CHAIN MANAGEMENT 9**

The Purchasing Process. Purchasing Policies and Procedures. Supply Management Integration for Competitive Advantage, Purchasing and Supply Management Organization.

**UNIT - II STRATEGIC SOURCING 9**

Supply Management and Commodity Strategy Development, Supplier Evaluation and Selection Supplier Quality Management Supplier Management and Development, Creating a World-Class Supply Base, Worldwide Sourcing.

**UNIT - III STRATEGIC SOURCING PROCESS 9**

Strategic Cost Management, Purchasing and Supply Chain Analysis: Tools and Techniques, Negotiation and Conflict Management Contract Management Purchasing Law and Ethics.

**UNIT - IV SUPPLIER PERFORMANCE AND QUALITY MANAGEMENT 9**

Performance Measurement and Evaluation: Strategies, tools and techniques for measuring and managing supplier performance, Supplier performance evaluation, Purchasing services, Supply Chain Information Systems and Electronic Sourcing.

**UNIT - V FUTURE DIRECTIONS 9**

Purchasing and Supply Strategy Trends Green Buying, Sustainability, material research, Lean supply Chain Management

**TOTAL: 45 PERIODS****OUTCOMES:**

- To Understand basic functions and nuances.
- To Understand the holistic dimensions of SCM & corporate perspectives.
- Learn to acquire skills to become a sourcing professional.

**TEXT BOOKS:**

1. Purchasing and Supply Chain Management, Robert .M. Monczka, Handfield, Glunipero Paterson, Waters, 6th Edition, Cengage Publication
2. Purchasing and Supply Chain Management, . Benton, 3 rd Edition, Tata Mc Graw Hill.
3. World Class Supply Chain Management, Burt, Dobler, Starling, 7th Edition, Tata Mc Graw Hill.
4. Supply Chain Management For The 21st Century by B S SAHAY. Macmillan Education,2001

**OBJECTIVE:**

This course provides you the basic concepts and advanced models in inventory management. This course discusses issues related to inventory in a supply chain context. It also gives a multidimensional view to approach a problem with case studies.

**UNIT I INTRODUCTION TO INVENTORY MANAGEMENT 9**

Inventory in SCM, Cash to cash cycle time, measure of inventory in terms of days, Inventory turnover ratio and its relationship with working capital, Review of models, Q-models and P-models Aggregation of Inventory, Cycle stock concepts, Ordering multiple items in a single order to reduce cycle stock

**UNIT II INVENTORY MODELS 9**

Safety stock issues Safety stock with lead time and demand uncertainty (for Q-models), Short term discounting & Forward Buying, Periodic review models with safety stock, Comparison of P and Q systems

**UNIT III INVENTORY MANAGEMENT STRATEGIES 9**

Single period models, Inventory management for fashion supply chains, Postponement strategies to reduce inventory, Examples of Fashion supply chains: NFL Reebok, ZARA and Sport Obermeyer Risk Pooling, Applications, Risk pooling in different forms-Substitution, Specialisation, Postponement and Information pooling

**UNIT IV INVENTORY OPTIMIZATION 9**

Distribution resource planning techniques, Inventory and transportation integration decisions, Vendor Managed Inventory, Product availability measures, Product fill rate, order fill rate, Cycle service level.

**UNIT V LATEST TRENDS IN INVENTORY MANAGEMENT SYSTEMS 9**

Industry initiatives, Efficient consumer Response and Quick response ,CPFR and other industry initiatives, Inventory reduction strategies, Managing inventory in Reverse Logistics and Remanufacturing situations , Best practices in Inventory Management in a Supply Chain

**TOTAL: 45 PERIODS****OUTCOME:**

At the end of this course, the students can confidently approach their supply chain inventory issues and they can use different tools appropriately to solve the problems and enhance the performance of their supply chains.

**TEXT BOOKS:**

1. Sunil Chopra, Peter Meindl, Supply Chain Management: Strategy, Planning, and Operation, Pearson, 2010.
2. Janat Shah, Supply Chain Management, Pearson Education India, 2009
3. Supply chain management, Chandrasekaran,N., Oxford University Publications, 2010
4. Supply Chain Management For The 21st Century by B S SAHAY. Macmillan Education,2001

**OBJECTIVES:**

- To explain the various technological aspects that are described in the different logistical background
- To explain the real time description updated technologies in the logistics sector and supply chain industry

**UNIT - I ELECTRONIC SCM, COMMUNICATION NETWORKS 9**

Introduction e-SCM – e-SCM framework - Key success factors for e-SCM - Benefits of e-SCM- Positioning information in Logistics - Strategic information linkage - Supply chain communication networks - Role of communication networks in supply chains - Overview of telecommunication networks –EDI - Data security in supply chain networks - Overview of internet able models

**UNIT - II ENTERPRISE INFORMATION SYSTEMS 9**

Overview of enterprise information systems - Information functionality and principles -Introduction enterprise information systems -Classification of enterprise information systems- Information architecture -Framework for managing supply chain information - Describe on popular enterprise application packages -Benefits of enterprise information systems

**UNIT - III SCM SYSTEMS DEVELOPMENT, DEPLOYMENT AND MANAGEMENT 9**

Stakeholders in supply chain information systems - Stakeholders in SCM - Stakeholders in supply chain information systems - Information systems development- Logistics information systems design- Defining enterprise architecture - Choosing appropriate system development methodologies - Adopting relevant systems development model

**UNIT - IV DEPLOYMENT AND MANAGEMENT 9**

Information systems deployment - IT Operations and infrastructure management - Portfolio, programme and project management - Management of risk - Management of value

**UNIT - V INFORMATION INTEGRATION 9**

Enterprise application integration and supply chain visibility - Enterprise application integration - Supply chain visibility - Supply chain event management -Supply chain performance -Planning and design methodology - Problem definition and planning - Data collection and analysis - Recommendations and implementation -Decision support systems

**TOTAL: 45 PERIODS****OUTCOME:**

The students will be able to understand the various enterprise information system and its architecture and benefits. Students can gain knowledge about various e-commerce models, e-SCM, benefits and communication networks.

**TEXT BOOKS:**

1. Bowersox & Closs, Logistical Management, McGraw-Hill Companies, 1996.
2. R.H.Ballou, Business Logistics Management, Prentice-Hall, 2004.

**REFERENCES:**

1. Strauss,E-Marketing, 4/e, Pearson Education 2008
2. Chaffey, E- Business and E- Commerce Management, 3/e, Pearson Education 2008
3. Blanchard, Logistics Engineering & Management, 6/e, Pearson Education 2008
4. Statistics for Managers Using MS Excel, 4/e, Levine, Pearson Education 2007
5. Donald J. Bowersox and David J. Closs, Logistical Management - The Integrated Supply chain

**OBJECTIVES:**

- To help the students in explaining the significance of Warehousing.
- To provide timely customer service,
- To keep track of items so they can be found readily & correctly
- To minimize the total physical effort
- To minimize the cost of moving goods in & out of stage.

**UNIT - I INTRODUCTION WAREHOUSING 9**

Introduction Warehousing – Basic Warehousing Decisions – Warehouse Operations – Types of Warehouses – Functions – Centralized & Decentralized – Storage Systems – Warehousing Cost Analysis – Warehouse Layout – Characteristics of Ideal Warehouse

**UNIT - II INVENTORY MANAGEMENT 9**

Inventory: Basic Concepts – Role in Supply Chain – Role in Competitive Strategy – Independent Demand Systems – Dependent Demand Systems – Functions – Types – Cost – Need for Inventory – Just in Time

**UNIT - III INVENTORY CONTROL 9**

Inventory Control – ABC Inventory Control – Multi-Echelon Inventory Systems – Distribution Requirement Planning – Bull Whip Effect – Using WMS for Managing Warehousing Operations

**UNIT - IV MATERIALS HANDLING 9**

Principles and Performance Measures Of Material Handling Systems – Fundamentals of Material Handling – Various Types of Material Handling Equipments – Types of Conveyors – Refrigerated Warehouses- Cold Chain- Agri SCM

**UNIT - V MODERN WAREHOUSING METHODS 9**

Modern Warehousing – Automated Storage & Retrieval Systems & their Operations – Bar Coding Technology & Applications in Logistics Industry – RFID Technology & Applications – Advantages of RFID

**TOTAL: 45 PERIODS****OUTCOME:**

At the end of the course, the students will be able to get complete insight in to warehouse concepts, various inventory control techniques and application of inventory management in supply chain.

**TEXT BOOKS:**

1. Vinod.V.Sople, Logistics Management, Pearson Education, 2004.
2. Arnold, Introduction Materials Management, Pearson Education, 2009.

**REFERENCES:**

1. Frazelle, World Class Warehousing & Material Handling, Tata McGraw-Hill, 2008
2. Satish K. Kapoor and PurvaKansal, Basics of Distribution Management - A Logistical Approach, Prentice Hall, 2003
3. Satish K. Kapoor and PurvaKansal Marketing, Logistics - A Supply Chain Approach , Pearson Education, 2003

**OBJECTIVES:**

- To explore the fundamental concepts of transportation and distribution management
- To gain knowledge in network planning, routing and scheduling and application of IT in transportation and distribution management.

|  |                                    |          |
|--|------------------------------------|----------|
| <b>UNIT - I</b>  | <b>DISTRIBUTION</b>                | <b>9</b> |
| Role of Distribution in Supply chain, Distribution channels – Functions, resources, Operations in Distribution, Designing Distribution network models - its features - advantages and disadvantages.             |                                    |          |
| <b>UNIT - II</b>   | <b>PLANNING</b>                    | <b>9</b> |
| Distribution network planning, Distribution network decisions, Distribution requirement planning (DRP)   |                                    |          |
| <b>UNIT - III</b>  | <b>TRANSPORTATION</b>              | <b>9</b> |
| Role of Transportation in Logistics and Business, Principle and Participants-Scope and relationship with other business functions, Modes of Transportation - Mode and Carrier selection, Routing and scheduling. |                                    |          |
| <b>UNIT - IV</b>   | <b>TRANSPORTATION</b>              | <b>9</b> |
| International transportation, Carrier, Freight and Fleet management, Transportation management systems-Administration, Rate negotiation, Trends in Transportation.   |                                    |          |
| <b>UNIT - V</b>  | <b>INFORMATION TECHNOLOGY (IT)</b> | <b>9</b> |
| Usage of IT applications -E commerce – ITMS, Communication systems-Automatic vehicle location systems, Geographic information Systems.   |                                    |          |
| <b>TOTAL: 45 PERIODS</b>   |                                    |          |

**OUTCOMES:** The students will be able to:

- Gain knowledge about the distribution requirements planning.
- Predict the scope and relationship of transportation with other business functions
- Make use of the advantages and disadvantages of the various models.

**TEXT BOOKS:**

1. Raghuram and N. Rangaraj, Logistics and Supply chain Management – Leveraging Mathematical and Analytical Models: Cases and Concepts, New Delhi: Macmillan, 2000.
2. Janat Shah, Supply Chain Management, Pearson Education India, 2009.

**REFERENCES:**

1. Sunil Chopra, Peter Meindl, Supply Chain Management: Strategy, Planning, and Operation, Pearson, 2010.
2. Michael B Stroh, Practical Guide to Transportation and Logistics, Logistics Network, 2006.
3. Alan Rushton, John Oxley, Handbook of Logistics & Distribution Management, Kogan Page Publishers, 2000.

**OBJECTIVES:**

- To prepare students successfully implement a contract logistics and closed supply chain in Retail, FMCG and Automobile sectors.
- To explain the concept and principle of contract logistics and closed supply chain

**UNIT - I CONTRACT LOGISTICS 9**

Third party logistics industry overview - A framework for strategic alliances - Evolution of contract logistics - Types of third party logistics providers – Automobile, FMCG and Retail-Third party services and integration

**UNIT - II CLOSED LOOP SUPPLY CHAINS AND LOGISTICS 9**

Introduction closed loop supply chains and logistics – Logistics and closed loop supply chain service - Overview of return logistics and closed loop supply chain models – Introduction product returns - Product Vs Parts returns - Strategic issues in closed loop supply chains

**UNIT - III BUSINESS AND MARKET 9**

Overview - Introduction life cycle management - Trends and opportunities – Auto Warranty management, return process and benchmarks - Market overview - Reasons for using reverse logistics - General characteristics - Consumer goods Depot repair and value added services - Operating dynamics - Competitive evaluation - Secondary markets and final disposal.

**UNIT - IV EMERGING TRENDS 9**

Emerging trends in Retail, E-Commerce- FMCG and Automobile sectors- Systems and technology - For consumer goods operations, High tech logistics system - Impact and value of advanced logistics

**UNIT - V MANAGING PROCESSES 9**

Managing processes - Step by step process - Use of third party service providers - Additional factors – Contemporary issues – Make in India and its impact on Countries GDP and Economic Growth.

**TOTAL: 45 PERIODS****OUTCOME:**

The students will be able to understand the basics of contract logistics, third party logistics industry and third party logistics providers. And it helps to gain knowledge about Make in India concept and its impact on the GDP growth

**TEXT BOOKS:**

1. Janat Shah, Supply Chain Management: Text and Cases, Pearson Education India, 2009
2. John Manners-Bell, Logistics and Supply Chains in Emerging Markets, Kogan Page, 2014.

**REFERENCES:**

1. Coyle et.al, Management Of Transportation, 7th Edition, Cengage Learning, 2011
2. D. F. Blumberg, Reverse Logistics & Closed Loop Supply Chain Processes, Taylor and Francis, 2005
3. Hsin-I Hsiao, Wageningen, Logistics Outsourcing in the Food Processing Industry, Academic Pub, 2009.
4. Surendra M. Gupta, Sustainability in Supply Chain Management Casebook: Applications in SCM, McGraw Hill, 2013

**OBJECTIVES:**

- To provide the participants with a good knowledge of airfreight operations, services and management that can support them in various business functions and roles such as operations, customer service, account management and sales.
- To create awareness about the Air Cargo management.
- To provide general information or a framework on the setup of air cargo processes, for business.

**UNIT - I AIR PORTS AND SHIPMENT 9**

Ground Handling Agencies - Air Craft - Advantage of Air shipment - Economics of Air Shipment - Sensitive Cargo by Air shipment - Do's and Don'ts in Air Cargo Business

**UNIT - II AIR CARGO 9**

Air Cargo Console - Freighting of Air Cargo - Volume based Calculation of Freight - Weight based Calculation of Freight - Import Documentation - Export Documentation

**UNIT- III AIRWAY BILLS 9**

Airway Bills - FIATA - IATA - History of IATA - Mission of IATA - Price setting by IATA -Licensing of Agencies - Sub Leasing of Agencies - freight carriers by scheduled freight tonne kilometers flown

**UNIT - IV CARGO VILLAGE 9**

History of Dubai Cargo Village - Location of DCV - Equipment and Handling at DCV - Operations - Advantage of Sea Air Cargo - Why Sea Air Cargo is Cheaper - Why Air freight from Dubai is Cheaper?

**UNIT - V DG CARGO 9**

DG Cargo by Air - Classification and labelling - Types of Labels according Cargo – Samples of Labels - Packing and Transportation of DG Goods by Air

**TOTAL: 45 PERIODS****OUTCOME:**

The outcome of this course will provide the basics concepts of airports and aircrafts and various participants in air cargo transportation. Students will come to know about roles of the customs and the government in air transport.

**TEXT BOOKS:**

1. Yoon SeokChang, Air Cargo Management, CRC Press, 2015.
2. Xie Chun Xun Zhu, Air Cargo Management Introduction - Aviation Logistics, Management Series (Chinese Edition), Southeast University Press, 2006.
3. Hampton Simon Taylor, Air transport logistics, CRC Press, 2000.

**REFERENCES:**

1. Paul, Air cargo distributions: a management analysis of its economic and marketing benefits, Jackson and William Brackenridge (Gower Press), 1988.
2. Peter S. Smith, Air freight: operations, marketing and economics, Chu (Boston : Kluwer Academic Publishers), 2004.
3. John Walter wood, Airports; some elements of designs and future development, Chu(Boston : Kluwer Academic Publishers), 1981.



**OBJECTIVES:**

- To provide an overview of the various elements of containerization and allied businesses
- To realize the potential of containerization and allied businesses

**UNIT –I BASIC CONCEPT OF CONTAINERIZATION 9**

Introduction to Liner Shipping industry - Unitization concept and methods - Malcolm Mclean and the birth of containerization - Generations of container ships and their specification - Container types, their specifications and cargoes carried in them.

**UNIT –II FREIGHTING AND SIZE OF CONTAINER 9**

Container shipping business - FCL and LCL sea freight products - Freight of FCL and LCL cargo - Slot utilization strategies - Estimation of optimum container fleet size - Multiport LCL consolidation

**UNIT – III CHARACTERISTICS AND PHYSICAL OPERATIONS 9**

Containerisation: Concept, Classification, Benefits and Constraints, Container terminal business-World's leading container terminals and location characteristics - container terminal infrastructure - container terminal productivity and profitability-Inland container Depots(ICD)Roles and functions - Container Freight Stations(CFS),Clearance at ICD, CONCOD,ICD's under CONCOD, Charting: Kinds of Charter, Charter Party and Arbitration.

**UNIT – IV CONTAINER TYPES AND BUSINESS 9**

Container manufacturing trends - Container leasing business - Types of container leasing and their terms - maintenance and repair of containers - tracking of container movements - Container interchange.

**UNIT – V MULTIMODAL TRANSPORT 9**

Alternate uses of containers -marketing of used containers -carriage of shipper own containers - multimodal transport options for containers -Insurance for containers -strategies for managing container imbalance.

**TOTAL: 45 PERIODS****OUTCOMES:**

- The students will learn the practices and ways to promote containerization and allied businesses
- The learners will have a complete idea about the different concepts, trends and strategies used for containerization and allied businesses

**REFERENCES:**

1. Marc Levinson, The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger, Princeton University Press, 2008.
2. Dr. K. V. Hariharan, Containerisation, Multimodal Transport & Infrastructure Development In India, Sixth Edition, Shroff Publishers and Distributors, 2015.
3. Lee, C.-Y., Meng, Q. (Eds.), Handbook of Ocean Container Transport Logistics Making Global Supply Chains Effective, Springer, 2015
4. Coyle et.al, Management Of Transportation, 7th Edition, Cengage Learning, 2011

**OBJECTIVES:**

- To enlighten the students about the major functions in export and import processes.
- To provide the expertise for solving issues related to requirements in EXIM management.

**UNIT – I      FUNDAMENTALS OF IMPORT AND EXPORT      9**

Role of Import and Export Trade in an Economy - Institutional Framework for Foreign trade in India -Role of Director General of Foreign Trade and Commerce - Objectives of EXIM Policy - Global trade flows - Contract of International Sale of Goods - INCOTERMS 2010

**UNIT - II      OVERVIEW OF EXPORT AND IMPORT      9**

Marketing for Exports - Negotiation and finalization of Export contract - Export Documentation Procedures - Cargo Insurance - Export Promotion Councils and incentive schemes- Role of Logistics in Exports- Export Houses / Trading Houses

**UNIT - III      DOCUMENTATION FRAMEWORK      9**

Import for industrial use / trading - Import Documentation and Customs clearance procedures - Types of Imports - Import Licenses - Cargo Insurance - Role of Logistics in Import

**UNIT - IV      CREDIT AND PAYMENTS      9**

Payment methods in Foreign Trade - Documentary Credit / Letter of Credit–LOU-UCP 600 with respect to Shipping Documents and L/C Negotiation – Export / import financing strategies - Managing payment risks.

**UNIT - V      CUSTOMS CLEARANCE AND AGENCIES      9**

Roles of Service providers in EXIM transactions – Global Traders – Commodity Brokers - Custom House Agents – Transport Operators – Freight Forwarders – Warehousing and 3PL service providers – Liners /Ship Agencies – Container Freight Stations - Port – Inspection Agencies/ surveyors – Quarantine Agencies – Pest Control Agencies – Chamber of Commerce.

**TOTAL: 45 PERIODS****OUTCOMES:**

- The students would be aware about the formalities of export and import industry
- The students will be able to comprehend the importance of exim management.

**REFERENCES:**

1. Justin Pauland Rajiv Aserkar, Export Import Management, Second Edition, Oxford University Press, 2013.
2. UshaKiranRai, Export - Import and Logistics Management, Second Edition, PHI Learning, 2010.
3. Director General of Foreign Trade, Foreign Trade Policy and Handbook of Procedures, 2015
4. Coyle et.al, Management Of Transportation, 7th Edition, Cengage Learning, 2011

**OBJECTIVES:**

- To provide the knowledge about fundamentals of shipping management
- To equip the students with the knowledge of shipping, ship building and repair

**UNIT – I INTERDICTION OF SHIPPING 9**  
 Role of Shipping in International trade-Types of ships and cargoes carried by them - International Organizations serving the shipping industry (IMO, BIMCO, ICS, IACS, IAPH)- Ship Registration and Classification.

**UNIT – II LINER SHIPPING OPERATIONS 9**  
 Liner shipping business - Types of Liner services - Container shipping lines and their services - Break bulk, Ro-Ro and project cargo services - Liner freight rates - Liner cargo documentation - Liner agency functions

**UNIT – III DRY BULK BUSINESS 9**  
 Dry Bulk shipping business- World's leading dry bulkports and cargoes handled by them - Types of Dry bulk ships and the Dry Bulk industry structure - Dry bulk market indices - Types of Chartering - Port agency functions.

**UNIT – IV TANKER OPERATIONS AND BUSINESS 9**  
 Liquid Bulk shipping business - World's leading wet bulk ports and cargoes handled by them- Types of tankers and gas carriers - Tanker freighting system (worldscale) -Factors affecting Tanker markets-Marine pollution conventions.

**UNIT – V SHIP BUILDING AND REPAIR 9**  
 Service providers to shipping industry -Ship management companies -Ports, inland terminals and Container Freight Stations- Ship building and repair yards -Financing the Shipping industry -Marine insurance providers.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- The students would be acquainted with the basics of shipping management
- The students will learn the skills needed for shipping industry

**REFERENCES:**

1. Michael Robarts, Branch"s Elements of Shipping, Ninth Edition, Routledge, 2014.
2. Peter Brodie, Commercial Shipping Handbook, Third Edition, Informa Law from Routledge, 2014.
3. Review of Maritime Transport, UNCTAD, 2014.
4. Coyle et.al, Management Of Transportation, 7th Edition, Cengage Learning, 2011

**BA5062**

**PORT AND TERMINAL MANAGEMENT**

**L T P C**  
**3 0 0 3**

**OBJECTIVES:**

- To enlighten the students about the major functions in the port and terminal management
- To expose the students on the trends in port and terminal management

**UNIT – I INTRODUCTION TO PORT AND TERMINAL 9**  
 Role of ports in international trade and transport - Economic impact of ports on the regional economy - Multiplier effect - Location characteristics of ports - Different types of ports (natural, manmade, river, estuary).

**UNIT – II PORT OPERATIONS 9**  
 Design features of facilities in ports for handling various cargoes - Organization structure in Ports - Delivery of port services and the relationship between various departments - Marine Department – Traffic Department – other departments.

**UNIT – III PORT MARKETING AND SERVICES 9**

Marketing of Port services - Pricing of Port services - Components of port tariff - Concept of hinterland – Identifying the needs of ship owners and operators, ship agents, forwarders, truckers, rail and barge operators - Concept of Total Logistics cost.

**UNIT – IV PORT PERFORMANCE 9**

Measurement of port performance - vessel turn round time, cargo volume, speed of cargo handling - Information flow requirements of the port, statutory bodies and port users - Port community computer systems and EDI applications.

**UNIT – V PORT SECURITY AND ISSUES 9**

Environmental issues connected with Ports & Terminals - Health and safety issues - Port security issues - International Ships and Port facility security (ISPS) code - Role of national, regional and local governments in owning / operating / managing ports.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- The students would be aware about skills pertaining to port and terminal management
- The students should be able to understand the principles and applications for port and terminal management

**REFERENCES:**

1. Maria G. Burns, Port Management and Operations, CRC Press, 2014.
2. Patrick Alderton, Port Management and Operations, Third Edition, Lloyd's Practical Shipping Guides, 2008
3. H. Ligteringen, H. Velsink, Ports and Terminals, VSSD Publishers, 2012.
4. Coyle et.al, Management Of Transportation, 7th Edition, Cengage Learning, 2011

**SECTORAL SPECIALISATION IN**

**INFRASTRUCTURE AND REAL ESTATE MANAGEMENT**

**BA5063 INFRASTRUCTURE PLANNING, SCHEDULING AND CONTROL L T P C  
3 0 0 3**

**OBJECTIVE:**

- To give an exposure to the students on the concept and the principles of planning, scheduling and control about infrastructure industry.

**UNIT I INTRODUCTION 9**

Introduction to infrastructure - Need and importance of infrastructure in India - Overview of power sector - Overview of water supply and sanitation sector-Overview of road, rail, air and port transportation sectors-Overview of telecommunication sector-Overview of rural and urban infrastructure-Introduction to special economic zones-Organizations and players in infrastructure field -Overview of infrastructure project finance.

**UNIT II INFRASTRUCTURE PRIVATIZATION 9**

Privatization of infrastructure in India - Benefits of privatization-Problems with privatization-Challenges in privatization of water supply projects- Challenges in privatization of power sector projects – Challenges in privatization of road transportation projects.

**UNIT III RISKS IN INFRASTRUCTURE PROJECTS 9**

Economic and demand risks, political risks, socio-economic risks and cultural risks in infrastructure projects -Legal and contractual issues in infrastructure projects- Challenges in construction of infrastructure projects.

**UNIT IV RISK MANAGEMENT FRAMEWORK 9**

Planning to mitigate risk-Designing sustainable contracts-Introduction to fair process and negotiation-Negotiation with multiple stakeholders - Sustainable development- Information technology and systems for successful management.

**UNIT V DESIGN & MAINTENANCE OF INFRASTRUCTURE 9**

Innovative design and maintenance of infrastructure facilities- Modeling and life cycle analysis techniques-Capacity building and improving Government's role in implementation- Integrated framework for successful planning and management.

**TOTAL :45 PERIODS**

**OUTCOMES**

On successful completion of the course, students will be able to

- explain the basic concepts related to infrastructure and understand management.
- explain the benefits and problems with infrastructure
- identify the challenges and strategies for successful planning and implementation of infrastructure.
- apply the above concepts to various infrastructure domains.

**REFERENCES**

1. Raina V.K, "Construction Management Practice – The inside Story", Tata McGraw Hill Publishing Limited, 2005
2. Leslie Feigenbaum, "Construction Scheduling With Primavera Project Planner", Prentice Hall, 2002
3. W.Ronald Hudson, Ralph Haas, Waheed Uddin, "Infrastructure Management: Integrating, Design, Construction, Maintenance, Rehabilitation and renovation", McGraw Hill Publisher, 2013
4. Prasanna Chandra, "Projects – Planning, Analysis, Selection, Implementation Review", Tata McGraw Hill Publishing Company Ltd., New Delhi. 2006.
5. Joy P.K., "Total Project Management - The Indian Context", Macmillan India Ltd., 1992
6. Report on Indian Urban Infrastructure and Services – The High Powered Expert Committee for estimating the Investment Requirements for Urban Infrastructure Services, March 2011
7. Urban Water Development in India 2011 – Published and Distributed by India Infrastructure Research
8. Manual on sewerage and sewage treatment, CPHEEO, Ministry of urban affairs and employment, Govt.of India, New Delhi, 2012
9. Manual of National Highway Authority of India, 1988

**BA5064**

**CONTRACTS AND ARBITRATION**

**L T P C  
3 0 0 3**

**OBJECTIVE:**

- To create awareness on contracts for construction industry, impart knowledge on tender preparation, tendering process, laws on arbitration, arbitration procedure and laws on dispute resolution in India.

**UNIT I INTRODUCTION TO CONTRACTS IN CONSTRUCTION INDUSTRY 9**

Brief details of engineering contracts -Definition, types and essentials of contracts and clauses for contracts - Preparation of tender documents and contract documents - Issues related to tendering process- Awarding contract, e-tendering process - Time of performance - Provisions of contract law - Breach of contract - Performance of contracts - Discharge of a contract- Indian contract Act 1872 - Extracts and variations in engineering contracts - Risk management in contracts.

**UNIT II LAWS RELATED TO CONSTRUCTION INDUSTRY 9**

Labor and industrial laws - Payment of wages act, contract labor - Workmen's compensation act - Insurance, industrial dispute act- Role of RERA

**UNIT III ARBITRATION OF ENGINEERING CONTRACTS 9**

Background of Arbitration in India - Indian Arbitration Act 1937 - UNCITRAL model law -Forms of arbitration - Arbitration agreement - Commencement of arbitral proceedings - Constitution of arbitral tribunal - Institutional procedure of arbitration -Impartiality and independence of arbitrators jurisdiction of arbitral tribunal - Interim measures - Enforcement of awards.

**UNIT IV NEGOTIATION, MEDIATION AND CONCILIATION 9**

Concepts and purpose - Statutory back ground ADR and mediation rules - Duty of mediator and disclose facts - Power of court in mediation.

**UNIT V ALTERNATE DISPUTE RESOLUTION 9**

Structure of Indian Judicial - The arbitration and reconciliation ordinance 1996 -Dispute resolution mechanism under the Indian judicial system - Litigation in Indian courts - Case studies.

**TOTAL :45 PERIODS**

**OUTCOMES:**

On successful completion of the course, students will be able to

- understand the laws on contracts for construction industry in india
- apply knowledge of contracts in preparation of contract document and tendering process
- apply appropriate methods to assess the critical factors in contracts leading to arbitration and disputes between the parties
- suggest suitable type of arbitration or dispute resolution for the situation of problem

**REFERENCES**

1. American Arbitration Association, "Construction industry arbitration rules andmediation procedures", 2007
2. Case study of Southern Railway Arbitration Caseswiki.iricen.gov.in/doku/lib/exe/fetch.php
3. Collex.K, "Managing Construction Contracts", Reston publishing company, Virginia,1982
4. Eastern Book Company "Arbitration and Conciliation Act 1996", June 2008
5. International Federation of Consulting Engineers (FIDIC) documents, Geneva,2009 (<http://www.fidic.org>)
6. Gajaria. G.T., " Laws relating to building and Engineer's Contracts", M.M. TripathiPvt Ltd., Mumbai, 1985
7. Horgon.M.O and Roulstion F.R., "Project Control of Engineering Contracts" E andFN, SPON, Norway, 1988
8. Krishna Sharma, Momota Oinam and Angshuman Kaushik, "Development andPractice of Arbitration in India- Has it evolved as an effective legal Institution",CDDRL, Stanford, 103, Oct 2009
9. Park.W.B., "Construction Bidding for Projects", John Wiley, Norway, 1978
10. Roshan Namavati, "Professional Practice", Anuphai Publications, Lakhani BookDepot, 2013
11. Vasavada.B.J. "Engineering Contracts and Arbitration" , March 1996

**OBJECTIVE:**

- To impart projects types, time & resource management, resource optimization and new trends in project management.

**UNIT I PROJECT AND ITS PROCESS**

Define project and process -Boundaries of project - Objectives and functions of project management -Characteristics and types of projects -Organization structure / styles -Roles of project management group - Project management office and its role - Project knowledge area - Project integration- Process group interaction -project flow - Project life cycle- Influencing factors. - Case study.

**UNIT II PROJECT TIME MANAGEMENT**

Project scope management - Work break down structure - Activity/Task – Events - Case study - Project planning tools - Rolling wave planning - Gantt charts, Milestone chart, Program progress chart- Creating milestone plan - Project network- Fulkerson's rules - A-O-A and A-O-N networks - Analyze project time- Critical path method (deterministic approach) - Activity oriented network analysis- 80-20 rule- Case study - Type of time estimates & square network diagram - Project updating and monitoring- Case study - Estimate time- Program Evaluation & Review Technique (Probabilistic approach)- Event oriented network analysis- Optimistic, pessimistic and most likely time - Degree of variability in average time - Probabilistic estimate - % utilization of resources.

**UNIT III RESOURCE MANAGEMENT**

Types of Resource- Time, Men, Material, Machinery, Money, Space - Balancing of resource - Resource smoothing technique- Time constraint - Resource leveling technique- Resource constraint- Case study.

**UNIT IV RESOURCE OPTIMIZATION**

Types of cost – Direct, indirect and total cost - Variation of cost with time - Schedule compression techniques- Crashing, fast tracking & Re-estimation- Crash timeand crash cost - Optimize project cost for time and resource - CPM cost model - Life cycle assessment - Impacts and economical assessment - Life cycle cost- Maintenance and operation -Life cycle forecasting – Concept and applications.

**UNIT V EMERGING TRENDS IN PROJECT MANAGEMENT**

AGILE Project management and Project Management using latest tools- Case study.

**TOTAL :45 PERIODS****OUTCOMES:**

On successful completion of the course, the students will be able to

- explain the concept of projects, its process, objectives and functions of project management
- analyze and manage time in projects through gantt charts, cpm and pert techniques
- balance resource requirements of projects so as to avoid idling of resources
- update projects and determine revised schedule of activities and critical path, if any
- crash projects to determine its optimum time-minimum cost relationships

**REFERENCES**

1. "A Guide to the Project Management Body of Knowledge (PMBOK Guide) – Fourth Edition, An American National Standard, ANSI/PMI 990001-2008"
2. A Risk Management Standard, AIRMIC Publishers, ALARM, IRM: 2002
3. Gene Dixon, "Service Learning and Integrated Collaborative Project Management", Project Management Journal, DOI:10.1002/pmi, February 2011, pp.42-58
4. Jerome D. Wiest and Ferdinand K. Levy, "A Management Guide to PERT/CPM", Prentice Hall of India Publishers Ltd., New Delhi, 1994.

5. Punmia B. C. and Khandelwal K.K., "Project Planning and Control with PERT/CPM", Laxmi publications, New Delhi, 1989.
6. Srinath L.S., "PERT & CPM- Principles and Applications", Affiliated East West Press Pvt., Ltd., New Delhi, 2008
7. Sengupta. B and Guha. H, "Construction Management and Planning", Tata McGraw Hill, New Delhi, 1995
8. SangaReddi. S and Meiyappan. PL, "Construction Management", Kumaran Publications, Coimbatore, 1999

**BA5066 MANAGEMENT OF HUMAN RESOURCES, SAFETY AND QUALITY**

**L T P C**  
**3 0 0 3**

**OBJECTIVE:**

- to impart knowledge on management of human resources, labor legislation, safety and quality aspects in construction

**UNIT I HUMAN RESOURCES MANAGEMENT 9**

Introduction - Concept- Growth - Role and function - Manpower planning for construction companies - Line and staff function - Recruitment, selection, placement, induction and training; over staffing; Time office and establishment functions; wage and salary administration - Discipline - Separation process.

**UNIT II LABOR LEGISLATION 9**

Labor laws- Labor law relating to construction industry- Interstate migration- Industrial relations- Collective bargaining- Worker's participation in management - Grievance handling - Discipline - Role of law enforcing agencies and judiciary -Women in construction industry.

**UNIT III SAFETY MANAGEMENT 9**

Importance of safety- Causes of accidents -Responsibility for safety - Role of various parties in safety management -Safety benefits- Approaches to improve safety in construction for different works - Measuring safety.

**UNIT IV SAFETY IMPLEMENTATION 9**

Application of ergonomics to the construction industry - Prevention of fires at construction site- Safety audit.

**UNIT V QUALITY MANAGEMENT IN CONSTRUCTION 9**

Importance of quality - Elements of quality - Quality characteristics- Quality by design - Quality conformance -Contractor quality control - Identification and traceability - Continuous chain management - Brief concept and application - Importance of specifications- Incentives and penalties in specifications - Workmanship as a mark of quality - Final inspection - Quality assurance techniques - Inspection, testing, sampling - Documentation - Organization for quality control, Cost of quality - Introduction to TQM, Six sigma concept- ISO 14000 in quality management.

**TOTAL :45 PERIODS**

**OUTCOMES:**

On successful completion of the course, students will be able to

- Identify the need and importance of human resource management, labour laws relating to construction industry
- Identify the need and measures to improve safety in construction industry and safety audit
- Identify the need for applying ergonomics to construction industry
- Enumerate the need, importance, elements of quality and significance of quality assurance in industry



## REFERENCES

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2. Arya Ashok, "Essence of Labour Laws"- [www.odiindia.in/about-the-books.pdf](http://www.odiindia.in/about-the-books.pdf)
3. Arya Ashok "Discipline & Disciplinary procedure" Organisation Development Institute, 1998
4. Arya Ashok, "Management case studies – An analytical and Developmental Tool" Organisation Development Institute, New Delhi, 1999
5. Corlecton Coulter, Jill Justice Coulter, "The Complete Standard Hand Book of Construction Management", Prentice Hall, (1989)
6. Dwivedi R.S., "Human Relations and Organisational Behaviour", (BH – 1987)
7. Grant E.L., and Leavens worth, "Statistical Quality Control", Mc Graw Hill, 1984.
8. James J Obrien, "Construction Inspection Hand Book – Quality Assurance and Quality Control", Van NOstrand, New York, 1989
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10. Juran Frank, J.M. and Gryna F.M. "Quality Planning and Analysis", Tata Mc Graw Hill, 1982.
11. Malik, P.L., "Handbook of Labour & Industrial Law", Eastern book company, Lalbagh, Lucknow, 2010
12. Manoria C.B., "Personnel Management", Himalaya Publishing House, 1992.

**BA5067**

**DISASTER MITIGATION AND MANAGEMENT**

**L T P C**  
**3 0 0 3**

### OBJECTIVES:

- To create an awareness on the various types of disasters and to expose the students about the measures, its effect against built structures, and hazard assessment procedure in India.
- To impart knowledge on the methods of mitigating various hazards such that their impact on communities is reduced.

### UNIT I INTRODUCTION

**9**

Difference between hazards and disaster -Types of disasters-Phases of disaster management - Hazards - Classification of hazards - Hazards affecting buildings - Building safety against hazards - Floods - Cyclone - Landslides -Tsunami - Fire.

### UNIT II EARTHQUAKE DISASTER

**9**

Earthquake hazard map -Causes of earthquakes -Classification of earthquakes -Seismic waves - Energy release - Inertia forces - Natural period - Resonance - Damping -Seismic response of free vibration -Seismic response of damped vibration -Performance of ground and buildings in past earthquakes-Earthquake resistant measures in RC and masonry buildings - Potential deficiencies of RC and masonry buildings.

### UNIT III OTHER DISASTERS

**9**

Landslides-Landslide zoning map - Causes -Protection measures Floods -Flood zone map -Effects on buildings -Protection measures from damage to buildings -Mitigation strategies -Tropical cyclones - Effects on buildings -Protection measures from damage to buildings - Tsunami - Tsunami wave characteristics -Peculiarities of tsunami deposits -Tsunami impact on coastal lines- Effects of Tsunami on built structures - Fire disaster - Causes and effects of fire disaster - Preventive mechanism .

#### **UNIT IV HAZARD ASSESSMENT**

**9**

Visual inspection and study of available documents -Detailed in-situ investigation planning and interpretation of results-Foundation capability -Non-structural components - Seismic strengthening of buildings –Repairs, restoration and strengthening of existing buildings - Strengthening materials -Retrofitting of load bearing wall buildings - Retrofitting of RC Buildings-RVS method of screening - RC and masonry structures -Seismic hazard assessment - Deterministic seismic hazard analysis - PSHA.

#### **UNIT V LAND USE ZONING REGULATIONS , QUALITY CONTROL AND DISASTER MANAGEMENT POLICY**

**9**

Introduction-Community planning - Community contingency plan - Report building and initial awareness - Recommendations for land use zoning regulations - Construction quality control - Evolution of quality management -Reasons for poor construction -Construction of quality control in masonry structures - Disaster management policy and procedure -Legal frame work - Institutional mechanism - Schemes and grants on DM - Recommendation of 13<sup>th</sup> finance commission -Plan schemes - Non plan schemes - Externally aided schemes Role of NDRF in Disaster Management - Medical First Responder - Flood Rescue &Relief Management.

**TOTAL :45 PERIODS**

#### **OUTCOMES:**

On successful completion of the course, students will be able to

- understand the various types of disaster viz hydrological, coastal and marine disasters, atmospheric disasters, geological, mass movement and land disasters, wind and water driven disasters.
- to identify the potential deficiencies of existing buildings for eq disaster and suggest suitable remedial measures.
- derive the guide lines for the precautionary measures and rehabilitation measures for eq disaster.
- understand the effects of disasters on built structures
- derive the protection measures against floods, cyclone and land slides
- understand the hazard assessment procedure
- get the awareness regarding landuse zoning regulations &quality control

#### **REFERENCES**

1. Annual Report, Ministry of Home Affairs, Government of India, 2009-10
2. Ayaz Ahmad, "Disaster Management: Through the New Millennium" Anmol Publications, 2003
3. Berg.GV, "Seismic Design codes and procedures", EERI, CA,1982
4. Booth, Edmund, "Concrete Structures in earthquake regions; Design and Analysis", Longman, 1994
5. Dowrick. D.J, "Earthquake resistant design for Engineers and Architects", John Wiley & Sons, Second Edition, 1987.
6. Ghosh G.K. "Disaster Management", A.P.H. Publishing Corporation, 2006
7. Goel, S. L. "Encyclopaedia of Disaster Management", Deep & Deep Publications Pvt Ltd.,2006
8. Jaikrishna & A.R.Chandrasekaran, "Elements of Earthquake Engineering", Sarita Prakashan, Meerut,1996
9. Singh R.B, "Disaster Management", Rawat Publications, 2008
10. Thirteenth Finance Commision Report, Ministry of Finance, Government of India, 2010-15

**OBJECTIVE:**

- To study the concepts of construction economics and finance such as comparing alternatives proposals, evaluating alternative investments, management of funds, Insurance procedures, risks involved and economics of costing.

**UNIT I                    BASIC PRINCIPLES** **9**

Time Value of Money - Cash flow diagram - Nominal and effective Interest - Continuous interest - Nominal and effective interest- continuous interest . Single Payment Compound Amount Factor (P/F,F/P) – Uniform series of Payments (F/A,A/F,F/P,A/P)– Problem time zero (PTZ)- equation time zero (ETZ). Constant increment to periodic payments – Arithmetic Gradient(G), Geometric Gradient (C)

**UNIT II                    MARKET STRUCTURE AND CONSTRUCTION ECONOMICS** **9**

Types of Market Structure in the Construction Industry – Markets and the competitive environment- Perfect competition -. Monopolistic competition - Oligopoly - Monopoly – Characteristics and economic Profit – Construction Economics – BOOT, BOT, BOO Methods - Depreciation - Inflation-Taxes

**UNIT III                    EVALUATING ALTERNATIVE INVESTMENTS** **9**

Present worth analysis, Annual worth analysis, Future worth analysis, Rate of Return Analysis (ROR) and Incremental Rate of Return (IROR) Analysis, Benefit/Cost Analysis, Break Even Analysis - Replacement Analysis- Equipment Replacement Analysis.

**UNIT IV                    FUNDS MANAGEMENT** **9**

Project Finance - Sources - Working capital management- Inventory Management- Mortgage Financing-- Interim construction financing - Security and risk aspects

**UNIT V                    ECONOMICS OF COSTING** **9**

Construction accounting-Chart of accounts- Meaning and definition of costing - Types of costing - Methods of calculation (Marginal costing, cost sheet, budget preparation) – Equipment Cost- Replacement Analysis - Role of costing technique in real estate and infrastructure management.

**TOTAL: 45 PERIODS**

**OUTCOME:**

- On completion of this course the students will be able to know the concepts in Economics and Finance in Construction.

**REFERENCES**

1. Pandey, I.M, Financial Management, 12th Edition Vikas Publishing House Pvt. Ltd., 2012.
2. Prasanna Chandra, Financial Management, 9th edition, Tata McGraw Hill, 2012.
3. Paul A. Samuelson, William D. Nordhaus, Sudip Chaudhuri and Anindya Sen, Economics, 19<sup>th</sup> edition, Tata McGraw Hill, 2010.
4. Blank, L.T., and Tarquin,a.J , Engineering Economy,4th Edn. Mc-Graw Hill, 1988.
5. Patel, B M, Project management- strategic Financial Planning, Evaluation and Control, Vikas Publishing House Pvt. Ltd. New Delhi, 2000.
6. Shrivastava,U.K., Construction Planning and Management,2nd Edn. Galgotia Publications Pvt. Ltd. New Delhi, 2000.
7. Steiner, H.M.,Engineering Economic principles, 2nd Edn. Mc-Graw Hill Book, New York, 1996.

**OBJECTIVES:**

- To create an awareness on the various environmental issues in an urban scenario and give an exposure to the urban water resources and its management.
- To impart knowledge on the stages of works involved in a water supply project of a city, safe wastewater collection system for generated wastewater and its management, solid waste and their safe disposal beyond urban limit to be free from pollution is also addressed in the course work.

**UNIT I URBAN ENVIRONMENTAL ISSUES 9**

Urbanization- Population growth scenario -Migration - Pollution of surface water resources -Rivers, tanks, channels -Ground water exploitation - Waste water -Characteristics -Pollution problems - Solid waste -Air pollution - CPCB norms.

**UNIT II URBAN MASTER PLANS 9**

Planning and organizational aspects -Urban waste resources management - Water in urban ecosystem -Urban water resources planning and organization aspects -Storm water management practices -Types of storage -Magnitude of storage -Storage capacity of urban components - Percolation ponds -Temple tanks -Rainwater harvesting -Urban water supply - Demand estimation -Population forecasting -Source identification -Water conveyance -Storage reservoirs -Fixing storage capacity - Distribution network -Types -Analysis -Computer applications - Conservation techniques -Integrated urban water planning - Smart city project planning - Green Building - LEED certification - Green audit

**UNIT III URBAN WASTEWATER MANAGEMENT 9**

Sewage generation -Storm drainage estimation -Industry contribution -Wastewater collection system -Separate and combined system -Hydraulic design of sewer and storm drain -Wastewater treatment -Disposal methods -Concept of decentralization - 3R concepts.

**UNIT IV MUNICIPAL SOLID WASTE MANAGEMENT 9**

Sources of solid waste -Characteristics -Rate of generation -Segregation at source -Collection of solid waste -Methods of collection -Route analysis -Transfer and transfer stations -Processing and disposal of solid waste.

**UNIT V CASE STUDIES 9**

Environmental economics- Social and physiological aspects of pollution - Successful urban management -Models- Urban management-Case studies from developed nations -Software.

**TOTAL :45 PERIODS****OUTCOMES:**

On successful completion of the course, students will be able to

- understand planning of a city and identify various urban environmental issues
- apply and prepare project plans to integrate urban water resource
- develop water resource management using available water resources
- understand and apply the principles of solid waste management

**REFERENCES**

1. George Tchobanoglous, Hilary Theisen and Samuel A, Vigil "Integrated Solid Waste Management", McGraw Hill Publishers, New York, 1993.
2. McGhee J., "Water supply and sewerage", McGraw Hill Publishers, 1991
3. Martin P. Wanelista and Yousef. "Storm Water Management and Operations", John Wiley and Sons, 1993.
4. Neil S. Grigg., "Urban Water Infrastructure Planning – Management and Operations", John Wiley and Sons, 1986.

**OBJECTIVE:**

- To give an exposure on the advanced materials, techniques and equipments used in infrastructure industry.

**UNIT I SPECIAL CONCRETES****9**

Concrete -Behavior of concrete - High strength and high performance concrete - Fibre reinforced concrete - Self compacting concrete - Bacterial concrete -Reactive powder concrete - Ready mix concrete -Geopolymer concrete -Alternative materials for concrete.

**UNIT II METALS****9**

Steels - New alloy steels - Coatings to reinforcement - Cold formed steel -Aluminum and its products -Applications. Composites: Plastics - Reinforced polymers- FRP -Applications. Smart and intelligent materials: smart and intelligent materials for intelligent buildings - Special features.

**UNIT III ADVANCED CONSTRUCTION TECHNIQUES****9**

Sub structure construction: Box jacking- Pipe jacking- Under water construction of diaphragm walls and basement- Tunneling techniques-Cable anchoring and grouting- Driving diaphragm walls, sheet piles, laying operations for built up offshore system- Shoring for deep cutting- Large reservoir construction -Trenchless technology.

**UNIT IV SUPERSTRUCTURE CONSTRUCTION FOR BUILDINGS****9**

Vacuum dewatering of concrete flooring- Concrete paving technology- Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections - Launching techniques suspended form work -Erection techniques of tall structures, large span structures- Launching techniques for heavy decks -Inset pre-stressing in high rise structures, aerial transporting, handling, erecting lightweight components on tall structures.

**UNIT V CONSTRUCTION OF SPECIAL STRUCTURES****9**

Erection of lattice towers and rigging of transmission line structures- Construction sequence in cooling towers, silos, chimney, sky scrapers, bow string bridges, cable stayed bridges - Launching and pushing of box decks -Advanced construction techniques of offshore structures- Construction sequence and methods in domes and prestress domes -Support structure for heavy equipment and conveyor and machinery in heavy industries -Erection of articulated structures, braced domes and space decks. Demolition Techniques -Advanced techniques and sequence in demolition and dismantling.

**TOTAL :45 PERIODS****OUTCOMES:**

On successful completion of the course, students will be able to

- explain the properties and applications of special concretes, composites, smart and intelligent materials
- identify and explain advanced construction techniques used for sub structure construction
- select appropriate techniques for super structure construction of buildings
- select suitable techniques for construction of special structures
- choose relevant technique for demolition and dismantling works

**REFERENCES**

1. Jerry Irvine, "Advanced Construction Techniques", C.A. Rocketr, 1984
2. Patrick Powers, "Construction Dewatering: New Methods and Applications", John Wiley & Sons, 1992
3. Robertwade Brown, "Practical foundation Engineering handbook", McGraw Hill Publications, 1995.
4. Sankar S.K. and Saraswathi. S, "Construction Technology", Oxford University Press, New Delhi, 2008.

**OBJECTIVE:**

- To provide the participants with a good knowledge on strategic planning and marketing in airport organizations.

**UNIT I INTRODUCTION TO AIRPORT INFRASTRUCTURE****9**

Growth of air transport, Airport organization and associations, Classification of airports airfield components, Air traffic zones and approach areas. Context of airport system planning - Development of airport planning process - Ultimate consumers - Airline decision - Other airport operations.

**UNIT II AIRPORT INFRASTRUCTURE CAPACITY DESIGN****9**

Components, size, turning radius, speed, airport characteristics. Capacity and Delay - Factors affecting capacity, determination of runway capacity related to delay, gate capacity and taxiway capacity.

**UNIT III AIRPORT INFRASTRUCTURE PLANNING AND SURVEYS****9**

Runway length and width, sight distances, longitudinal and transverse, runway intersections, taxiways, clearances, aprons, numbering, holding apron. Planning and design of the terminal area: Operational concepts, space relationships and area requirements, noise control, vehicular traffic and parking at airports. Air traffic control and aids: Runways and taxiways markings, day and night landing aids, airport lighting and other associated aids.

**UNIT IV AIRPORT INFRASTRUCTURE ENTERPRISE****9**

The economic impact on countries and regions - the main governance patterns in the airport business - The International path of evolution in the airport business - Airport transport value chain - Air enterprises - two primary actors in the air transport value chain - Skipping peripheral positions in the value chain. Rise of airport marketing for the aviation related business - Airport revenue management- Airport alliances- management contract.

**UNIT V THE DEVELOPMENT OF THE NON AVIATION INFRASTRUCTURE****9**

Related value Proposition. Evolution of traditional Airport - Evolutionary patterns for airport enterprises- Commercial Airport Philosophy - tourist and conference service - logistic services- property management- consulting services - BAA and the non aviation business - best airport in the world: The case of Singapore Airport - Role and meaning of loyalty for a service company- Bench marking airline experience - Provider - Customer relational link - benefits from ALPS implementation of ALPS.

**TOTAL :45 PERIODS****OUTCOMES :**

On the successful completion of the course, students will be able to:

- explain the classification of airports airfield components
- explain the main governance patterns in the airport business
- identify the evolutionary patterns for airport enterprises.
- explain the primary actors in the air transport value chain

**REFERENCES**

1. Aviation Safety Programs A Management Hand Book: Richard H. Wood - Jeppesen Sanderson Inc.
2. Airport Systems,: Planning, Design and Management, Second Edition, Richard L. De Neufville , Amedeo R. Odoni, Peter Belobaba,& Tom G. Reynolds ), 2013.
3. Airport Planning and Management, Sixth Edition, Seth B. Young, Ph.D., Alexander T. Wells, Ed.D., McGraw-Hill Education, 2011.
4. Asset and Infrastructure Management for Airports—Primer and Guidebook, The national academic press.

**OBJECTIVE:**

- To provide the participants with a good knowledge on real estate marketing and management.

|   |  |          |
|---|--|----------|
| <b>UNIT I</b>   | <b>CONCEPT</b>                                     | <b>9</b> |
| Fundamental concepts and techniques involved in real estate development process- Role of various organizations - CREDAI- BAI etc  |  |          |
| <b>UNIT II</b>  | <b>EVENTS AND PRE-PROJECT STUDIES</b>              | <b>9</b> |
| Modeling sequential events in real estate development process - Site evaluation - Land procurement - Development Team assembly - Market study   |  |          |
| <b>UNIT III</b>   | <b>DEVELOPMENT PLANNING &amp; APPROVAL PROCESS</b> | <b>9</b> |
| Identifying technical inputs required, planning objectives, front end clearances from various authorities, timing of the project and scheduling   |  |          |
| <b>UNIT IV</b>  | <b>CONSTRUCTION AND PROJECT MANAGEMENT</b>         | <b>9</b> |
| Identifying the elements of infrastructure and the resource mobilization, disaggregating the project components, mobilizing the human and fiscal resources procuring and storing materials  |  |          |
| <b>UNIT V</b>   | <b>PROJECT MARKETING &amp; HANDING OVER</b>        | <b>9</b> |
| Over of the completed project- Communication tools required for presenting the project -In house sales promotion -Franchisee system -Joint venture and sharing issues - Procedure and laws relating to transfer of completed project. |  |          |

**TOTAL :45 PERIODS****OUTCOMES:**

On successful completion of the course, students will be able to

- Explain the fundamental concepts and techniques involved in real estate development process
- Explain the procedure and laws relating to transfer of completed project
- Identify the fiscal resources procuring and storing materials process.

**REFERENCES:**

1. Gerald R. Cortesi, "Mastering real estate principles" (2001); Dearborn Trade Publishing, New York, USA.
2. Fillmore W Galaty, "Modern real estate practice" (2002); Dearborn Trade publishing, New York, USA
3. Tanya Davis, "Real estate developer's handbook" (2007), Atlantic pub company, Ocala, USA.
4. Mike E. Miles, "Real estate development - Principles & process 3<sup>rd</sup> edition" (2000); Urban Land Institute, ULI, Washington DC.

**OBJECTIVES:**

- To develop and strengthen entrepreneurial quality and motivation in students.
- To impart basic entrepreneurial skills and understandings to run a business efficiently and effectively.

**UNIT I      ENTREPRENEURIAL COMPETENCE      9**

Entrepreneurship concept - Entrepreneurship as a Career - Entrepreneurial Personality - Characteristics of Successful, Entrepreneur - Knowledge and Skills of Entrepreneur.

**UNIT II      ENTREPRENEURIAL ENVIRONMENT      9**

Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support Organizational Services - Central and State Government Industrial Policies and Regulations - International Business.

**UNIT III      BUSINESS PLAN PREPARATION      9**

Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product - Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria.

**UNIT IV      LAUNCHING OF SMALL BUSINESS      9**

Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching -Incubation, Venture capital, IT startups.

**UNIT V      MANAGEMENT OF SMALL BUSINESS      9**

Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business.

**TOTAL :45 PERIODS****OUTCOME:**

Students will gain knowledge and skills needed to start and run an enterprise.

**REFERENCES**

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi, 2001.
2. S.S.Khanka, Entrepreneurial Development, S.Chand and Company Limited, New Delhi, 2001.
3. Mathew Manimala, Entrepreneurship Theory at the Crossroads, Paradigms & Praxis, Biztrantra ,2nd Edition ,2005
4. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill, 1996.
5. P.Saravanel, Entrepreneurial Development, Ess Pee kay Publishing House, Chennai -1997.
6. Arya Kumar. Entrepreneurship. Pearson. 2012
7. Donald F Kuratko, T.V Rao. Entrepreneurship: A South Asian perspective. Cengage Learning. 2012



**OBJECTIVE:**

- To gain knowledge about the valuation of different infrastructure assets

**UNIT I REAL ESTATE VALUATION**

9

Scope and objectives - Concepts of valuation - Types of value - Value vs Price vs Cost-Different methods of valuation- SWOT analysis

**UNIT II APPROACHES TO REAL ESTATE VALUATION**

9

Sales comparison approach - Cost approach - Income approach - SWOT analysis

**UNIT III VALUATION OF VARIOUS CATEGORIES OF REAL ESTATE**

9

Residential real estate valuation - Commercial real estate valuation - Industrial real estate valuation - Retail real estate valuation- Mixed-use real estate valuation

**UNIT IV INFRASTRUCTURE ASSET VALUATION**

9

Objective and approaches-Different categories of infrastructure assets- Valuation methodology- Key operational and financial parameters -Valuation framework and models.

**UNIT V SECTORAL INFRASTRUCTURE VALUATION**

9

Power sector- IT sector - Telecom sector - Aviation-Education sector- Other service sectors- Plant and Machinery -Case studies

**TOTAL :45 PERIODS****OUTCOME:**

- Students will gain knowledge and skills in connection to the valuation of different types of real estates and infrastructure assets.

**REFERENCES :**

- Infrastructure valuation –Frederic Blanc - Brude and Majid Hasan, EDHEC Risk Institute
- Infrastructure Asset Management - Frederic Blanc - Brude and Majid Hasan, EDHEC Risk Institute
- Valuation techniques for infrastructure investment decisions, Michael J. Garvin, Department of Civil Engineering and Engineering Mechanics , Columbia University
- <https://www.thebalance.com/different-types-of-real-estate-investments-you-can-make-357986>
- [http://rbsa.in/valuation\\_of\\_infrastructure\\_assets\\_specialized\\_assets.html](http://rbsa.in/valuation_of_infrastructure_assets_specialized_assets.html)
- [http://edhec.infrastructure.institute/wp-content/uploads/publications/blanc-brude\\_2015a.pdf](http://edhec.infrastructure.institute/wp-content/uploads/publications/blanc-brude_2015a.pdf)
- Application of Real Options in Infrastructure Projects Charles Y.J. Cheah, PhD, CFA



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