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.

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 <u>secures overall attendance between 65% and 74%</u> 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)		
			Internal	External	Internal	External	Supervisor
5	7.5	7.5	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 $4)^{th}$ semester to register for courses in n^{th} 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.

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

where C_i is the number of Credits assigned to the course

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

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. 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.

iii. Successfully passed any additional courses prescribed by the Director, Academic Courses whenever readmitted under regulations R-2017 (vide clause 18.3)

iv. Successfully completed the NCC / NSS / NSO / YRC requirements.

v. No disciplinary action pending against the student.

vi. 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.

ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
B.E. COMPUTER SCIENCE AND ENGINEERING
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM

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

POs	PEOs	
	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. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	1
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	1
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.	3	2
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.	3	2
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.	2	3
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.	2	2

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.	2	1
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	3	1
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	3	2
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.	3	2
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.	2	2
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.	1	3

PSOs		
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

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
SEMESTER 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	√	√	√					√	√	√		
SEMESTER II	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)											
		COURSE TITLE	1	2	3	4	5	6	7	8	9	**10**	**11**	**12**
YEAR II	SEMESTER III	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	Semester	Course												
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 III	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												

Semester	Course												
	Professional Elective II												
	Professional Elective III												
	Cloud Computing Laboratory	√	√	√		√			√	√	√		√
	Security Laboratory	√	√	√		√			√	√	√		√
SEMESTER VIII	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	√	√	√									

ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
B.E. COMPUTER SCIENCE AND ENGINEERING
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM
I - VIII SEMESTERS CURRICULA AND SYLLABI

SEMESTER I

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
			TOTAL	31	19	0	12	25

SEMESTER II

SI.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
7.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
8.	CS8261	C Programming Laboratory	PC	4	0	0	4	2
			TOTAL	28	20	0	8	24

SEMESTER III

Sl.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
			TOTAL	31	17	0	14	24

SEMESTER IV

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
			TOTAL	29	19	0	10	24

SEMESTER V

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
			TOTAL	**31**	**19**	**0**	**12**	**25**

SEMESTER VI

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
			TOTAL	**32**	**18**	**0**	**14**	**25**

SEMESTER VII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
7.	CS8711	Cloud Computing Laboratory	PC	4	0	0	4	2
8.	IT8761	Security Laboratory	PC	4	0	0	4	2
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER VIII

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective IV	PE	3	3	0	0	3
2.		Professional Elective V	PE	3	3	0	0	3
PRACTICALS								
3.	CS8811	Project Work	EEC	20	0	0	20	10
			TOTAL	**26**	**6**	**0**	**20**	**16**

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

SI. 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

SI. 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

SI. 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%
	Total	25	24	24	24	25	25	22	16	185	
8.	Non Credit / Mandatory										

	L	T	P	C

HS8151   **COMMUNICATIVE ENGLISH**   **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 Coursebook for Undergarduate 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 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, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th 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, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd 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", 12th Edition, Pearson India, 2016.

	L	T	P	C
	3	0	0	3

PH8151   **ENGINEERING PHYSICS**

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_2-O_2 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'', 2nd 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, 50th 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, 2nd 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**   **L   T   P   C**
                  (Common to all branches of B.E. / B.Tech Programmes)   **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 viscometery.

1. Estimation of HCl using Na_2CO_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.

<div align="right">TOTAL: 30 PERIODS</div>

TEXTBOOK:

1. Vogel's Textbook of Quantitative Chemical Analysis (8TH 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 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- newsapapers- **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 cgarts, 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/ talkls 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   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 $w = z + c,\ cz, \dfrac{1}{z}, z^2$ - 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, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th 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, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3rd 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, 4th 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)	L	T	P	C
		3	0	0	3

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 able to
- Gain knowledge on classical and quantum electron theories, and energy band structuues,
- 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 Seksena and Kaustuv Dasgupta, Fundaments 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', 2nd 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.

CS8251   **PROGRAMMING IN C**   **L T P C**

                                                                         3 0 0 3

OBJECTIVES:
- To develop C Programs using basic programming constructs
- To develop C programs using arrays and strings
- To develop applications in C using functions , pointers and structures
- To do input/output and file handling in C

UNIT I   BASICS OF C PROGRAMMING   9
Introduction to programming paradigms - Structure of C program - C programming: Data Types –
Storage classes - Constants – Enumeration Constants - Keywords – Operators: Precedence and
Associativity - Expressions - Input/Output statements, Assignment statements – Decision making
statements - Switch statement - Looping statements – Pre-processor directives - Compilation
process

UNIT II   ARRAYS AND STRINGS   9
Introduction to Arrays: Declaration, Initialization – One dimensional array – Example Program**:**
Computing Mean, Median and Mode - Two dimensional arrays – Example Program: Matrix
Operations (Addition, Scaling, Determinant and Transpose) - String operations: length, compare,
concatenate, copy – Selection sort, linear and binary search

UNIT III   FUNCTIONS AND POINTERS   9
Introduction to functions: Function prototype, function definition, function call, Built-in functions
(string functions, math functions) – Recursion – Example Program: Computation of Sine series,
Scientific calculator using built-in functions, Binary Search using recursive functions – Pointers –
Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Example
Program: Sorting of names – Parameter passing: Pass by value, Pass by reference – Example
Program: Swapping of two numbers and changing the value of a variable using pass by reference

UNIT IV   STRUCTURES   9
Structure - Nested structures – Pointer and Structures – Array of structures – Example Program
using structures and pointers – Self referential structures – Dynamic memory allocation - Singly
linked list - typedef

UNIT V   FILE PROCESSING   9
Files – Types of file processing: Sequential access, Random access – Sequential access file -
Example Program: Finding average of numbers stored in sequential access file - Random access
file - Example Program: Transaction processing using random access files – Command line
arguments

OUTCOMES:
Upon completion of the course, the students will be able to
- Develop simple applications in C using basic constructs
- Design and implement applications using arrays and strings
- Develop and implement applications in C using functions and pointers.
- Develop applications in C using structures.
- Design applications using sequential and random access file processing.

TEXT BOOKS:
1. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition,
   Pearson Education, 2006

REFERENCES:
1. Paul Deitel and Harvey Deitel, "C How to Program", Seventh edition, Pearson Publication
2. Juneja, B. L and Anita Seth, "Programming in C", CENGAGE Learning India pvt. Ltd., 2011

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, 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:

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", 7th 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, 30th Reprint, 2011.

REFERENCES:
1. Grimaldi, R.P. "Discrete and Combinatorial Mathematics: An Applied Introduction", 4th 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, 3rd 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.

UNIT III   SYNCHRONOUS SEQUENTIAL LOGIC   12

Sequential Circuits - Storage Elements: Latches , Flip-Flops - Analysis of Clocked Sequential Circuits - State Reduction and Assignment - Design Procedure - Registers and Counters - HDL Models of Sequential Circuits.

UNIT IV   ASYNCHRONOUS SEQUENTIAL LOGIC   12

Analysis and Design of Asynchronous Sequential Circuits – Reduction of State and Flow Tables – Race-free State Assignment – Hazards.

UNIT V   MEMORY AND PROGRAMMABLE LOGIC   12

RAM – Memory Decoding – Error Detection and Correction - ROM - Programmable Logic Array – Programmable Array Logic – Sequential Programmable Devices.

TOTAL :   60   PERIODS

OUTCOMES:
On Completion of the course, the students should be able to:
- Simplify Boolean functions using KMap
- Design and Analyze Combinational and Sequential Circuits
- Implement designs using Programmable Logic Devices
- Write HDL code for combinational and Sequential Circuits

TEXT BOOK:
1. M. Morris R. Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog", 6th Edition, Pearson Education, 2017.

REFERENCES:
1. G. K. Kharate, Digital Electronics, Oxford University Press, 2010
2. John F. Wakerly, Digital Design Principles and Practices, Fifth Edition, Pearson Education, 2017.
3. Charles H. Roth Jr, Larry L. Kinney, Fundamentals of Logic Design, Sixth Edition, CENGAGE Learning, 2013
4. Donald D. Givone, Digital Principles and Designǁ, Tata Mc Graw Hill, 2003.

CS8391	DATA STRUCTURES	L T P C
		3 0 0 3

OBJECTIVES:
- To understand the concepts of ADTs
- To Learn linear data structures – lists, stacks, and queues
- To understand sorting, searching and hashing algorithms
- To apply Tree and Graph structures

UNIT I   LINEAR DATA STRUCTURES – LIST   9

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation ––singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

UNIT II   LINEAR DATA STRUCTURES – STACKS, QUEUES   9

Stack ADT – Operations - Applications - Evaluating arithmetic expressions- Conversion of Infix to postfix expression - Queue ADT – Operations - Circular Queue – Priority Queue - deQueue – applications of queues.

UNIT III   NON LINEAR DATA STRUCTURES – TREES   9

Tree ADT – tree traversals - Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree - B+ Tree **-** Heap – Applications of heap.

UNIT IV   NON LINEAR DATA STRUCTURES - GRAPHS   9

Definition – Representation of Graph – Types of graph - Breadth-first traversal - Depth-first traversal – Topological Sort – Bi-connectivity – Cut vertex – Euler circuits – Applications of graphs.

UNIT V   SEARCHING, SORTING AND HASHING TECHNIQUES   9

Searching- Linear Search - Binary Search. Sorting - Bubble sort - Selection sort - Insertion sort - Shell sort – Radix sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Implement abstract data types for linear data structures.
- Apply the different linear and non-linear data structures to problem solutions.
- Critically analyze the various sorting algorithms.

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

    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 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", 8th Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, "Core Java Volume –I Fundamentals", 9th Edition, Prentice Hall, 2013.

REFERENCES:
1. Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3rd 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

UNITII   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", 3rd 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**	L	T	P	C
		0	0	4	2

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**
HS8381	**INTERPERSONAL SKILLS/LISTENING&SPEAKING**	**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 :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 MamtaBhatnagar. 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	L	T	P	C
		4	0	0	4

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.

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 - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.

UNIT IV   QUEUEING MODELS   12
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 reneging.

UNIT V   ADVANCED QUEUEING MODELS   12
Finite source models - M/G/1 queue – Pollaczek Khinchin formula - M/D/1 and M/E$_K$/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 4th Edition, 2014.
2. Ibe, O.C., "Fundamentals of Applied Probability and Random Processes", Elsevier, 1st 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", 9th Edition, Pearson India Education Services, Delhi, 2016.
3. Trivedi, K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002.
4. Yates, R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd 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.

3. John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approachll, 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 Systemsǁ, 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", 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. 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   L   T   P   C
                                                                        3   0   0   3
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.

9

UNIT V PROJECT MANAGEMENT

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 PrivateLimited, 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

	L	**T**	**P**	**C**
HS8461 **ADVANCED READING AND WRITING**	**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, 5th 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, 2nd 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. Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware",TMH,2012
2. A.K.Ray,K.M.Bhurchandi,"Advanced Microprocessors and Peripherals "3rd 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.

UNIT IV   PROPERTIES OF CONTEXT FREE LANGUAGES   9

Normal Forms for CFG – Pumping Lemma for CFL – Closure Properties of CFL – Turing Machines – Programming Techniques for TM.

UNIT V   UNDECIDABILITY   9

Non Recursive Enumerable (RE) Language – Undecidable Problem with RE – Undecidable Problems about TM – Post's Correspondence Problem, The Class P and NP.

TOTAL :45PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:
- Construct automata, regular expression for any pattern.
- Write Context free grammar for any construct.
- Design Turing machines for any language.
- Propose computation solutions using Turing machines.
- Derive whether a problem is decidable or not.

TEXT BOOK:
1. J.E.Hopcroft, R.Motwani and J.D Ullman, "Introduction to Automata Theory, Languages and Computations", Second Edition, Pearson Education, 2003.

REFERENCES:
1. H.R.Lewis and C.H.Papadimitriou, "Elements of the theory of Computation", Second Edition, PHI, 2003.
2. J.Martin, "Introduction to Languages and the Theory of Computation", Third Edition, TMH, 2003.
3. Micheal Sipser, "Introduction of the Theory and Computation", Thomson Brokecole, 1997.

CS8592   OBJECT ORIENTED ANALYSIS AND DESIGN   L T P C
                                                                                     3 0 0 3
OBJECTIVES:
- To understand the fundamentals of object modeling
- To understand and differentiate Unified Process from other approaches.
- To design with static UML diagrams.
- To design with the UML dynamic and implementation diagrams.
- To improve the software design with design patterns.
- To test the software against its requirements specification

UNIT I   UNIFIED PROCESS AND USE CASE DIAGRAMS   9

Introduction to OOAD with OO Basics - Unified Process – UML diagrams – Use Case –Case study – the Next Gen POS system, Inception -Use case Modelling – Relating Use cases – include, extend and generalization – When to use Use-cases

UNIT II   STATIC UML DIAGRAMS   9

Class Diagram— Elaboration – Domain Model – Finding conceptual classes and description classes – Associations – Attributes – Domain model refinement – Finding conceptual class Hierarchies – Aggregation and Composition - Relationship between sequence diagrams and use cases – When to use Class Diagrams

UNIT III   DYNAMIC AND IMPLEMENTATION UML DIAGRAMS   9

Dynamic Diagrams – UML interaction diagrams - System sequence diagram – Collaboration diagram – When to use Communication Diagrams - State machine diagram and Modelling –When to use State Diagrams - Activity diagram – When to use activity diagrams

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, a n d 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

CS8651	INTERNET PROGRAMMING	L	T	P	C
		3	0	0	3

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.

CS8601   **MOBILE COMPUTING**   **L T P C**
                                                                      3 0 0 3

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.Toh, "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	L	T	P	C
		3	0	2	4

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.

PRACTICALS	**30**	**PERIODS**
THEORY	**45**	**PERIODS**
TOTAL :	**75**	**PERIODS**

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 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.

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

CS8662   MOBILE APPLICATION DEVELOPMENT LABORATORY   L   T   P   C
                                                              0   0   4   2
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.

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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**   **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 .

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 –

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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., 10th 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

CS8792	CRYPTOGRAPHY AND NETWORK SECURITY	L	T	P	C
		3	0	0	3

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.

CS8711   **CLOUD COMPUTING LABORATORY**   **L T P C**
                                                                          0 0 4 2

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.

IT8761   **SECURITY LABORATORY**   **L   T P C**
                                                                        0   0 4 2

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, 35th 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.

IT8076   **SOFTWARE TESTING**   **L T P C**
                                                                          3 0 0 3

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 Gopalaswamy 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", 2 nd 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	L	T	P	C
		3	0	0	3

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 IV   AGILITY AND REQUIREMENTS ENGINEERING   9

Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.

UNIT V   AGILITY AND QUALITY ASSURANCE   9

Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance - Test Driven Development – Agile Approach in Global Software Development.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:
- Realize the importance of interacting with business stakeholders in determining the requirements for a software system
- Perform iterative software development processes: how to plan them, how to execute them.
- Point out the impact of social aspects on software development success.
- 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.

CS8077	GRAPH THEORY AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:
- To understand fundamentals of graph theory.
- To study proof techniques related to various concepts in graphs.
- To explore modern applications of graph theory.

UNIT I   9
Introduction - Graph Terminologies - Types of Graphs - Sub Graph- Multi Graph - Regular Graph - Isomorphism - Isomorphic Graphs - Sub-graph - Euler graph - Hamiltonian Graph - Related Theorems.

UNIT II   9
Trees -Properties- Distance and Centres - Types - Rooted Tree-- Tree Enumeration- Labeled Tree - Unlabeled Tree - Spanning Tree - Fundamental Circuits- Cut Sets - Properties - Fundamental Circuit and Cut-set- Connectivity- Separability -Related Theorems.

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.

		L	T	P	C
IT8071	**DIGITAL SIGNAL PROCESSING**	**3**	**0**	**0**	**3**

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. Schafer 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
                                                    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. 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	L	T	P	C
		3	0	0	3

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.

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 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 indentity 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.

CS8092 **COMPUTER GRAPHICS AND MULTIMEDIA** **L   T   P   C**
                                                    3   0   0   3

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", 2nd 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	L	T	P	C
		3	0	0	3

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. Gopalaswamy Ramesh, "Managing Global Software Projects" – McGraw Hill Education (India), Fourteenth Reprint 2013.

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 Madisetti, "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, 2nd Edition, O'Reilly Media, 2011.
    https://www.arduino.cc/
    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.Besterfiled, 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", 8th 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-Kauffman/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)

CS8073	C# AND .NET PROGRAMMING	L	T	P	C
		3	0	0	3

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 - PNRP - 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

OUTCOMES:
 Upon completion of the course, the students will be able to:
- Write various applications using C# Language in the .NET Framework.
- Develop distributed applications using .NET Framework.
- Create mobile applications using .NET compact Framework.

TEXT BOOKS:

1. Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner . —Professional C# 2012 and .NET 4.5‖, Wiley, 2012
2. Harsh Bhasin, —Programming in C#‖, Oxford University Press, 2014.

REFERENCES
1. Ian Gariffiths, Mathew Adams, Jesse Liberty, —Programming C# 4.0‖, O'Reilly, Fourth Edition, 2010.
2. Andrew Troelsen, Pro C# 5.0 and the .NET 4.5 Framework, Apress publication, 2012.
3. Andy Wigley, Daniel Moth, Peter Foot, —Mobile Development Handbook‖, Microsoft Press, 2011.

CS8088	WIRELESS ADHOC AND SENSOR NETWORKS	L T P C
		3 0 0 3

OBJECTIVES:
- To learn about the issues and challenges in the design of wireless ad hoc networks.
- To understand the working of MAC and Routing Protocols for ad hoc and sensor networks
- To learn about the Transport Layer protocols and their QoS for ad hoc and sensor networks.
- To understand various security issues in ad hoc and sensor networks and the corresponding solutions.

UNIT I   MAC & ROUTING IN AD HOC NETWORKS   9
 Introduction – Issues and challenges in ad hoc networks – MAC Layer Protocols for wireless ad hoc networks – Contention-Based MAC protocols – MAC Protocols Using Directional Antennas – Multiple-Channel MAC Protocols – Power-Aware MAC Protocols – Routing in Ad hoc Networks – Design Issues – Proactive, Reactive and Hybrid Routing Protocols

UNIT II   TRANSPORT & QOS IN AD HOC NETWORKS   9
 TCP‖s challenges and Design Issues in Ad Hoc Networks – Transport protocols for ad hoc networks – Issues and Challenges in providing QoS – MAC Layer QoS solutions – Network Layer QoS solutions – QoS Model

UNIT III   MAC & ROUTING IN WIRELESS SENSOR NETWORKS   9
Introduction – Applications – Challenges – Sensor network architecture – MAC Protocols for wireless sensor networks – Low duty cycle protocols and wakeup concepts – Contention-Based protocols – Schedule-Based protocols – IEEE 802.15.4 Zigbee – Topology Control – Routing Protocols

UNIT IV   TRANSPORT & QOS IN WIRELESS SENSOR NETWORKS   9
 Data-Centric and Contention-Based Networking – Transport Layer and QoS in Wireless Sensor Networks – Congestion Control in network processing – Operating systems for wireless sensor networks – Examples

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 2 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 (2ⁿᵈ Edition)", World Scientific Publishing, 2011.
3. Waltenegus 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.

GE8072	FOUNDATION SKILLS IN INTEGRATED PRODUCT	L	T	P	C
	DEVELOPMENT	3	0	0	3

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

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- 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. 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.

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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 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, Scenarious 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	L	T	P	C
		3	0	0	3

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", 1st 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	L	T	P	C
		3	0	0	3

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

UNIT II   SECURITY INVESTIGATION   9
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

UNIT III   SECURITY ANALYSIS   9
Risk Management: Identifying and Assessing Risk, Assessing and Controlling Risk - Systems: Access Control Mechanisms, Information Flow and Confinement Problem

UNIT IV   LOGICAL DESIGN   9
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

UNIT V   PHYSICAL DESIGN   9
Security Technology, IDS, Scanning and Analysis Tools, Cryptography, Access Control Devices, Physical Security, Security and Personnel

TOTAL   45   PERIODS

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.

CS8087	SOFTWARE DEFINED NETWORKS	L	T	P	C
		3	0	0	3

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

UNIT I   INTRODUCTION   9
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

UNIT II   OPEN FLOW & SDN CONTROLLERS   9
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 Beginners‖, 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**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

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 Certfied 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", 3rd 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.

CS8086	SOFT COMPUTING	L	T	P	C
		3	0	0	3

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
2.   www.nspe.org
3.   www.globalethics.org
4.   www.ethics.org

CS8080   **INFORMATION RETRIEVAL TECHNIQUES**   **L T P C**

                                                                   3 0 0 3

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	L	T	P	C
		3	0	0	3

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", 3rd 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 Programmingǁ, 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
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 Python‖, 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 Java‖, 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	L	T	P	C
		3	0	0	3

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**   **L T P C**
                                                                                      3 0 0 3
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_2, MgO, ZrO_2, NiO, nanoalumina, CaO, $AgTiO_2$, 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.

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 ability 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
	THEORY												
SEM I	Communicative English									✓	✓		✓
	Engineering Mathematics - I	✓	✓			✓							✓
	Engineering Physics	✓	✓	✓		✓		✓					✓
	Engineering Chemistry	✓	✓	✓		✓							✓
	Problem Solving and Python Programming	✓	✓	✓	✓	✓							✓
	Engineering Graphics			✓	✓								
	PRACTICAL												
	Problem Solving and Python Programming Laboratory	✓		✓	✓	✓	✓				✓		✓
	Physics and Chemistry Laboratory	✓	✓										
	THEORY												
SEM II	Technical English									✓	✓		✓
	Engineering Mathematics - II	✓	✓	✓		✓							✓
	Physics For Electronics Engineering	✓	✓	✓		✓		✓					✓
	Basic Civil and Mechanical Engineering				✓		✓						
	Circuit Theory	✓	✓	✓	✓	✓							✓
	Environmental Science and Engineering	✓	✓			✓	✓	✓	✓				✓
	PRACTICALS												
	Engineering Practices Laboratory	✓		✓	✓	✓	✓				✓		
	Electric Circuits Lab	✓		✓	✓	✓	✓				✓		✓
	THEORY												
SEM III	Transforms and Partial Differential Equations	✓	✓			✓							✓
	Digital Logic Circuits				✓	✓							
	Electromagnetic Theory	✓	✓	✓	✓	✓					✓		✓
	Electrical Machines – I	✓	✓	✓	✓	✓					✓		

SEM	Course	1	2	3	4	5	6	7	8	9	10	11	12
	Electron Devices and Circuits	✓	✓	✓	✓	✓							✓
	Power Plant Engineering			✓	✓	✓		✓	✓	✓			
	PRACTICALS												
	Electronics Laboratory	✓			✓	✓						✓	✓
	Electrical Machines Laboratory - I	✓			✓	✓						✓	✓
	THEORY												
SEM IV	Numerical Methods	✓	✓	✓									✓
	Electrical Machines – II	✓	✓	✓	✓	✓		✓					✓
	Transmission and Distribution	✓	✓	✓	✓	✓		✓					✓
	Measurements and Instrumentation	✓	✓	✓	✓	✓							✓
	Linear Integrated Circuits and Applications	✓	✓	✓		✓							
	Control Systems	✓	✓	✓	✓	✓							✓
	PRACTICALS												
	Electrical Machines Lab II	✓	✓	✓	✓	✓							✓
	Linear and Digital Integrated Circuits Laboratory	✓			✓	✓					✓	✓	✓
	Technical Seminar										✓	✓	✓
	THEORY												
SEM V	Power System Analysis	✓	✓	✓	✓	✓		✓					✓
	Microprocessors and Microcontrollers	✓		✓		✓			✓	✓		✓	✓
	Power Electronics	✓	✓	✓	✓	✓		✓					
	Digital Signal Processing	✓	✓	✓	✓	✓		✓					✓
	Object Oriented Programming			✓	✓	✓							✓
	Open Elective I												
	PRACTICALS												
	Control and Instrumentation Laboratory			✓	✓	✓	✓			✓	✓		

SEM	Course													
	Professional Communication										✓	✓	✓	
	Object Oriented Programming Laboratory			✓	✓	✓								✓
	THEORY													
SEM VI	Solid State Drives	✓	✓	✓	✓	✓		✓						
	Protection and Switchgear	✓	✓	✓	✓	✓		✓						✓
	Embedded Systems													
	Professional Elective I													
	Professional Elective II													
	PRACTICALS													
	Power Electronics and Drives Laboratory	✓		✓	✓							✓	✓	✓
	Microprocessors and Microcontrollers Laboratory	✓		✓	✓							✓	✓	✓
	Mini Project	✓		✓	✓							✓	✓	✓
	THEORY													
SEM VII	High Voltage Engineering	✓	✓	✓	✓	✓		✓						✓
	Power System Operation and Control	✓	✓	✓	✓	✓		✓						✓
	Renewable Energy Systems	✓	✓	✓	✓	✓		✓						✓
	Open Elective II													
	Professional Elective III													
	Professional Elective IV													
	PRACTICALS													
	Power System Simulation Laboratory	✓		✓	✓							✓	✓	✓
	Renewable Energy Systems Laboratory	✓		✓	✓							✓	✓	✓
SEM VIII	**THEORY**													
	Professional Elective V													

SL.NO.	NAME OF THE SUBJECT												
	Professional Elective VI												
	PRACTICALS												
	Project Work	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

. **PROFESSIONAL ELECTIVE**

SL.NO.	NAME OF THE SUBJECT	PROGRAM OUTCOMES											
		a	b	c	d	e	f	g	h	i	j	k	l
	THEORY												
ELECTIVE – I	Advanced Control System		✓	✓					✓	✓			
	Visual Languages and Applications	✓	✓		✓	✓							
	Design of Electrical Apparatus	✓		✓	✓	✓		✓					
	Power Systems Stability				✓	✓							
	Modern Power Converters	✓		✓	✓	✓		✓					
	Intellectual Property Rights								✓		✓		✓
ELECTIVE – II	Principles of Robotics	✓		✓		✓							
	Special Electrical Machines	✓		✓	✓	✓			✓				
	Power Quality	✓		✓	✓	✓			✓				✓
	EHVAC Transmission	✓		✓	✓	✓			✓				✓
	Communication Engineering												
ELECTIVE – III	Disaster Management	✓		✓		✓	✓					✓	✓
	Human Rights			✓	✓	✓	✓						
	Operations Research	✓	✓	✓					✓	✓			✓
	Probability and Statistics												
	Fibre Optics and Laser Instrumentation	✓	✓			✓						✓	✓
	Foundation Skills in Integrated Product Development												

		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
ELECTIVE – IV	System Identification and Adaptive Control	✓	✓	✓		✓							
	Computer Architecture	✓		✓		✓							
	Control of Electrical Drives	✓		✓		✓			✓				✓
	VLSI Design	✓	✓	✓			✓	✓					
	Power Systems Transients		✓		✓	✓							
	Total Quality Management		✓			✓	✓	✓	✓	✓	✓		
ELECTIVE – V	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					✓	✓			✓			
ELECTIVE – VI	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
THEORY								
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
PRACTICALS								
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
			TOTAL	31	19	0	12	25

SEMESTER II

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
7.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
8.	EE8261	Electric Circuits Laboratory	PC	4	0	0	4	2
			TOTAL	30	20	2	8	25

SEMESTER III

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
7.	EC8311	Electronics Laboratory	ES	4	0	0	4	2
8.	EE8311	Electrical Machines Laboratory - I	PC	4	0	0	4	2
			TOTAL	**30**	**16**	**6**	**8**	**23**

SEMESTER IV

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
			TOTAL	**32**	**18**	**4**	**10**	**25**

8

SEMESTER V

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
			TOTAL	**29**	**17**	**2**	**10**	**23**

SEMESTER VI

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
			TOTAL	**27**	**15**	**0**	**12**	**21**

SEMESTER VII

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
7.	EE8711	Power System Simulation Laboratory	PC	4	0	0	4	2
8.	EE8712	Renewable Energy Systems Laboratory	PC	4	0	0	4	2
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER VIII

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective V	PE	3	3	0	0	3
2.		Professional Elective VI	PE	3	3	0	0	3
PRACTICALS								
3.	EE8811	Project Work	EEC	20	0	0	20	10
			TOTAL	**26**	**6**	**0**	**20**	**16**

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)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
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)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
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)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
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
	Total	25	25	23	25	23	21	22	16	180
	Non Credit / Mandatory	-	-	-	-	-	-	-	-	0

	L	T	P	C
	4	0	0	4

HS8151   **COMMUNICATIVE ENGLISH**

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 Undergarduate 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 Skillsfor BusinessEnglish.** Cambridge University Press, Cambridge: Reprint 2011
  3   Dutt P. Kiranmai and RajeevanGeeta. **Basic Communication Skills,** Foundation Books: 2013
  4   Means,L. Thomas and Elaine Langlois.   **English & Communication For Colleges.** CengageLearning ,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 – 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, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th 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, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd 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", 12th 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 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_2-O_2 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'', 2nd 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.

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, 50th 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, 2nd 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**   **LT P C**
                          LABORATORY   **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**   **L T P C**
                (Common to all branches of B.E. / B.Tech Programmes)   **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

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 viscometery.

1. Estimation of HCl using Na_2CO_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 (8TH 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- newsapapers-   **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 cgarts, graphs- **Vocabulary Development-**vocabularyused 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/ talkls 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 suplementary 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 $w = z + c,\ cz, \dfrac{1}{z}, z^2$ - 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, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th 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, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3rd 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, 4th 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&I, ICE)	**L** **3**	**T** **0**	**P** **0**	**C** **3**

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   **NANOELECTRONIC 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 able to
- gain knowledge on classical and quantum electron theories, and energy band structuues,
- 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.

<u>**C – MECHANICAL ENGINEERING**</u>

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 PublishingCo.,NewDelhi,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.,"BasicCivil Engineering",AnuradhaAgencies,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.

EE8251   **CIRCUIT THEORY**   L   T   P   C
                                                                              2   2   0   3

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', 2nd 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.

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, 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:

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	

EE8261   **ELECTRIC CIRCUITS LABORATORY**   L   T   P   C
                                                                    0   0   4   2

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", 43rd 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", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
4. James, G., "Advanced Modern Engineering Mathematics", 3rd 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	L	T	P	C
		2	2	0	3

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.

UNIT III   SYNCHRONOUS SEQUENTIAL CIRCUITS   6+6

Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Melay models- Counters, state diagram; state reduction; state assignment.

UNIT IV   ASYNCHRONOUS SEQUENTIAL CIRCUITS AND   6+6
**   PROGRAMMABILITY LOGIC DEVICES**

Asynchronous sequential logic circuits-Transition tability, flow tability-race conditions, hazards &errors in digital circuits; analysis of asynchronous sequential logic circuits-introduction to Programmability Logic Devices: PROM – PLA –PAL, CPLD-FPGA.

UNIT V   VHDL   6+6

RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & De multiplexers).

TOTAL :   60   PERIODS

OUTCOMES:

- Ability to design combinational and sequential Circuits.
- Ability to simulate using software package.
- Ability to study various number systems and simplify the logical expressions using Boolean functions
- Ability to design various synchronous and asynchronous circuits.
- Ability to introduce asynchronous sequential circuits and PLDs
- Ability to introduce digital simulation for development of application oriented logic circuits.

TEXT BOOKS:
1. James W. Bignel, Digital Electronics, Cengage learning, 5th Edition, 2007.
2. M. Morris Mano, 'Digital Design with an introduction to the VHDL', Pearson Education, 2013.
3. Comer "Digital Logic & State Machine Design, Oxford, 2012.

REFERENCES
1. Mandal, "Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
2. William Keitz, Digital Electronics-A Practical Approach with VHDL, Pearson, 2013.
3. Thomas L.Floyd, 'Digital Fundamentals', 11th edition, Pearson Education, 2015.
4. Charles H.Roth, Jr, Lizy Lizy Kurian John, 'Digital System Design using VHDL, Cengage, 2013.
5. D.P.Kothari,J.S.Dhillon, 'Digital circuits and Design',Pearson Education, 2016.

EE8391	**ELECTROMAGNETIC THEORY**	**L**	**T**	**P**	**C**
		2	**2**	**0**	**3**

OBJECTIVES:
- To introduce the basic mathematical concepts related to electromagnetic vector fields
- To impart knowledge on the concepts of
  - ✓ Electrostatic fields, electrical potential, energy density and their applications.
  - ✓ Magneto static fields, magnetic flux density, vector potential and its applications.

UNIT I   ELECTROSTATICS – I   6+6
Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields –Gradient, Divergence, Curl – theorems and applications - Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and applications.

UNIT II   ELECTROSTATICS – II   6+6
Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization – Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications.

UNIT III   MAGNETOSTATICS   6+6
Lorentz force, magnetic field intensity (H) – Biot–Savart's Law - Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media – Boundary conditions, scalar and vector potential, Poisson's Equation, Magnetic force, Torque, Inductance, Energy density, Applications.

UNIT IV   ELECTRODYNAMIC FIELDS   6+6
Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current - Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory – Applications.

UNIT V   ELECTROMAGNETIC WAVES   6+6
Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth - Poynting vector – Plane wave reflection and refraction.

TOTAL : 60 PERIODS

OUTCOMES:
- Ability to understand the basic mathematical concepts related to electromagnetic vector fields.
- Ability to understand the basic concepts about electrostatic fields, electrical potential, energy density and their applications.
- Ability to acquire the knowledge in magneto static fields, magnetic flux density, vector potential and its applications.
- Ability to understand the different methods of emf generation and Maxwell's equations
- Ability to understand the basic concepts electromagnetic waves and characterizing parameters
- Ability to understand and compute Electromagnetic fields and apply them for design and analysis of electrical equipment and systems

TEXT BOOKS:
1.   Mathew N. O. Sadiku, 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition, 2015.
2.   William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014.
3.   Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.

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		L	T	P	C
	ELECTRICAL MACHINES – I	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   6+6
**   IN ROTATING MACHINES**
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'4th 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,3rd Edition ,Reprint 2015.
3. S.K. Bhattacharya, 'Electrical Machines' McGraw - Hill Education, New Delhi, 3rd 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.

EC8353   **ELECTRON DEVICES AND CIRCUITS**   **L T P C**
                                                                             3 0 0 3

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 diodecharacteristics- 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 ability 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, 5th edition 2008.
2. Sedra and smith, “Microelectronic circuits”,7th Ed., Oxford University Press

REFERENCES:
1. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2nd edition 2014.
2. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th 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	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 : B*oiling Water Reactor* (BWR), P*ressurized 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 enability 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, ± 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** | **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", 9th Edition, Cengage Learning, 2016.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th 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, 6th Edition, New Delhi, 2006.
3. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.
4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

EE8401   **ELECTRICAL MACHINES – II**   **L   T   P   C**
                                                                      2   2   0   3

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   6+6
                   MOTOR**
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'4th 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,3rd 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**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

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 Coffer, '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.

6. V.K.Mehta, Rohit Mehta, 'Principles of power system', S. Chand & Company Ltd, New Delhi, 2013

EE8403   **MEASUREMENTS AND INSTRUMENTATION**   L   T   P   C
                                                                      3   0   0   3
OBJECTIVES:
To impart knowledge on the following Topics
  - Basic functional elements of instrumentation
  - Fundamentals of electrical and electronic instruments
  - Comparison between various measurement techniques
  - Various storage and display devices
  - Various transducers and the data acquisition systems

UNIT I   INTRODUCTION   9
Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration-Principle and types of analog and digital voltmeters, ammeters.

UNIT II   ELECTRICAL AND ELECTRONIC INSTRUMENTS   9
Principle and types of multi meters – Single and three phase watt meters and energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase.

UNIT III   COMPARATIVE METHODS OF MEASUREMENTS   9
D.C potentiometers, D.C (Wheat stone, Kelvin and Kelvin Double bridge) & A.C bridges (Maxwell, Anderson and Schering bridges), transformer ratio bridges, self-balancing bridges. Interference & screening – Multiple earth and earth loops - Electrostatic and electromagnetic Interference – Grounding techniques.

UNIT IV   STORAGE AND DISPLAY DEVICES   9
Magnetic disk and tape – Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD & Dot matrix display – Data Loggers.

UNIT V   TRANSDUCERS AND DATA ACQUISITION SYSTEMS   9
Classification of transducers – Selection of transducers – Resistive, capacitive & inductive Transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – Smart sensors-Thermal Imagers.

                                                          TOTAL :   45   PERIODS
OUTCOMES:
  - To acquire knowledge on Basic functional elements of instrumentation
  - To understand the concepts of Fundamentals of electrical and electronic instruments
  - Ability to compare between various measurement techniques
  - To acquire knowledge on Various storage and display devices
  - To understand the concepts Various transducers and the data acquisition systems
  - Ability to model and analyze electrical and electronic Instruments and understand the operational features of display Devices and Data Acquisition System.

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.

EE8451	LINEAR INTEGRATED CIRCUITS AND APPLICATIONS	L	T	P	C
		3	0	0	3

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.

REFERENCES
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**   **LT 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

- To introduce state variable representation of physical systems

UNIT I   SYSTEMS AND REPRESENTATION   9
Basic elements in control systems: – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.

UNIT II   TIME RESPONSE   9
Time response: – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Root locus construction- Effects of P, PI, PID modes of feedback control –Time response analysis.

UNIT III   FREQUENCY RESPONSE   9
Frequency response: – Bode plot – Polar plot – Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications

UNIT IV   STABILITY AND COMPENSATOR DESIGN   9
Characteristics equation – Routh Hurwitz criterion – Nyquist stability criterion- Performance criteria – Effect of Lag, lead and lag-lead compensation on frequency response-Design of Lag, lead and lag-lead compensator using bode plots.

UNIT V   STATE VARIABLE ANALYSIS   9
Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability.

TOTAL (L: 45+T:30): 75 PERIODS

COURSE OUTCOMES
At the end of the course, the student should have the :

- Ability to develop various representations of system based on the knowledge of Mathematics, Science and Engineering fundamentals.
- Ability to do time domain and frequency domain analysis of various models of linear system.
- Ability to interpret characteristics of the system to develop mathematical model.
- Ability to design appropriate compensator for the given specifications.
- Ability to come out with solution for complex control problem.
- Ability to understand use of PID controller in closed loop system.

TEXT BOOKS
1.   Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2017.
2.   Benjamin C. Kuo, "Automatic Control Systems", Wiley, 2014.

REFERENCES
1.   Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015.
2.   Richard C.Dorf and Bishop, R.H., "Modern Control Systems", Pearson Education,2009.
3.   John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor& Francis Reprint 2009.
4.   Rames C.Panda and T. Thyagarajan, "An Introduction to Process Modelling Identification and Control of Engineers", Narosa Publishing House, 2017.
5.   M.Gopal, "Control System: Principle and design", McGraw Hill Education, 2012.
6.   NPTEL Video Lecture Notes on "Control Engineering "by Prof. S. D. Agashe, IIT Bombay.

EE8411   **ELECTRICAL MACHINES LABORATORY - II**   **L   T   P   C**
                                                                  0   0   4   2

OBJECTIVES:
- To expose the students to the operation of synchronous machines and induction motors and give them experimental skill.

LIST OF EXPERIMENTS
1. Regulation of three phase alternator by EMF and MMF methods.
2. Regulation of three phase alternator by ZPF and ASA methods.
3. Regulation of three phase salient pole alternator by slip test.
4. Measurements of negative sequence and zero sequence impedance of alternators.
5. V and Inverted V curves of Three Phase Synchronous Motor.
6. Load test on three-phase induction motor.
7. No load and blocked rotor tests on three-phase induction motor (Determination of equivalent circuit parameters).
8. Separation of No-load losses of three-phase induction motor.
9. Load test on single-phase induction motor.
10. No load and blocked rotor test on single-phase induction motor.
11. Study of Induction motor Starters

                                                                  TOTAL: 60 PERIODS

OUTCOMES:
At the end of the course, the student should have the :
- Ability to understand and analyze EMF and MMF methods
- Ability to analyze the characteristics of V and Inverted V curves
- Ability to understand the importance of Synchronous machines
- Ability to understand the importance of Induction Machines
- Ability to acquire knowledge on separation of losses

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Synchronous Induction motor 3HP – 1 No.

2. DC Shunt Motor Coupled With Three phase Alternator – 4 nos

3. DC Shunt Motor Coupled With Three phase Slip ring Induction motor – 1 No.

4. Three Phase Induction Motor with Loading Arrangement – 2 nos

5. Single Phase Induction Motor with Loading Arrangement – 2 nos

6. Tachometer -Digital/Analog – 8 nos

7. Single Phase Auto Transformer – 2 nos

8. Three Phase Auto Transformer – 3 nos

9. Single Phase Resistive Loading Bank – 2 nos

10. Three Phase Resistive Loading Bank – 2 nos

11. Capacitor Bank – 1 No.

EE8461   **LINEAR AND DIGITAL INTEGRATED CIRCUITS**   **L   T   P   C**
                 LABORATORY   **0   0   4   2**

OBJECTIVES:
- To learn design, testing and characterizing of circuit behavior with digital and analog ICs.

LIST OF EXPERIMENTS

1. Implementation of Boolean Functions, Adder and Subtractor circuits.

2. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa

3. Parity generator and parity checking

4. Encoders and Decoders

5. Counters: Design and implementation of 3-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.

6. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitability IC's.

7. Study of multiplexer and de multiplexer

8. Timer IC application: Study of NE/SE 555 timer in Astability, Monostability operation.

9. Application of Op-Amp: inverting and non-inverting amplifier, Adder, comparator, Integrator and Differentiator.

10. Voltage to frequency characteristics of NE/ SE 566 IC.

11. Variability Voltage Regulator using IC LM317.

TOTAL: 60 PERIODS

OUTCOMES:
At the end of the course, the student should have the :
- Ability to understand and implement Boolean Functions.
- Ability to understand the importance of code conversion
- Ability to Design and implement 4-bit shift registers
- Ability to acquire knowledge on Application of Op-Amp
- Ability to Design and implement counters using specific counter IC.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS: (3 per Batch)

S.No	Name of the equipments / Components	Quantity Required	Remarks
1	Dual ,(0-30V) variability Power Supply	10	-
2	CRO	9	30MHz
3	Digital Multimeter	10	Digital
4	Function Generator	8	1 MHz
5	IC Tester (Analog)	2	
6	Bread board	10	

7	Computer (PSPICE installed)	1	
Consumabilitys (sufficient quantity)			
1	IC 741/ IC NE555/566/565		
2	Digital IC types		
3	LED		
4	LM317		
5	LM723		
6	ICSG3524 / SG3525		
7	Transistor – 2N3391		
8	Diodes, IN4001,BY126		
9	Zener diodes		
10	Potentiometer		
11	Step-down transformer 230V/12-0-12V		
12	Capacitor		
13	Resistors 1/4 Watt Assorted		
14	Single Strand Wire		

EE8412　　　　　　　　　　**TECHNICAL SEMINAR**　　　　　　　　**LT P C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　0 0 2 1

OBJECTIVES:
- To encourage the students to study advanced engineering developments
- To prepare and present technical reports.
- To encourage the students to use various teaching aids such as overhead
  projectors, power point presentation and demonstrative models.

METHOD OF EVALUATION:

During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for a duration of about 8 to 10 minutes. In a session of three periods per week, 15 students are expected to present the seminar. Each student is expected to present atleast twice during the semester and the student is evaluated based on that. At the end of the semester, he / she can submit a report on his / her topic of seminar and marks are given based on the report.   A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also. Evaluation is 100% internal.

TOTAL: 30 PERIODS

EE8501   **POWER SYSTEM ANALYSIS**   L   T   P   C
                                                                      3   0   0   3

OBJECTIVES:
* To model the power system under steady state operating condition
* To understand and apply iterative techniques for power flow analysis
* To model and carry out short circuit studies on power system
* To model and analyze stability problems in power system

UNIT I   POWER SYSTEM   9
Need for system planning and operational studies - Power scenario in India - Power system components – Representation - Single line diagram - per unit quantities - p.u. impedance diagram - p.u. reactance diagram - Network graph, Bus incidence matrix, Primitive parameters, Bus admittance matrix from primitive parameters - Representation of off-nominal transformer - Formation of bus admittance matrix of large power network.

UNIT II   POWER FLOW ANALYSIS   9
Bus classification - Formulation of Power Flow problem in polar coordinates - Power flow solution using Gauss Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton Raphson method.

UNIT III   SYMMETRICAL FAULT ANALYSIS   9
Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix building algorithm (without mutual coupling) - Symmetrical fault analysis through bus impedance matrix - Post fault bus voltages - Fault level - Current limiting reactors.

UNIT IV   UNSYMMETRICAL FAULT ANALYSIS   9
Symmetrical components - Sequence impedances - Sequence networks - Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG - unsymmetrical fault occurring at any point in a power system - computation of post fault currents in symmetrical component and phasor domains.

UNIT V   STABILITY ANALYSIS   9
Classification of power system stability – Rotor angle stability - Swing equation - Swing curve - Power-Angle equation - Equal area criterion - Critical clearing angle and time - Classical step-by-step solution of the swing equation – modified Euler method.

                                                          TOTAL :   45   PERIODS
OUTCOMES:
* Ability to model the power system under steady state operating condition
* Ability to understand and apply iterative techniques for power flow analysis
* Ability to model and carry out short circuit studies on power system
* Ability to model and analyze stability problems in power system

- Ability to acquire knowledge on Fault analysis.
- Ability to model and understand various power system components and carry out power flow, short circuit and stability studies.

TEXT BOOKS:
1. John J. Grainger, William D. Stevenson, Jr, 'Power System Analysis', Mc Graw Hill Education (India) Private Limited, New Delhi, 2015.
2. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, Second Edition, 2008.
3. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

REFERENCES
1. Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
2. J. Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye, 'Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.
3. Gupta B.R., 'Power System - Analysis and Design', S. Chand Publishing, 2001.
4. Kundur P., 'Power System Stability and Control', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

EE8551	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3

OBJECTIVES:
To impart knowledge on the following Topics
- Architecture of µP8085 & µC 8051
- Addressing modes & instruction set of 8085 & 8051.
- Need & use of Interrupt structure 8085 & 8051.
- Simple applications development with programming 8085 & 8051

UNIT I   8085 PROCESSOR   9
Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts.

UNIT II   PROGRAMMING OF 8085 PROCESSOR
**   9**
Instruction -format and addressing modes – Assembly language format – Data transfer, data manipulation& control instructions – Programming: Loop structure with counting & Indexing – Look up tability - Subroutine instructions - stack.

UNIT III   8051 MICRO CONTROLLER   9
Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts- Data Transfer, Manipulation, Control Algorithms& I/O instructions, Comparison to Programming concepts with 8085.

UNIT IV   PERIPHERAL INTERFACING   9

Study on need, Architecture, configuration and interfacing, with ICs: 8255, 8259, 8254, 8279, - A/D and D/A converters &Interfacing with 8085& 8051.

UNIT V   MICRO CONTROLLER PROGRAMMING & APPLICATIONS   9

Simple programming exercises- key board and display interface –Control of servo motor- stepper motor control- Application to automation systems.

                                                                    TOTAL :   45   PERIODS

OUTCOMES:
- Ability to acquire knowledge in Addressing modes & instruction set of 8085 & 8051.
- Ability to need & use of Interrupt structure 8085 & 8051.
- Ability to understand the importance of Interfacing
- Ability to explain the architecture of Microprocessor and Microcontroller.
- Ability to write the assembly language programme.
- Ability to develop the Microprocessor and Microcontroller based applications.

TEXT BOOKS:
1. Sunil Mathur &Jeebananda Panda, "Microprocessor and Microcontrollers", PHI Learning Pvt. Ltd, 2016.
2. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013.
3. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.

REFERENCES
1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.
2. B.RAM," Computer Fundamentals Architecture and Organization" New age International Private Limited, Fifth edition, 2017.
3. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.
4. Ajay V.Deshmukh, 'Microcontroller Theory &Applications', McGraw Hill Edu,2016
5. Douglas V.Hall, 'Microprocessor and Interfacing', McGraw Hill Edu,2016.

EE8552   **POWER ELECTRONICS**   **L   T   P   C**
                                                                       3   0   0   3

OBJECTIVES:

To impart knowledge on the following Topics
- Different types of power semiconductor devices and their switching
- Operation, characteristics and performance parameters of controlled rectifiers
- Operation, switching techniques and basics topologies of DC-DC switching regulators.
- Different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- Operation of AC voltage controller and various configurations.

UNIT I   POWER SEMI-CONDUCTOR DEVICES   9
 Study of switching devices, SCR, TRIAC, GTO, BJT, MOSFET, IGBT and IGCT- Static characteristics: SCR, MOSFET and IGBT - Triggering and commutation circuit for SCR- Introduction to Driver and snubber circuits.

UNIT II   PHASE-CONTROLLED CONVERTERS   9
2-pulse, 3-pulse and 6-pulseconverters– performance parameters –Effect of source inductance–– Firing Schemes for converter–Dual converters, Applications-light dimmer, Excitation system, Solar PV systems.

UNIT III   DC TO DC CONVERTERS   9
Step-down and step-up chopper-control strategy– Introduction to types of choppers-A, B, C, D and E -Switched mode regulators- Buck, Boost, Buck- Boost regulator, Introduction to Resonant Converters, Applications-Battery operated vehicles.

UNIT IV   INVERTERS   9
Single phase and three phase voltage source inverters (both120^0 mode and 180^0 mode)– Voltage& harmonic control--PWM techniques: Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM – Introduction to space vector modulation –Current source inverter, Applications-Induction heating, UPS.

UNIT V   AC TO AC CONVERTERS   9
Single   phase and Three phase AC voltage controllers–Control strategy- Power Factor Control – Multistage sequence control   -single phase and three phase cyclo converters – Introduction to Matrix converters, Applications –welding .

TOTAL :   45   PERIODS

OUTCOMES:
- Ability to analyse AC-AC and DC-DC and DC-AC converters.
- Ability to choose the converters for real time applications.

TEXT BOOKS:
1. M.H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, Third   Edition, New Delhi, 2004.
2. P.S.Bimbra "Power Electronics" Khanna Publishers, third Edition, 2003.
3. Ashfaq Ahmed 'Power Electronics for Technology', Pearson Education, Indian reprint, 2003.

REFERENCES
1. Joseph Vithayathil,' Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint, 2013.
2. Philip T. Krein, "Elements of Power Electronics" Oxford University Press, 2004 Edition.
3. L. Umanand, "Power Electronics Essentials and Applications", Wiley, 2010.
4. Ned Mohan Tore. M. Undel and, William. P. Robbins, 'Power Electronics: Converters, Applications and Design', John Wiley and sons, third edition, 2003.
5. S.Rama Reddy, 'Fundamentals of Power Electronics', Narosa Publications, 2014.
6. M.D. Singh and K.B. Khanchandani, "Power Electronics," Mc Graw Hill India, 2013.
7. JP Agarwal," Power Electronic Systems: Theory and Design" 1e, Pearson Education, 2002.

EE8591   **DIGITAL SIGNAL PROCESSING**   L   T   P   C
                                                                          2   2   0   3

OBJECTIVES: To impart knowledge about the following topics:
- Signals and systems & their mathematical representation.
- Discrete time systems.
- Transformation techniques & their computation.
- Filters and their design for digital implementation.
- Programmability digital signal processor & quantization effects.

UNIT I   INTRODUCTION   6+6
Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

UNIT II   DISCRETE TIME SYSTEM ANALYSIS   6+6
Z-transform and its properties, inverse z-transforms; difference equation – Solution by z-transform, application to discrete systems - Stability analysis, frequency response – Convolution – Discrete Time Fourier transform , magnitude and phase representation.

UNIT III   DISCRETE FOURIER TRANSFORM & COMPUTATION   6+6
Discrete Fourier Transform- properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT &DIF using radix 2 FFT – Butterfly structure.

UNIT IV   DESIGN OF DIGITAL FILTERS   6+6
FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. Analog filter design – Butterworth and Chebyshev approximations; IIR Filters, digital design using impulse invariant and bilinear transformation Warping, pre warping.

UNIT V   DIGITAL SIGNAL PROCESSORS   6+6
Introduction – Architecture – Features – Addressing Formats – Functional modes - Introduction to Commercial DS Processors.

                                             TOTAL :   60   PERIODS
OUTCOMES:
1. Ability to understand the importance of Fourier transform, digital filters and DS Processors.
2. Ability to acquire knowledge on Signals and systems & their mathematical representation.
3. Ability to understand and analyze the discrete time systems.
4. Ability to analyze the transformation techniques & their computation.
5. Ability to understand the types of filters and their design for digital implementation.
6. Ability to acquire knowledge on programmability digital signal processor & quantization effects.
TEXT BOOKS:
1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms

and Applications', Pearson Education, New Delhi, PHI. 2003.

2. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', McGraw Hill Edu, 2013.

3. Lonnie C.Ludeman ,"Fundamentals of Digital Signal Processing",Wiley,2013

REFERENCES

1. Poorna Chandra S, Sasikala. B ,Digital Signal Processing, Vijay Nicole/TMH,2013.

2. Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab", Cengage Learning,2014.

3. B.P.Lathi, 'Principles of Signal Processing and Linear Systems', Oxford University Press, 2010 3. Taan S. ElAli, 'Discrete Systems and Digital Signal Processing with Mat Lab', CRC Press, 2009.

4. SenM.kuo, woonseng…s.gan, "Digital Signal Processors, Architecture, Implementations & Applications, Pearson,2013

5. DimitrisG.Manolakis, Vinay K. Ingle, applied Digital Signal Processing,Cambridge,2012

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 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

COURSE 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", 8th Edition, McGraw Hill Education, 2011.

2. Cay S. Horstmann, Gary cornell, "Core Java Volume –I Fundamentals", 9th Edition, Prentice Hall, 2013.

REFERENCES
1. Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3rd 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.

EE8511	CONTROL AND INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:
- To provide knowledge on analysis and design of control system along with basics of instrumentation.

LIST OF EXPERIMENTS
   CONTROLSYSTEMS:

1. P, PI and PID controllers

2. Stability Analysis

3. Modeling of Systems – Machines, Sensors and Transducers

4. Design of Lag, Lead and Lag-Lead Compensators

5. Position Control Systems

6. Synchro-Transmitter- Receiver and Characteristics

7. Simulation of Control Systems by Mathematical development tools.

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.

71

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 ability 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,. OrientBalckSwan: 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.

EE8601   **SOLID STATE DRIVES**   L T P C
                                                                       3 0 0 3

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 ,6th 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 InternationalPvt 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**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

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^2C) –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 (1Φ & 3Φ semi converters, 1Φ & 3Φ full converters, DC-DC converters, AC voltage controllers).
12 Characteristics of GTO & IGCT.
13 Characteristics of PMBLDC 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** **L T P C**
LABORATORY **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**   **L T 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.

EE8702   **POWER SYSTEM OPERATION AND CONTROL**   **L   T   P   C**
                                                                                            3   0   0   3

OBJECTIVES:
To impart knowledge on the following topics

- Significance of power system operation and control.
- Real power-frequency interaction and design of power-frequency controller.
- Reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.
- Economic operation of power system.
- SCADA and its application for real time operation and control of power systems

**UNIT I   PRELIMINARIES ON POWER SYSTEM OPERATION AND   9
                 CONTROL**
Power scenario in Indian grid – National and Regional load dispatching centers – requirements of good power system - necessity of voltage and frequency regulation - real power vs frequency and reactive power vs voltage control loops - system load variation, load curves and basic concepts of load dispatching - load forecasting - Basics of speed governing mechanisms and modeling - speed load characteristics - regulation of two generators in parallel.

UNIT II   REAL POWER - FREQUENCY CONTROL   9
Load Frequency Control (LFC) of single area system-static and dynamic analysis of uncontrolled and controlled cases - LFC of two area system - tie line modeling - block diagram representation of two area system - static and dynamic analysis - tie line with frequency bias control – state variability model - integration of economic dispatch control with LFC.

UNIT III   REACTIVE POWER – VOLTAGE CONTROL   9
Generation and absorption of reactive power - basics of reactive power control – Automatic Voltage Regulator (AVR) – brushless AC excitation system – block diagram representation of AVR loop - static and dynamic analysis – stability compensation – voltage drop in transmission line - methods of reactive power injection - tap changing transformer, SVC (TCR + TSC) and STATCOM for voltage control.

UNIT IV   ECONOMIC OPERATION OF POWER SYSTEM   9
Statement of economic dispatch problem - input and output characteristics of thermal plant - incremental cost curve - optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) - base point and participation factors method - statement of unit commitment (UC) problem - constraints on UC problem - solution of UC problem using priority list – special aspects of short term and long term hydrothermal problems.

UNIT V   COMPUTER CONTROL OF POWER SYSTEMS   9
Need of computer control of power systems-concept of energy control centers and functions – PMU - system monitoring, data acquisition and controls - System hardware configurations - SCADA and EMS functions - state estimation problem – measurements and errors - weighted least square estimation - various operating states - state transition diagram.

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. Compliers: C, C++, VB, VC++ - 30 users

EE8712   **RENEWABLE ENERGY SYSTEMS**   **L   T   P   C**
                               LABORATORY   **0   0   4   2**

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	

Consumabilitys (Minimum of 5 Nos. each)		
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:
   i.   To provide knowledge on design state feedback control and state observer.
  ii.   To provide knowledge in phase plane analysis.
 iii.   To give basic knowledge in describing function analysis.
  iv.   To study the design of optimal controller.
   v.   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 nonlinearites, 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", 4th 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, 3rd edition, New Age International Publishers, 2014.
2. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies 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	L	T	P	C
		3	0	0	3

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

interface, toolbars, status bars and File I/O Serialization.
- To study about the integrated development programming event driven programming, variabilitys, constants, procedures and basic ActiveX controls in visual basic.
- To understand the database and the database management system, visual data manager, data bound controls and ADO controls in VB.

UNIT I   FUNDAMENTALS OF WINDOWS AND MFC   9

Messages - Windows programming - SDK style - Hungarian notation and windows data types - SDK programming in perspective. The benefits of C++ and MFC - MFC design philosophy – Document / View architecture - MFC class hierarchy - AFX functions. Application object - Frame window object - Message map. Drawing the lines – Curves – Ellipse – Polygons and other shapes. GDI pens – Brushes - GDI fonts - Deleting GDI objects and deselecting GDI objects. Getting input from the mouse: Client & Non-client - Area mouse messages - Mouse wheel - Cursor. Getting input from the keyboard: Input focus - Keystroke messages - Virtual key codes - Character & dead key messages.

UNIT II   RESOURCES AND CONTROLS   9

Creating a menu – Loading and displaying a menu – Responding to menu commands – Command ranges - Updating the items in menu, update ranges – Keyboard accelerators. Creating menus programmatically - Modifying menus programmatically - The system menu - Owner draw menus – Cascading menus - Context menus. The C button class – C list box class – C static class - The font view application – C edit class – C combo box class – C scrollbar class. Model dialog boxes – Modeless dialog boxes.

UNIT III   DOCUMENT / VIEW ARCHITECTURE   9

The in existence function revisited – Document object – View object – Frame window object – Dynamic object creation. SDI document template - Command routing. Synchronizing multiple views of a document – Mid squares application – Supporting multiple document types – Alternatives to MDI. Splitter Windows: Dynamic splitter window – Static splitter windows. Creating & initializing a toolbar - Controlling the toolbar's visibility – Creating & initializing a status bar - Creating custom status bar panes – Status bar support in appwizard. Opening, closing and creating the files - Reading & Writing – C file derivatives – Serialization basics - Writing serializability classes.

UNIT IV   FUNDAMENTALS OF VISUAL BASIC   9

Menu bar – Tool bar – Project explorer – Toolbox – Properties window – Form designer – Form layout – Intermediate window. Designing the user interface: Aligning the controls – Running the application – Visual development and event driven programming.

Variabilitys: Declaration – Types – Converting variability types – User defined data types - Lifetime of a variability. Constants - Arrays – Types of arrays. Procedures: Subroutines – Functions – Calling procedures. Text box controls – List box & Combo box controls – Scroll bar and slider controls – File controls.

UNIT V   DATABASE PROGRAMMING WITH VB   9

Record sets – Data control – Data control properties, methods. Visual data manager: Specifying indices with the visual data manager – Entering data with the visual data manager. Data bound list control – Data bound combo box – Data bound grid control. Mapping databases: Database object – Tability def object, Query def object. Programming the active database objects – ADO object model – Establishing a connection - Executing SQL statements – Cursor types and locking mechanism – Manipulating the record set

object – Simple record editing and updating.

TOTAL : 45 PERIODS

OUTCOMES:
- Ability to understand and apply computing platform and software for engineering problems
- Ability to study about the concepts of windows programming models.
- Ability to study the concepts of Menu basics, menu magic and classic controls.
- Ability to study the concept of Document/View Architecture with single & multiple document interface.
- Ability to study about the integrated development programming event driven programming.
- Ability to understand the database and the database management system.

TEXT BOOKS:
1. Jeff Prosise, 'Programming Windows With MFC', Second Edition, WP Publishers & Distributors (P) Ltd, Reprinted, 2002.
2. Evangelos Petroutsos, 'Mastering Visual Basic 6.0', BPB Publications, 2002.

REFERENCES
1. Herbert Schildt, 'MFC Programming From the Ground Up', Second Edition, McGraw Hill, reprinted, 2002.
2. John Paul Muller, 'Visual C++ 6 From the Ground Up Second Edition', McGraw Hill, Reprinted, 2002.
3. Curtis Smith & Micheal Amundsen, 'Teach Yourself Database Programming with Visual Basic 6 in 21 days', Techmedia Pub, 1999.

EE8002	DESIGN OF ELECTRICAL APPARATUS	L	T	P	C
		3	0	0	3

OBJECTIVES: To impart knowledge about the following topics:
- Magnetic circuit parameters and thermal rating of various types of electrical machines.
- Armature and field systems for D.C. machines.
- Core, yoke, windings and cooling systems of transformers.
- Design of stator and rotor of induction machines and synchronous machines.
- The importance of computer aided design method.

UNIT I   DESIGN OF FIELD SYSTEM AND ARMATURE   9
Major considerations in Electrical Machine Design – Materials for Electrical apparatus – Design of Magnetic circuits – Magnetising current – Flux leakage – Leakage in Armature. Design of lap winding and wave winding.

UNIT II   DESIGN OF TRANSFORMERS   9
Construction - KVA output for single and three phase transformers – Overall dimensions – design of yoke, core and winding for core and shell type transformers – Estimation of No load current – Temperature rise in Transformers – Design of Tank and cooling tubes of Transformers. Computer program: Complete Design of single phase core transformer

UNIT III   DESIGN OF DC MACHINES   9
Construction - Output Equations – Main Dimensions – Choice of specific loadings – Selection of number of poles – Design of Armature – Design of commutator and brushes – design of field Computer program: Design of Armature main dimensions

UNIT IV   DESIGN OF INDUCTION MOTORS   9
Construction - Output equation of Induction motor – Main dimensions – choice of specific loadings – Design of squirrel cage rotor and wound rotor –Magnetic leakage calculations – Operating characteristics : Magnetizing current - Short circuit current – Circle diagram - Computer program: Design of slip-ring rotor

UNIT V   DESIGN OF SYNCHRONOUS MACHINES   9
Output equations – choice of specific loadings – Design of salient pole machines – Short circuit ratio – Armature design – Estimation of air gap length – Design of rotor –Design of damper winding – Determination of full load field MMF – Design of field winding – Design of turbo alternators -Computer program: Design of Stator main dimensions-Brushless DC Machines

                                                    TOTAL :   45   PERIODS

OUTCOMES:
  - Ability to understand basics of design considerations for rotating and static electrical machines
  - Ability to design of field system for its application.
  - Ability to design sing and three phase transformer.
  - Ability to design armature and field of DC machines.
  - Ability to design stator and rotor of induction motor.
  - Ability to design and analyze synchronous machines.

TEXT BOOKS:
1.   Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai& Sons, New Delhi, Fifth Edition, 1984.
2.   M V Deshpande 'Design and Testing of Electrical Machines' PHI learning Pvt Lt, 2011.
3.   Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2009.

REFERENCES
  1.   A.Shanmugasundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint 2007.
  2.   'Electrical Machine Design', Balbir Singh, Vikas Publishing House Private Limited, 1981.
  3.   V Rajini, V.S Nagarajan, 'Electrical Machine Design', Pearson, 2017.
  4.   K.M.Vishnumurthy 'Computer aided design of electrical machines' B S Publications,2008

EE8003   **POWER SYSTEM STABILITY**   L T P C
                                                                       3 0 0 3

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   9
               STABILITY
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. EW. Kimbark., "Power System Stability", John Wiley & Sons Limited, New Jersey, 2013.
3. SB. Crary., "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.

EE8004	MODERN POWER CONVERTERS	L	T	P	C
		3	0	0	3

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

AC-DC converter; AC-AC converter with DC link - topologies and operation - with and without resonance link - converter with dc link converter; Performance comparison with matrix converter with DC link converters.

UNIT V   SOFT-SWITCHING POWER CONVERTERS   9
Soft switching techniques. ZVS, ZCS, quasi resonance operation; Performance comparison hard switched and soft switched converters.AC-DC converter, DC-DC converter, DC-AC converter.; Resonant DC power supplies .

                                                                TOTAL :   45   PERIODS

OUTCOMES:
- Ability to suggest converters for AC-DC conversion and SMPS

TEXT BOOKS:
1. Power Electronics Handbook, M.H.Rashid, Academic press, New york, 2000.
2. Advanced DC/DC Converters, Fang Lin Luo and Fang Lin Luo, CRC Press, NewYork, 2004.
3. Control in Power Electronics- Selected Problem, Marian P.Kazmierkowski, R.Krishnan and Frede Blaabjerg, Academic Press (Elsevier Science), 2002.

REFERENCES
1. Power Electronic Circuits, Issa Batarseh, John Wiley and Sons, Inc.2004
2. Power Electronics for Modern Wind Turbines, Frede Blaabjerg and Zhe Chen, Morgan & Claypool Publishers series, United States of America, 2006.
3. Krein Philip T, Elements of Power Electronics,Oxford University press, 2008
4. Agarwal ,Power Electronics: Converters, Applications, and Design, 3rd edition, Jai P, Prentice Hall,2000
5. L. Umanand, Power Electronics: Essentials & Applications, John Wiley and Sons, 2009.

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. 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.

RO8591 **PRINCIPLES OF ROBOTICS** **L T P C**
3 0 0 3

OBJECTIVES:
- To introduce the functional elements of Robotics
- To impart knowledge on the direct and inverse kinematics
- To introduce the manipulator differential motion and control
- To educate on various path planning techniques
- To introduce the dynamics and control of manipulators

UNIT I BASIC CONCEPTS 9

Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and controlissues- Various manipulators – Sensors - work cell - Programming languages.

UNIT II DIRECT AND INVERSE KINEMATICS 9

Mathematical representation of Robots - Position and orientation – Homogeneous transformation-Various joints- Representation using the Denavit Hattenberg parameters -Degrees of freedom-Direct kinematics-Inverse kinematics- SCARA robots- Solvability – Solution methods-Closed form solution.

UNIT III MANIPULATOR DIFFERENTIAL MOTION AND STATICS 9

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance.

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 add 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.

EE8005   **SPECIAL ELECTRICAL MACHINES**   **L T P C**
                                                                          3 0 0 3

OBJECTIVES:
To impart knowledge on the following Topics
- Construction, principle of operation, control and performance of stepping motors.
- Construction, principle of operation, control and performance of switched reluctance motors.
- Construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.
- Construction, principle of operation and performance of permanent magnet synchronous motors.
- Construction, principle of operation and performance of other special Machines.

UNIT I   STEPPER MOTORS   9
Constructional features –Principle of operation –Types – Torque predictions – Linear Analysis – Characteristics – Drive circuits – Closed loop control – Concept of lead angle - Applications.

UNIT II   SWITCHED RELUCTANCE MOTORS (SRM)   9
Constructional features –Principle of operation- Torque prediction–Characteristics Steady state performance prediction – Analytical Method – Power controllers – Control of SRM drive- Sensor less operation of SRM – Applications.

UNIT III   PERMANENT MAGNET BRUSHLESS D.C. MOTORS   9
Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis- EMF and Torque equations- Power Converter Circuits and their controllers - Characteristics and control- Applications.

UNIT IV   PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM)   9
Constructional features -Principle of operation – EMF and Torque equations - Sine wave motor with practical windings - Phasor diagram - Power controllers – performance characteristics -Digital controllers – Applications.

UNIT V   OTHER SPECIAL MACHINES   9
Constructional features – Principle of operation and Characteristics of Hysteresis motor- Synchronous Reluctance Motor–Linear Induction motor-Repulsion motor- Applications.

                                                              TOTAL :   45   PERIODS
OUTCOMES:
- Ability to analyze and design controllers for special Electrical Machines.
- Ability to acquire the knowledge on construction and operation of stepper motor.
- Ability to acquire the knowledge on construction and operation of stepper switched reluctance motors.
- Ability to construction, principle of operation, switched reluctance motors.
- Ability to acquire the knowledge on construction and operation of permanent magnet brushless D.C. motors.
- Ability to acquire the knowledge on construction and operation of permanent magnet synchronous motors.
- Ability to select a special Machine for a particular application.

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	L	T	P	C
		3	0	0	3

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	L	T	P	C
		3	0	0	3

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.

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

UNITII   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", 3rd 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.

DISASTER MANAGEMENT

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 ability 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, Scenarious 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, 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.

GE8074   **HUMAN RIGHTS**   **LT P C**
                                              3 0 0 3

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 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 Disabilityd 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	L	T	P	C
		3	0	0	3

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, 8th Edition, 2015.
2. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.

REFERENCES :
1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
2. Papoulis, A. and Unnikrishnapillai, S., "Probability, Random Variables and Stochastic Processes", McGraw Hill Education India, 4th Edition, New Delhi, 2010.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd 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, 8th 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 andMedical 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 (θa), Numerical aperture and Skew mode, –Different types of fibres and their properties: Single and multimode fibers and Step index and graded index fibers,– fibrecharacteristics: 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 opticalfibers
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.

4. Monte Ross, 'Laser Applications', McGraw Hill, 1968.
5. John and Harry, "Industrial lasers and their application", McGraw-Hill, 2002.
6. Keiser, G., "Optical Fiber Communication", McGraw-Hill, 3rd Edition, 2000.
   http://nptel.ac.in/courses/117101002/

GE8072	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

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

EE8008   **SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL**   **L   T   P   C**
                                                                        3   0   0   3

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   9
              REGULATOR (STR)
 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, 3rd 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 Approachǁ, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.

EE8009	CONTROL OF ELECTRICAL DRIVES	L	T	P	C
		3	0	0	3

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 MOTORDRIVE   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	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, 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, Schmmit 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", 4th 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", Addisson Wesley, 1997

2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim "CMOS Digital Integrated Circuits:Analysis & Design",4th 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	L	T	P	C
		3	0	0	3

OBJECTIVES: To impart knowledge about the following topics:
- Generation of switching transients and their control using circuit – theoretical concept.
- Mechanism of lighting strokes and the production of lighting 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   9
               TRANSIENTS**
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 lighting 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, 2nd 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.Besterfiled, 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", 8th 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   9
                APPLICATIONS**

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 andJohnWiley&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,"FlexibleA.C.TransmissionSystems",InstitutionofElectricalandElectronic Engineers(IEEE), 1999.
3. V.K.Sood, HVDC and FACTS controllers–Applications of Static Converters in Power System, APRIL2004,KluwerAcademic Publishers,2004.

EE8012   **SOFT COMPUTING TECHNIQUES**   L   T   P   C
                                                                    3   0   0   3

OBJECTIVES: To impart knowledge about the following topics:
- Basics of artificial neural network.
- Concepts of modelling and control of neural and fuzzy control schemes.
- Features of hybrid control schemes.

UNIT I   ARTIFICIAL NEURAL NETWORK   9
Review of fundamentals – Biological neuron, artificial neuron, activation function, single layer perceptron – Limitation – Multi layer perceptron – Back Propagation Algorithm (BPA) – Recurrent Neural Network (RNN) – Adaptive Resonance Theory (ART) based network – Radial basis function network – online learning algorithms, BP through time – RTRL algorithms – Reinforcement learning.

UNIT II   NEURAL NETWORKS FOR MODELING AND CONTROL   9
Modelling of non-linear systems using ANN – Generation of training data – Optimal architecture– Model validation – Control of non-linear systems using ANN – Direct and indirect neuro control schemes – Adaptive neuro controller – Familiarization with neural network toolbox.

UNIT III   FUZZY SET THEORY   9
Fuzzy set theory – Fuzzy sets – Operation on fuzzy sets – Scalar cardinality, fuzzy cardinality, union and intersection, complement (Yager and Sugeno), equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation – Fuzzy membership functions.

UNIT IV   FUZZY LOGIC FOR MODELING AND CONTROL   9
Modelling of non-linear systems using fuzzy models – TSK model – Fuzzy logic controller – Fuzzification – Knowledge base – Decision making logic – Defuzzification – Adaptive fuzzy systems – Familiarization with fuzzy logic toolbox.

UNIT V   HYBRID CONTROL SCHEMES   9
Fuzzification and rule base using ANN – Neuro fuzzy systems – ANFIS – Fuzzy neuron– GA – Optimization of membership function and rule base using Genetic Algorithm – Introduction to other evolutionary optimization techniques, support vector machine– Case study – Familiarization with ANFIS toolbox.

                                                    TOTAL :   45   PERIODS
OUTCOMES:
- Ability to understand the concepts of ANN, different features of fuzzy logic and their modelling, control aspects and different hybrid control schemes.
- Ability to understand the basics of artificial neural network.
- Ability to get knowledge on modelling and control of neural.
- Ability to get knowledge on modelling and control of fuzzy control schemes.
- Ability to acquire knowledge on hybrid control schemes.
- Ability to understand the concepts of Adaptive Resonance Theory

TEXT BOOKS:
1. Laurence Fausett, "Fundamentals of Neural Networks", Prentice Hall, Englewood

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	L	T	P	C
		3	0	0	3

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. EI-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.

EE8014   **SMPS AND UPS**   **L T P C**
                                                                                  3 0 0 3

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.

EE8015	ELECTRIC ENERGY GENERATION, UTILIZATION AND CONSERVATION	L	T	P	C
		3	0	0	3

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-Various 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**   **L T 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 ability 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
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

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.

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 ability 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., 10th 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", 7th 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 impact 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 impact 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.

REFERENCES
1. Reay D.A, Industrial Energy Conservation, 1ˢᵗedition, Pergamon Press, 1977.
2. IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities, IEEE, 196.
3. Amit K. Tyagi, Handbook on Energy Audits and Management, TERI, 2003.
4. Electricity in buildings good practice guide, McGraw-Hill Education, 2016.
5. National Productivity Council Guide Books

CS8391	DATA STRUCTURES	L T P C
		3 0 0 3

OBJECTIVES:
- To understand the concepts of ADTs
- To Learn linear data structures – lists, stacks, and queues
- To understand sorting, searching and hashing algorithms
- To apply Tree and Graph structures

UNIT I   LINEAR DATA STRUCTURES – LIST   9
Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation –– singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

UNIT II   LINEAR DATA STRUCTURES – STACKS, QUEUES   9
Stack ADT – Operations - Applications - Evaluating arithmetic expressions- Conversion of Infix to postfix expression - Queue ADT – Operations - Circular Queue – Priority Queue - deQueue – applications of queues.

UNIT III   NON LINEAR DATA STRUCTURES – TREES   9
Tree ADT – tree traversals - Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree - B+ Tree - Heap – Applications of heap.

UNIT IV   NON LINEAR DATA STRUCTURES - GRAPHS   9
Definition – Representation of Graph – Types of graph - Breadth-first traversal - Depth-first traversal – Topological Sort – Bi-connectivity – Cut vertex – Euler circuits – Applications of graphs.

UNIT V   SEARCHING, SORTING AND HASHING TECHNIQUES   9
Searching- Linear Search - Binary Search. Sorting - Bubble sort - Selection sort - Insertion sort - Shell sort – Radix sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Implement abstract data types for linear data structures.
- Apply the different linear and non-linear data structures to problem solutions.
- Critically analyze the various sorting algorithms.

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

EE8017	HIGH VOLTAGE DIRECT CURRENT TRANSMISSION	L	T	P	C
		3	0	0	3

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.

EE8018	MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

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^2C 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"PearsonEducation,3rdEdition, 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

IntroductiontoSmartMeters,AdvancedMeteringinfrastructure(AMI)driversandbenefits, 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   9
                    APPLICATIONS

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",CRCPress2012.
2. JanakaEkanayake,NickJenkins,KithsiriLiyanage,JianzhongWu,AkihikoYokoyama, "Smart Grid: TechnologyandApplications",Wiley2012.

REFERENCES
- VehbiC. 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, November2011.
- Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang"SmartGrid –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.

EI8073   **BIOMEDICAL INSTRUMENTATION**   **L T P C**
                                                                                      3 0 0 3

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_2, pO_2, 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,2nd edition, 2003
3. Joseph J Carr and John M.Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th 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_2,MgO, ZrO_2, NiO, nanoalumina, CaO, $AgTiO_2$, 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.

ANNA UNIVERSITY, CHENNAI
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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

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	√	√		√		√	√	√			√	√

Sem	COURSE OUTCOMES 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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REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM
I - VIII SEMESTERS CURRICULA AND SYLLABI

SEMESTER I

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
			TOTAL	31	19	0	12	25

SEMESTER II

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
7.	EC8261	Circuits and Devices Laboratory	PC	4	0	0	4	2
8.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
			TOTAL	29	21	0	8	25

SEMESTER III

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
			TOTAL	**30**	**20**	**0**	**10**	**25**

SEMESTER IV

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
			TOTAL	**28**	**20**	**0**	**8**	**24**

SEMESTER V

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
			TOTAL	**31**	**19**	**0**	**12**	**25**

SEMESTER VI

SI. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
			TOTAL	**30**	**18**	**0**	**12**	**24**

SEMESTER VII

Sl.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
7.	EC8711	Embedded Laboratory	PC	4	0	0	4	2
8.	EC8761	Advanced Communication Laboratory	PC	4	0	0	4	2
			TOTAL	26	18	0	8	22

SEMESTER VIII

Sl.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective IV	PE	3	3	0	0	3
2.		Professional Elective V	PE	3	3	0	0	3
PRACTICALS								
3.	EC8811	Project Work	EEC	20	0	0	20	10
			TOTAL	26	6	0	20	16

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

SI. 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

SI. 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	Advanced Digital Signal Processing	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

SI. 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

Sl.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

Sl.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%
	Total	25	25	25	24	25	24	22	16	186	
8.	Non Credit / Mandatory										

	L	T	P	C

HS8151　　　　　　**COMMUNICATIVE ENGLISH**　　　　**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 Coursebook for Undergarduate 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 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, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th 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, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd 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", 12th Edition, Pearson India, 2016.

	L	**T**	**P**	**C**
PH8151 **ENGINEERING PHYSICS**	**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 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_2-O_2 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'', 2nd 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, 50th 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, 2nd 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

PHYSICS AND CHEMISTRY LABORATORY   **L T P C**
(Common to all branches of B.E. / B.Tech Programmes)   **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 viscometery.

1. Estimation of HCl using Na_2CO_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 (8TH edition, 2014)

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 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- newsapapers- **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 cgarts, graphs- **Vocabulary Development**- vocabularyused 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/ talkls 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**   **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 $w = z + c,\ cz, \dfrac{1}{z}, z^2$ - 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, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th 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, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3rd 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, 4th 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	L	T	P	C
	(Common to BME, ME, CC, ECE, EEE, E&I, ICE)	3	0	0	3

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   NANOELECTRONIC 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 able to
- Gain knowledge on classical and quantum electron theories, and energy band structuues,
- 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

BE8254   **BASIC ELECTRICAL AND INSTRUMENTATION ENGINEERING   L T P C**
3 0 0 3

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, 24th reprint 2016
5. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009

EC8251   **CIRCUIT ANALYSIS**   **L T P C**
                                                                      4 0 0 4

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 π 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, 11th 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, 9th Reprint 2015.
2. A.Bruce Carlson, "Cicuits: Engineering Concepts and Analysis of Linear Electric Circuits", Cengage Learning, India Edition 2nd Indian Reprint 2009.
3. Allan H.Robbins, Wilhelm C.Miller, "Circuit Analysis Theory and Practice", Cengage Learning, Fifth Edition, 1st Indian Reprint 2013.

EC8252   **ELECTRONIC DEVICES**   **L T P C**
                                                                      3 0 0 3

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 -π 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:
1. Donald A Neaman, "Semiconductor Physics and Devices", Fourth Edition, Tata Mc GrawHill Inc. 2012.
2. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, "Electronic Devices and circuits", Third Edition, Tata McGraw- Hill, 2008.

REFERENCES:
1. Robert Boylestad and Louis Nashelsky, "Electron Devices and Circuit Theory" Pearson Prentice Hall, 10th edition, July 2008.
2. R.S.Sedha, " A Text Book of Applied Electronics" S.Chand Publications, 2006.
3. Yang, "Fundamentals of Semiconductor devices", McGraw Hill International Edition,   1978.

EC8261 **CIRCUITS AND DEVICES LABORATORY** **L T P C**
                                                        0 0 4 2

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

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, 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:

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, 43rd 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", 9th 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", 5th 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	T	P	C
		3	0	0	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 π equivalent circuit of BJT – Early effect - Analysis of CE, CC and CB amplifiers using Hybrid π 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 π equivalent circuit of FET and MOSFET - Analysis of CS, CD and CG amplifiers using Hybrid π 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 – fα, fβ 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, 3rd Edition, Mc Graw Hill Education (India) Private Ltd., 2010. (Unit I-IV)
2. Robert L. Boylestad and Louis Nasheresky, "Electronic Devices and Circuit Theory", 11th Edition, Pearson Education, 2013. (Unit V)

REFERENCES
1. Millman J, Halkias.C.and Sathyabrada Jit, Electronic Devices and Circuits, 4th Edition, Mc Graw Hill Education (India) Private Ltd., 2015.
2. Salivahanan and N. Suresh Kumar, Electronic Devices and Circuits, 4th 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, 5th 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	L	T	P	C
		4	0	0	4

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	L	T	P	C
		3	0	0	3

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

UNIT I   DIGITAL FUNDAMENTALS   9
Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

UNIT II   COMBINATIONAL CIRCUIT DESIGN   9
Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.

UNIT III   SYNCHRONOUS SEQUENTIAL CIRCUITS   9
Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment, circuit implementation – Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT IV   ASYNCHRONOUS SEQUENTIAL CIRCUITS   9
Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.

UNIT V   MEMORY DEVICES AND DIGITAL INTEGRATED CIRCUITS   9
Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL.

Digital integrated circuits: Logic levels, propagation delay, power dissipation, fan-out and fan-in, noise margin, logic families and their characteristics-RTL, TTL, ECL, CMOS

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course:
- Use digital electronics in the present contemporary world
- Design various combinational digital circuits using logic gates
- Do the analysis and design procedures for synchronous and asynchronous sequential circuits
- Use the semiconductor memories and related technology
- Use electronic circuits involved in the design of logic gates

TEXT BOOK:
 1.   M. Morris Mano and Michael D. Ciletti, "Digital Design", 5th Edition, Pearson, 2014.

REFERENCES:
1.   Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
2.   Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011
3.   S.Salivahanan and S.Arivazhagan"Digital Electronics", Ist Edition, Vikas Publishing House pvt Ltd, 2012.
4.   Anil K.Maini "Digital Electronics", Wiley, 2014.
5.   A.Anand Kumar "Fundamentals of Digital Circuits", 4th Edition, PHI Learning Private Limited, 2016.
6.   Soumitra Kumar Mandal " Digital Electronics", McGraw Hill Education Private Limited, 2016.

EC8391	**CONTROL SYSTEMS ENGINEERING**	L	T	P	C
		3	0	0	3

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 th 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.

EC8381 **FUNDAMENTALS OF DATA STRUCTURES IN C LABORATORY**   **L T P C**
                                                                   0 0 4 2

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

EC8361   **ANALOG AND DIGITAL CIRCUITS LABORATORY**   **L   T   P   C**
                                                                0   0   4   2

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
		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 :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 MamtaBhatnagar. 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	L	T	P	C
		4	0	0	4

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 ", 1st Indian Reprint, Elsevier, 2007.
2. Peebles, P.Z., "Probability, Random Variables and Random Signal Principles ", Tata McGraw Hill, 4th Edition, New Delhi, 2002.

REFERENCES:

1. Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", Oxford University Press, New Delhi, 3rd 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, 3rd Edition, 2002.
5. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", Wiley India Pvt. Ltd., Bangalore, 2nd Edition, 2012.

EC8452	ELECTRONIC CIRCUITS II	L	T	P	C
		3	0	0	3

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.

UNIT II   OSCILLATORS   9
Barkhausen criterion for oscillation – phase shift, Wien bridge - Hartley & Colpitt's oscillators – Clapp oscillator-Ring oscillators and crystal oscillators – oscillator amplitude stabilization.

UNIT III   TUNED AMPLIFIERS   9
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.

UNIT IV   WAVE SHAPING AND MULTIVIBRATOR CIRCUITS   9
Pulse circuits – attenuators – RC integrator and differentiator circuits – diode clampers and clippers –Multivibrators - Schmitt Trigger- UJT Oscillator.

UNIT V   POWER AMPLIFIERS AND DC CONVERTERS   9
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

TOTAL: 45   PERIODS

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.

EC8491   **COMMUNICATION THEORY**   L   T   P   C
                                                              3   0   0   3

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, 3rd 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	L	T	P	C
		4	0	0	4

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

OUTCOMES:
By the end of this course, the student should be able to:
- Display an understanding of fundamental electromagnetic laws and concepts
- Write Maxwell's equations in integral, differential and phasor forms and explain their physical meaning
- Explain electromagnetic wave propagation in lossy and in lossless media
- Solve simple problems requiring estimation of electric and magnetic field quantities based on these concepts and laws

TEXT BOOKS:
1. D.K. Cheng, Field and wave electromagnetics, 2nd ed., Pearson (India), 1989 (UNIT I, II,III IV,V)
2. W.H. Hayt and J.A. Buck, Engineering electrmagnetics, 7th ed., McGraw-Hill (India), 2006 (UNIT I-V)

REFERENCES
1. D.J. Griffiths, Introduction to electrodynamics, 4th ed., Pearson (India), 2013
2. B.M. Notaros, Electromagnetics, Pearson: New Jersey, 2011
3. M.N.O. Sadiku and S.V. Kulkarni, Principles of electromagnetics, 6th ed., Oxford (Asian Edition), 2015

	L	**T**	**P**	**C**
EC8453 **LINEAR INTEGRATED CIRCUITS**	**3**	**0**	**0**	**3**

OBJECTIVES:
- To introduce the basic building blocks of linear integrated circuits
- To learn the linear and non-linear applications of operational amplifiers
- To introduce the theory and applications of analog multipliers and PLL
- To learn the theory of ADC and DAC
- To introduce the concepts of waveform generation and introduce some special function ICs

UNIT I   BASICS OF OPERATIONAL AMPLIFIERS   9
Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations – JFET Operational Amplifiers – LF155 and TL082.

UNIT II   APPLICATIONS OF OPERATIONAL AMPLIFIERS   9
Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

UNIT III   ANALOG MULTIPLIER AND PLL   9
Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronisation.

UNIT IV   **ANALOG TO DIGITAL AND DIGITAL TO ANALOG**   **9**
                       CONVERTERS

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,5th Edition, 2009.
5. William D.Stanley, "Operational Amplifiers with Linear Integrated Circuits", Pearson Education,4th Edition,2001.
6. S.Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH,2nd Edition, 4th Reprint, 2016.

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', 2nd 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.

EC8461   CIRCUITS DESIGN AND SIMULATION LABORATORY   L T P C
                                                              0 0 4 2

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)

EC8462   **LINEAR INTEGRATED CIRCUITS LABORATORY**   **L   T   P   C**
                                                           0   0   4   2

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 uA741, LM 301, LM311, LM 324, LM317, LM723, 7805, 7812, 2N3524, 2N3525, 2N3391, AD 633, LM 555, LM 565 may be used.

EC8501	DIGITAL COMMUNICATION	L	T	P	C
		3	0	0	3

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	L	T	P	C
		4	0	0	4

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. Ifeachor & Barrie. W. Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2002.
2. A. V. Oppenheim, R.W. Schafer 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. Varanesic 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.

EC8551	COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

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, 2nd 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" 3rd 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", 4th 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", Addisson Wesley, 1997
2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim "CMOS Digital Integrated Circuits:Analysis & Design",4th 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**	L	T	P	C
		3	0	0	3

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 communicationsǁ, Pearson Education, Second Edition, 2010.(UNIT I, II, IV)
2. Andreas.F. Molisch, ―Wireless Communicationsǁ, 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 Communicationǁ, Oxford University Press, 2009.

MG8591   **PRINCIPLES OF MANAGEMENT**   **L T P C**
                                                                                    3 0 0 3

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., 10th 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

EC8651   **TRANSMISSION LINES AND RF SYSTEMS**   L   T   P   C
                                                              3   0   0   3

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 Z0 - 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

		L	T	P	C
EC8661	**VLSI DESIGN LABORATORY**	0	0	4	2

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

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.

EC8701   **ANTENNAS AND MICROWAVE ENGINEERING**   **L   T   P   C**
                                                               3   0   0   3

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

OPTICAL COMMUNICATION

EC8751

	L	T	P	C
	3	0	0	3

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-noise sources-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	L	T	P	C
		3	0	0	3

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 EMBEDDEDSYSTEM 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.

EC8702   **AD HOC AND WIRELESS SENSOR NETWORKS**   **L   T   P   C**
                                                              3   0   0   3

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**   **9**
                 PROTOCOLS
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	L	T	P	C
		0	0	4	2

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

EC8761   **ADVANCED COMMUNICATION LABORATORY**   **L   T   P   C**
                                                                          0   0   4   2

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:

S.NO	NAME OF THE EQUIPMENT	REQUIRED
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", 8th Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, "Core Java Volume –I Fundamentals", 9th Edition, Prentice Hall, 2013.

REFERENCES:
1. Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3rd 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	L	T	P	C
		3	0	0	3

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   9
**   MEASUREMENT**
pH, PO2, PCO2, 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	L	T	P	C
		3	0	0	3

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 Klafter, 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

UINI 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.Besterfiled, 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", 8th 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

		L	**T**	**P**	**C**
CS8792	**CRYPTOGRAPHY AND NETWORK SECURITY**	**3**	**0**	**0**	**3**

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 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

EC8091   **ADVANCED DIGITAL SIGNAL PROCESSING**   **L T P C**
                                                                    3 0 0 3

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   MULTIRESOLUTION 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

EC8001	MEMS AND NEMS	L	T	P	C
		3	0	0	3

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

EC8002	MULTIMEDIA COMPRESSION AND COMMUNICATION	L	T	P	C
		3	0	0	3

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 Standardsǁ, 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 Networksǁ, Pearson Education 2007
4. R. Steimnetz, K. Nahrstedt, ―Multimedia Computing, Communications and Applicationsǁ, 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', Addision Wesley, 1998

EC8003	CMOS ANALOG IC DESIGN	L	T	P	C
		3	0	0	3

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   9
                COMPENSATION**

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, 33rd 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	L	T	P	C
		3	0	0	3

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 UTMS 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. 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.

EC8092	**ADVANCED WIRELESS COMMUNICATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

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 Communicationǁ, Cambridge University Press, 2005.
4.   Sergio Verdu " Multi User Detection" Cambridge University Press, 1998

EC8071	COGNITIVE RADIO	L	T	P	C
		3	0	0	3

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.

GE8072	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

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

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.

EC8005	ELECTRONIC PACKAGING AND TESTING	L	T	P	C
		3	0	0	3

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   9
                 CONSIDERATIONS
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

EC8006	MIXED SIGNAL IC DESIGN	L	T	P	C
		3	0	0	3

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, 33rd Re-print, 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 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 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.

EC8072	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:
- To introduce the basic concepts of Electromagnetic Interference
- To teach the importance of Electromagnetic Compatible designs
- To explain the existing standards for Electromagnetic Compatibility

UNIT I   EMI/EMC CONCEPTS   9
EMI-EMC definitions; Sources and Victims of EMI; Conducted and Radiated EMI Emission and Susceptibility; Case Histories; Radiation Hazards to humans.

UNIT II   EMI COUPLING PRINCIPLES   9
Conducted, radiated and transient coupling; Common ground impedance coupling; Common mode and ground loop coupling; Differential mode coupling; Near field cable to cable coupling; Field to cable coupling; Power mains and Power supply coupling; Transient EMI, ESD.

UNIT III   EMI CONTROL   9
Shielding; EMI Filters; Grounding; Bonding; Isolation transformer; Transient suppressors; EMI Suppression Cables.

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.

EC8007	LOW POWER SoC DESIGN	L	T	P	C
		3	0	0	3

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**   **9**
                LOGIC MACHINES FOR SOC

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**   **9**
                SOC

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:
1. J.Rabaey, "Low Power Design Essentials (Integrated Circuits and Systems)", Springer, 2009
2. Wayne Wolf, "Modern VLSI Design – System – on – Chip Design", Prentice Hall, 3rd Edition, 2008.

REFERENCES:
1. J.B.Kuo & J.H.Lou, "Low-voltage CMOS VLSI Circuits", Wiley, 1999.
2. A.Bellaowar & M.I.Elmasry,"Low power Digital VLSI Design, Circuits and Systems", Kluwer, 1996.
3. Wayne Wolf, "Modern VLSI Design – IP based Design", Prentice Hall, 4th Edition, 2008.
4. M.J.S. Smith : Application Specific Integrated Circuits, Pearson, 2003
5. Sudeep Pasricha and NikilDutt, On-Chip Communication Architectures System on Chip Interconnect, Elsevier, 2008
6. Recent literature in Low Power VLSI Circuits.
7. 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, Ist Edition, 2002.
3. P.E. Green, Jr., "Fiber Optic Networks", Prentice Hall, NJ, 1993.
4. Biswanath Mukherjee, "Optical WDM Networks", Springer Series, 2006.

EC8009	COMPRESSIVE SENSING	L	T	P	C
		3	0	0	3

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. Vandergheynst "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.

EC8093   **DIGITAL IMAGE PROCESSING**   **L   T   P   C**

                                                                              3   0   0   3

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	LT 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
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

EC8010	VIDEO ANALYTICS	L	T	P	C
		3	0	0	3

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- smoothening- 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 &   9
                  TRAFFIC MONITIRING AND ASSISTANCE

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

EC8011	DSP PROCESSOR ARCHITECTURE AND	L	T	P	C
	PROGRAMMING	3	0	0	3

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

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.

UNIT II   SPACE SEGMENT   9

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.

UNIT III   SATELLITE LINK DESIGN   9

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

UNIT IV   SATELLITE ACCESS AND CODING METHODS   9

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.

UNIT V   SATELLITE APPLICATIONS   9

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).

TOTAL:45 PERIODS

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",2nd 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 Bostan 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.

SOFT COMPUTING L T P C

3 0 0 3

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.

IT8006	**PRINCIPLES OF SPEECH PROCESSING**	L	T	P	C
		3	0	0	3

OBJECTIVES:
The student should be made:
- To understand the speech production mechanism and the various speech analysis techniques and speech models
- To understand the speech compression techniques
- To understand the speech recognition techniques
- To know the speaker recognition and text to speech synthesis techniques

UNIT I   SPEECH SIGNAL CHARACTERISTICS & ANALYSIS   11

Speech production process - speech sounds and features- - Phonetic Representation of Speech -- representing= speech in time and frequency domains - Short-Time Analysis of Speech - Short-Time Energy and Zero-Crossing Rate - Short-Time Autocorrelation Function - Short-Time Fourier Transform (STFT) - Speech Spectrum - Cepstrum - Mel-Frequency Cepstrum Coefficients - Hearing and Auditory Perception - Perception of Loudness - Critical Bands - Pitch Perception

UNIT II   SPEECH COMPRESSION   12

Sampling and Quantization of Speech (PCM) - Adaptive differential PCM - Delta Modulation - Vector Quantization- Linear predictive coding (LPC) - Code excited Linear predictive Coding (CELP)

UNIT III   SPEECH RECOGNITION   12

LPC for speech recognition- Hidden Markov Model (HMM)- training procedure for HMM- subword unit model based on HMM- language models for large vocabulary speech recognition - Overall recognition system based on subword units - Context dependent subword units- Semantic post processor for speech recognition

UNIT IV   SPEAKER RECOGNITION   5

Acoustic parameters for speaker verification- Feature space for speaker recognition-similarity measures- Text dependent speaker verification-Text independent speaker verification techniques

UNIT V   SPEAKER RECOGNITION AND TEXT TO SPEECH SYNTHESIS   5

Text to speech synthesis(TTS)-Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness-role of prosody

TOTAL:45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Design speech compression techniques
- Configure speech recognition techniques
- Design speaker recognition systems
- Design text to speech synthesis systems

TEXT BOOKS:
1. L. R. Rabiner and R. W. Schafer, Introduction to Digital Signal Processing, Foundations and Trendsin Signal Processing Vol. 1, Nos. 1–2 (2007) 1–194

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, TiO2,MgO, ZrO2, NiO, Nano alumina, CaO, AgTiO2, 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.

ANNA UNIVERSITY, CHENNAI
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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, formulates, 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		✓	✓	✓	✓				✓

			COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
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			✓						
			COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
	SEM 2		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			✓						
			COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
YEAR 2	SEM 3		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			✓						
			COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
	SEM 4		Statistics and Numerical Methods	✓	✓							
			Kinematics of Machinery	✓	✓	✓		✓				
			Manufacturing Technology– II	✓		✓	✓	✓			✓	✓
			Engineering Metallurgy							✓		

COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
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							✓		✓

YEAR 3 — SEM 5

COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
Thermal Engineering- II	✓	✓			✓			✓	
Design of Machine Elements		✓		✓			✓	✓	✓
Metrology and Measurements	✓		✓	✓			✓	✓	
Dynamics of Machines	✓	✓	✓		✓		✓		✓
Kinematics and Dynamics Laboratory	✓	✓	✓	✓					
Thermal Engineering Laboratory	✓	✓	✓						
Metrology and Measurements Laboratory	✓	✓	✓	✓			✓		

YEAR 3 — SEM 6

COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
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				✓	✓	✓	✓		✓

YEAR 4 — SEM 7

COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
Power Plant Engineering	✓	✓	✓	✓				✓	
Mechatronics	✓	✓	✓		✓			✓	✓
Process Planning and Cost Estimation		✓		✓					
Simulation and Analysis Laboratory	✓				✓		✓		
Mechatronics Laboratory	✓	✓	✓		✓			✓	✓
Technical Seminar						✓			

YEAR 4 — SEM 8

COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
Project Work	✓	✓	✓			✓	✓		
Principles of Management						✓			✓

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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
THEORY								
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
PRACTICALS								
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
			TOTAL	**31**	**19**	**0**	**12**	**25**

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICALS								
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
			TOTAL	**30**	**20**	**2**	**8**	**25**

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICAL								
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
			TOTAL	**33**	**17**	**2**	**14**	**25**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICAL								
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
			TOTAL	**29**	**19**	**0**	**10**	**24**

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICAL								
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
			TOTAL	28	16	0	12	22

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICAL								
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
			TOTAL	30	18	2	10	24

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
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
PRACTICAL								
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
			TOTAL	**28**	**18**	**0**	**10**	**23**

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MG8591	Principles of Management	HS	3	3	0	0	3
2.		Professional Elective– IV	PE	3	3	0	0	3
PRACTICAL								
3.	ME8811	Project Work	EEC	20	0	0	20	10
			TOTAL	**29**	**9**	**0**	**20**	**16**

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%
	Total	25	25	25	24	22	24	23	16	184	
8.	Non Credit / Mandatory										

		L	**T**	**P**	**C**
HS8151	**COMMUNICATIVE ENGLISH**	**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, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th 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, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd 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", 12th Edition, Pearson India, 2016.

	L	**T**	**P**	**C**

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 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_2-O_2 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'', 2nd 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 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, 50th 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, 2nd 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	L	T	P	C
	(Common to all branches of B.E. / B.Tech Programmes)	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 viscometery.

1. Estimation of HCl using Na_2CO_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 (8TH 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 cgarts, graphs- Vocabulary Development-vocabularyused 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/ talkls 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.

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
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 $w = z + c,\ cz, \dfrac{1}{z}, z^2$ - 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, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th 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, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3rd 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, 4th 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.

PH8251	**MATERIALS SCIENCE** (Common to courses offered in Faculty of Mechanical Engineering Except B.E. Materials Science and Engineering)	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

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, baintic 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 IV   MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS   9

Ferromagnetism – domain theory – types of energy – hysteresis – hard and soft magnetic materials – ferrites - dielectric materials – types of polarization – Langevin-Debye equation – frequency effects on polarization - dielectric breakdown – insulating materials – Ferroelectric materials - superconducting materials and their properties.

UNIT V   NEW MATERIALS   9

Ceramics – types and applications – composites: classification, role of matrix and reinforcement, processing of fiber reinforced plastics – metallic glasses: types , glass forming ability of alloys, melt spinning process, applications - shape memory alloys: phases, shape memory effect, pseudoelastic effect, NiTi alloy, applications – nanomaterials: preparation (bottom up and top down approaches), properties and applications – carbon nanotubes: types.

TOTAL :   45   PERIODS

OUTCOMES:

Upon completion of this course,
- the students will have knowledge on the various phase diagrams and their applications
- the students will acquire knowledge on Fe-Fe$_3$C phase diagram,various microstructures and alloys
- the students will get knowledge on mechanical properties of materials and their measurement
- the students will gain knowledge on magnetic, dielectric and superconducting properties of materials
- the students will understand the basics of ceramics, composites and nanomaterials.

TEXT BOOKS:
1.   Balasubramaniam, R. "Callister's Materials Science and Engineering". Wiley India Pvt. Ltd., 2014.
2.   Raghavan, V. "Physical Metallurgy: Principles and Practice". PHI Learning, 2015.
3.   Raghavan, V. "Materials Science and Engineering : A First course". PHI Learning, 2015.

REFERENCES
1.   Askeland, D. "Materials Science and Engineering". Brooks/Cole, 2010.
2.   Smith, W.F., Hashemi, J. & Prakash, R. "Materials Science and Engineering".
      Tata McGraw Hill Education Pvt. Ltd., 2014.
3.   Wahab, M.A. "Solid State Physics: Structure and Properties of Materials".
      Narosa Publishing House, 2009.

BE8253   BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION   L T P C
ENGINEERING   3 0 0 3

OBJECTIVES:

 To impart knowledge on
- Electric circuit laws, single and three phase circuits and wiring
- Working principles of Electrical Machines
- Working principle of Various electronic devices and measuring instruments

UNIT I   ELECTRICAL CIRCUITS   9

Basic circuit components -, Ohms Law - Kirchoff's Law – Instantaneous Power – Inductors - Capacitors – Independent and Dependent Sources - steady state solution of DC circuits - Nodal analysis, Mesh analysis- Thevinin's Theorem, Norton's Theorem, Maximum Power transfer theorem- Linearity and Superposition Theorem.

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 Grabel, "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

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', 2nd 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.

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", 8th 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.   Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
3.   Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th 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", 3rd 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.

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.

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

2.   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	

BE8261   BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION   L T P C
ENGINEERING LABORATORY   0 0 4 2

OBJECTIVE:
- To train the students in performing various tests on electrical drives, sensors and circuits.

LIST OF EXPERIMENTS:
1. Load test on separately excited DC generator
2. Load test on Single phase Transformer
3. Load test on Induction motor
4. Verification of Circuit Laws
5. Verification of Circuit Theorems
6. Measurement of three phase power
7. Load test on DC shunt motor.
8. Diode based application circuits
9. Transistor based application circuits
10. Study of CRO and measurement of AC signals
11. Characteristics of LVDT
12. Calibration of Rotometer
13. RTD and Thermistor

Minimum of 10 Experiments to be carried out :-

TOTAL: 60 PERIODS

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   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", 43rd 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 ", 10th Edition, John Wiley, India, 2016.
3. G. James, "Advanced Modern Engineering Mathematics", 3rd 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", 9th 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 psychometric 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 & Sonnatag, "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", 5th 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 - CO_2 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 Chouldhary 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", 4th 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

S. NO.	NAME OF THE EQUIPMENT	Qty.
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.

ME8381 **COMPUTER AIDED MACHINE DRAWING** **L T P C**
                                                    0 0 4 2

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 MamtaBhatnagar. 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.

MA8452   **STATISTICS AND NUMERICAL METHODS**   L T P C
                                                                  4 0 0 4

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 derivates 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 ", 10th 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, 8th Edition, 2015.

REFERENCES :
1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th 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", 8th 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 – Involutes 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", 4th Edition, Tata McGraw-Hill, 2014.
3. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4 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", 3rd 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", 3rd 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. Geofrey 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.

ME8491   **ENGINEERING METALLURGY**   L   T   P   C
                                                                        3   0   0   3

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-   and   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_2O_3, SiC, Si_3N_4, 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.

CE8395	STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS	L	T	P	C
		3	0	0	3

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 hollows 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 – Lame's theorem.

TOTAL: 45 PERIODS

OUTCOMES

Students will be able to

- Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.
- Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
- Apply basic equation of simple torsion in designing of shafts and helical spring
- Calculate the slope and deflection in beams using different methods.
- Analyze and design thin and thick shells for the applied internal and external pressures.

TEXT BOOKS:

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009

REFERENCES:

1. Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2002
2. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013
4. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.

ME8493	THERMAL ENGINEERING - I	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To integrate the concepts, laws and methodologies from the first course in thermodynamics into analysis of cyclic processes
- To apply the thermodynamic concepts into various thermal application like IC engines, Steam.
- Turbines, Compressors and Refrigeration and Air conditioning systems

(Use of standard refrigerant property data book, Steam Tables, Mollier diagram and Psychrometric chart permitted)

UNIT I   GAS AND STEAM POWER CYCLES   9

Air Standard Cycles - Otto, Diesel, Dual, Brayton – Cycle Analysis, Performance and Comparison – Rankine, reheat and regenerative cycle.

UNIT II   RECIPROCATING AIR COMPRESSOR   9

Classification and comparison, working principle, work of compression - with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency. Multistage air compressor with Intercooling. Working principle and comparison of Rotary compressors with reciprocating air compressors.

UNIT III   INTERNAL COMBUSTION ENGINES AND COMBUSTION   9

IC engine – Classification, working, components and their functions. Ideal and actual : Valve and port timing diagrams, p-v diagrams- two stroke & four stroke, and SI & CI engines – comparison. Geometric, operating, and performance comparison of SI and CI engines. Desirable properties and qualities of fuels. Air-fuel ratio calculation – lean and rich mixtures. Combustion in SI & CI Engines – Knocking – phenomena and control.

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

ME8462   **MANUFACTURING TECHNOLOGY LABORATORY – II**   L   T   P   C
                                                                      0   0   4   2

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	Cylinderical 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

CE8381	STRENGTH OF MATERIALS AND FLUID MECHANICS AND MACHINERY LABORATORY	L	T	P	C
		0	0	4	2

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", 1st 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 Reinhols, 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", 4th 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", 1st 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", 4th Edition, Wiley, 2005
6. Sundararajamoorthy T. V. Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2015.

ME8501	METROLOGY AND MEASUREMENTS	L	T	P	C
		3	0	0	3

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", 5th edition, Cengage Learning EMEA,1990.
4. Donald Peckman, "Industrial Instrumentation", Wiley Eastern, 2004.
5. Raghavendra ,Krishnamurthy "Engineering Metrology & Measurements", Oxford Univ. Press, 2013.

ME8594   **DYNAMICS OF MACHINES**   **L   T   P   C**
                                                                              4   0   0   4

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.

UNIT I   FORCE ANALYSIS   12

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.

UNIT II   BALANCING   12

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.

UNIT III   FREE VIBRATION   12

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.

UNIT IV   FORCED VIBRATION   12

Response of one degree freedom systems to periodic forcing – Harmonic disturbances – Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation vibration measurement.

UNIT V   MECHANISM FOR CONTROL   12

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", 4th Edition, Tata McGraw-Hill, 2014.
3. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4th 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", 3rd Edition Affiliated East-West Pvt. Ltd., New Delhi, 2006.
3. Khurmi, R.S.,"Theory of Machines", 14th Edition, S Chand Publications, 2005.
4. Rao.J.S. and Dukkipati.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.

ME8511   **KINEMATICS AND DYNAMICS LABORATORY**   L   T   P   C
                                                                           0   0   4   2

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
1. a) Study of gear parameters.
   b) Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
2. a)Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.
   b) Kinematics of single and double universal joints.
3. 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.
4. Motorized gyroscope – Study of gyroscopic effect and couple.
5. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
6. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
7. 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.
8. a) Determination of torsional natural frequency of single and Double Rotor systems.- Undamped and Damped Natural frequencies.
   b) Vibration Absorber – Tuned vibration absorber.
9. Vibration of Equivalent Spring mass system – undamped and damped vibration.
10. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
11. a) Balancing of rotating masses. (b) Balancing of reciprocating masses.
12. 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 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

	NAME OF THE EQUIPMENT	Qty.
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.

S.No.	NAME OF THE EQUIPMENT	Qty.
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.

ME8513 **METROLOGY AND MEASUREMENTS LABORATORY** **L T P C**
0 0 4 2

OBJECTIVE:
- To familiar with different measurement equipments and use of this industry for quality inspection.

LIST OF EXPERIMENTS

1. Calibration and use of measuring instruments – Vernier caliper, micrometer, Vernier height gauge – using gauge blocks
2. Calibration and use of measuring instruments – depth micrometer, bore gauge, telescopic gauge
3. Measurement of linear dimensions using Comparators
4. Measurement of angles using bevel protractor and sine bar
5. Measurement of screw thread parameters – Screw thread Micrometers and Three wire method '(floating carriage micrometer)
6. Measurement of gear parameters – disc micrometers, gear tooth vernier caliper
7. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM)
8. Programming of CNC Coordinate Measuring Machines for repeated measurements of identical components
9. Non-contact (Optical) measurement using Toolmaker's microscope / Profile projector and Video measurement system
10. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments.
11. Machine tool metrology – Level tests using precision level; Testing of straightness of a machine tool guide way using Autocollimator, spindle tests.
12. 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

16	Coordinate measuring machine	1
17	Surface finish measuring equipment	1
18	Bore gauge	1
19	Telescope gauge	1

ME8651	**DESIGN OF TRANSMISSION SYSTEMS**	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
- To understand the standard procedure available for Design of Transmission of Mechanical elements
- To learn to use standard data and catalogues
  (Use of P S G Design Data Book permitted)

UNIT I DESIGN OF FLEXIBLE ELEMENTS 9
Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropes and pulleys – Design of Transmission chains and Sprockets.

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 9
Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane-Equivalent number of teeth-forces for helical gears.

UNIT III BEVEL, WORM AND CROSS HELICAL GEARS 9
Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits-terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.

UNIT IV GEAR BOXES 9
Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box - Speed reducer unit. – Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.

UNIT V CAMS, CLUTCHES AND BRAKES 9
Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes - external shoe brakes – Internal expanding shoe brake.

TOTAL : 45 PERIODS

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", 4th Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008.

REFERENCES:
1. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 8th 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", 4th 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 andB-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	L	T	P	C
		3	2	0	4

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

ME8692   **FINITE ELEMENT ANALYSIS**   **L   T   P   C**
                                                                            3   0   0   3

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 PRINICIPLES 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
HARDWARE		
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
SOFTWARE		
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 : B*oiling Water Reactor* (BWR), P*ressurized 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.

ME8793	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

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", 9th 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	L	T	P	C
		3	0	0	3

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

UNIT II   MICROPROCESSOR AND MICROCONTROLLER   9

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram,.

UNIT III   PROGRAMMABLE PERIPHERAL INTERFACE   9

Introduction – Architecture of 8255, Keyboard interfacing, LED display –interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface.

UNIT IV   PROGRAMMABLE LOGIC CONTROLLER   9

Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.

UNIT V   ACTUATORS AND MECHATRONIC SYSTEM DESIGN   9

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.

ME8711	**SIMULATION AND ANALYSIS LABORATORY**	L	T	P	C
		0	0	4	2

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

SI. No.	NAME OF THE EQUIPMENT	Qty.
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

MG8591   **PRINCIPLES OF MANAGEMENT**   L   T   P   C
                                                                               3   0   0   3

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:
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., 10th 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", 7th Edition, Pearson Education, 2011.
4. 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, 34th reprint, 2008.
2. Parmer R.S., "Welding Engineering and Technology", 1st 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. 8th 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, 1st 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.

ME8096	**GAS DYNAMICS AND JET PROPULSION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

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   NORMAL AND OBLIQUE SHOCKS   9
Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications.

UNIT IV   JET PROPULSION   9
Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

UNIT V   SPACE PROPULSION   9
Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.

TOTAL: 45 PERIODS

OUTCOMES:
Upon the completion of this course the students will be able to
CO1   Apply the concept of compressible flows in variable area ducts.
CO2   Apply the concept of compressible flows in constant area ducts.
CO3   examine the effect of compression and expansion waves in compressible flow.
CO4   use the concept of gas dynamics in Jet Propulsion.
CO5   apply the concept of gas dynamics in Space Propulsion.

TEXT BOOKS:
1. Anderson, J.D., "Modern Compressible flow", 3rd Edition, McGraw Hill, 2012.
2. Yahya, S.M. "Fundamentals of Compressible Flow", New Age International (P) Limited, New Delhi, 2002.

REFERENCES:
1. Cohen. H., G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Longman Group Ltd.,1980
2. Ganesan. V., "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2010.
3. Shapiro. A.H.," Dynamics and Thermodynamics of Compressible fluid Flow", John wiley, New York, 1953.
4. Sutton. G.P., "Rocket Propulsion Elements", John wiley, New York,2010,.
5. Zucrow. N.J., "Principles of Jet Propulsion and Gas Turbines", John Wiley, New York, 1970.

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. 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_2,MgO, ZrO_2, NiO, nanoalumina, CaO, $AgTiO_2$, 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 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.

ME8071	REFRIGERATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3

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", 3rd edition, McGraw Hill, New Delhi, 2010.

REFERENCES:
1. ASHRAE Hand book, Fundamentals, 2010
2. Jones W.P., "Air conditioning engineering", 5th edition, Elsevier Butterworth-Heinemann, 2007
3. Roy J. Dossat, "Principles of Refrigeration", 4th 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

ME8098 **QUALITY CONTROL AND RELIABILITY ENGINEERING** **L   T   P   C**
                                                          3   0   0   3

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", 7th 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.

ME8073	UNCONVENTIONAL MACHINING PROCESSES	L	T	P	C
		3	0	0	3

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

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.Besterfiled, 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", 8th 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**	**L**	**T**	**P**	**C**
		3	0	0	3

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-Various 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. Klafter 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**
		3	**0**	**0**	**3**

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", 5th 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.

ME8093   **COMPUTATIONAL FLUID DYNAMICS**   **L T P C**

                                                                                3 0 0 3

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-) 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	L	T	P	C
		3	0	0	3

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, 2nd Edition New Jersey, 2005

ME8092	**COMPOSITE MATERIALS AND MECHANICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

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 (Qij), 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

UNIT II   FLAT PLATE LAMINATE CONSTITUTE EQUATIONS   9

Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

UNIT III   LAMINA STRENGTH ANALYSIS   9

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure

UNIT IV   THERMAL ANALYSIS   9

Assumption of Constant C.T.E's. Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's. C.T.E's for special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates

UNIT V   ANALYSIS OF LAMINATED FLAT PLATES   9

Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies

TOTAL: 45 PERIODS

OUTCOMES:
Upon the completion of this course the students will be able to
CO1   Summarize the various types of Fibers, Equations and manufacturing methods for Composite materials
CO2   Derive Flat plate Laminate equations
CO3   Analyze Lamina strength
CO4   Analyze the thermal behavior of Composite laminates
CO5   Analyze Laminate flat plates

TEXT BOOKS:
1. Gibson, R.F., "Principles of Composite Material Mechanics", Second Edition, McGraw-Hill, CRC press in progress, 1994, -.
2. Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw Hill, 1998

REFERENCES:
1. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
2. Halpin, J.C., "Primer on Composite Materials, Analysis", Technomic Publishing Co., 1984.
3. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition - 2007
4. Mallick, P.K., Fiber, "Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, 1993.
5. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.

GE8072   **FOUNDATION SKILLS IN INTEGRATED PRODUCT**   **L   T   P   C**
                                   DEVELOPMENT   **3   0   0   3**

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 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, Scenarious in the Indian context, Disaster damage assessment and management.

TEXT BOOKS:
1. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
2. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.
3. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
4. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]

REFERENCES
1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

IE8693	PRODUCTION PLANNING AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:
- To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I   INTRODUCTION   9
Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design-Marketing aspect - Functional aspects- Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNIT II   WORK STUDY   9
Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

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", 2nd Edition, Oxford university press, 2007.
5. Melynk, Denzler, " Operations management – A value driven approach" Irwin Mcgraw hill.
6. Norman Gaither, G. Frazier, "Operations Management" 9th 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" 1st 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", 9th 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" 8th Edition, Tata McGraw-Hill, 2013.
3. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2nd Edition Dream tech, 2005.
4. Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011.

ME8094   COMPUTER INTEGRATED MANUFACTURING SYSTEMS   L   T   P   C
3   0   0   3

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

TEXT BOOKS:
1. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
2. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

REFERENCES:
1. Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach" Chapman & Hall, London, 1995.
2. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India.
3. Rao. P, N Tewari &T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.

ME8074	VIBRATION AND NOISE CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVE:
- The student will be able to understand the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components

UNIT I   BASICS OF VIBRATION   9
Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

UNIT II   BASICS OF NOISE   9
Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT III   AUTOMOTIVE NOISE SOURCES   9
Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tire noise, brake noise.

UNIT IV   CONTROL TECHNIQUES   9
Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT V   SOURCE OF NOISE AND CONTROL   9
Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

TOTAL: 45 PERIODS

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", 6th Edition, Pearson Education, 2016.

REFERENCES:
1. Balakumar Balachandran and Edward B. Magrab, "Fundamentals of Vibrations", 1st Editon, Cengage Learning, 2009
2. Benson H. Tongue, "Principles of Vibrations", 2nd 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",4th 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 – Anisotrophic 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.

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. 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.

Web sources:
1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

OPEN ELECTIVES (Offered by Other Branches)

SEMESTER V
OPEN ELECTIVE - I

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OCE551	Air Pollution and Control Engineering	OE	3	3	0	0	3
2.	OMD551	Basic of Biomedical Instrumentation	OE	3	3	0	0	3
3.	OBT552	Basics of Bioinformatics	OE	3	3	0	0	3
4.	OBM551	Bio Chemistry	OE	3	3	0	0	3
5.	OTL552	Digital Audio Engineering	OE	3	3	0	0	3
6.	OME551	Energy Conservation and Management	OE	3	3	0	0	3
7.	OBT553	Fundamentals of Nutrition	OE	3	3	0	0	3
8.	OCE552	Geographic Information System	OE	3	3	0	0	3
9.	OPY551	Herbal Technology	OE	3	3	0	0	3
10.	OMD552	Hospital Waste Management	OE	3	3	0	0	3
11.	OCH551	Industrial Nanotechnology	OE	3	3	0	0	3
12.	OBT551	Introduction to Bioenergy and Biofuels	OE	3	3	0	0	3
13.	OME553	Industrial Safety Engineering	OE	3	3	0	0	3
14.	OEI551	Logic and Distributed Control Systems	OE	3	3	0	0	3
15.	OBM552	Medical Physics	OE	3	3	0	0	3
16.	OML552	Microscopy	OE	3	3	0	0	3
17.	OBT554	Principles of Food Preservation	OE	3	3	0	0	3
18.	OMF551	Product Design and Development	OE	3	3	0	0	3
19.	OAN551	Sensors and Transducers	OE	3	3	0	0	3
20.	OTL551	Space Time Wireless Communication	OE	3	3	0	0	3
21.	OEC552	Soft Computing	OE	3	3	0	0	3
22.	OTL553	Telecommunication Network Management	OE	3	3	0	0	3
23.	OMD553	Telehealth Technology	OE	3	3	0	0	3
24.	OTL554	Wavelets and its Applications	OE	3	3	0	0	3
25.	OIM551	World Class Manufacturing	OE	3	3	0	0	3

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OAI751	Agricultural Finance, Banking and Co-operation	OE	3	3	0	0	3
2.	OEE751	Basic Circuit Theory	OE	3	3	0	0	3
3.	OBM751	Basics of Human Anatomy and Physiology	OE	3	3	0	0	3
4.	OGI751	Climate Change and its Impact	OE	3	3	0	0	3
5.	OPY751	Clinical Trials	OE	3	3	0	0	3
6.	OEC751	Electronic Devices	OE	3	3	0	0	3
7.	OML752	Electronic Materials	OE	3	3	0	0	3
8.	OCH752	Energy Technology	OE	3	3	0	0	3
9.	OCE751	Environmental and Social Impact Assessment	OE	3	3	0	0	3
10.	OGI752	Fundamentals of Planetary Remote Sensing	OE	3	3	0	0	3
11.	OEN751	Green Building Design	OE	3	3	0	0	3
12.	OBM752	Hospital Management	OE	3	3	0	0	3
13.	OEE752	Introduction to Renewable Energy Systems	OE	3	3	0	0	3
14.	OBT753	Introduction of Cell Biology	OE	3	3	0	0	3
15.	OMF751	Lean Six Sigma	OE	3	3	0	0	3
16.	OAN751	Low Cost Automation	OE	3	3	0	0	3
17.	OEC754	Medical Electronics	OE	3	3	0	0	3
18.	OEC756	MEMS and NEMS	OE	3	3	0	0	3
19.	OBT752	Microbiology	OE	3	3	0	0	3
20.	OCH751	Process Modeling and Simulation	OE	3	3	0	0	3
21.	OIE751	Robotics	OE	3	3	0	0	3
22.	OEC753	Signals and Systems	OE	4	4	0	0	4
23.	OME752	Supply Chain Management	OE	3	3	0	0	3
24.	OME753	Systems Engineering	OE	3	3	0	0	3
25.	OTL751	Telecommunication System Modeling and Simulation	OE	3	3	0	0	3
26.	OCY751	Waste Water Treatment	OE	3	3	0	0	3

OCE551 **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.

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 - Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators.

UNIT IV   CONTROL OF GASEOUS CONTAMINANTS   11
Factors affecting Selection of Control Equipment – Working principle - absorption, Adsorption, condensation, Incineration, Bio filters – Process control and Monitoring.

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.

OMD551   **BASICS OF BIOMEDICAL INSTRUMENTATION**   **L T P C**
                                                                                3 0 0 3

OBJECTIVES:
- To study about the different bio potential and its propagation
- To understand the different types of electrodes and its placement for various recording
- To study the design of bio amplifier for various physiological recording
- To learn the different measurement techniques for non-physiological parameters.
- To familiarize the different biochemical measurements.

CO-PO MAPPING:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				✓		✓					
CO2				✓		✓					
CO3	✓	✓	✓	✓	✓	✓					
CO4				✓	✓	✓	✓				
CO5				✓	✓	✓	✓				

UNIT I   BIO POTENTIAL GENERATION AND ELECTRODES TYPES   9
Origin of bio potential and its propagation. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes

UNIT II   BIOSIGNAL CHARACTERISTICS AND ELECTRODECONFIGURATIONS   9
Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode.

UNIT III   SIGNAL CONDITIONING CIRCUITS   9
Need for bio-amplifier - differential bio-amplifier, Impedance matching circuit, isolation amplifiers, Power line interference, Right leg driven ECG amplifier, Band pass filtering

UNIT IV   MEASUREMENT OF NON-ELECTRICALPARAMETERS   10
Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, direct methods: electronic manometer, Systolic, diastolic pressure, Blood flow and cardiac output measurement: Indicator dilution, and dye dilution method, ultrasound blood flow measurement.

UNIT V   BIO-CHEMICAL MEASUREMENT   8
Blood gas analyzers and Non-Invasive monitoring, colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

                                                                    TOTAL: 45 PERIODS
OUTCOMES:
At the end of the course, the student should be able to:
    CO1: To Learn the different bio potential and its propagation.
    CO2: To get Familiarize the different electrode placement for various physiological recording
    CO3: Students will be able design bio amplifier for various physiological recording
    CO4: Students will understand various technique non electrical physiogical measurements
    CO5: Understand the different biochemical measurements

TEXT BOOKS:
   1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
   2. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2004. (Units I, II & V)

REFERENCES:
1. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill Publisher, 2003.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.(Units II & IV)
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

OBT552   **BASICS OF BIOINFORMATICS**   **L T P C**
                                                                          3 0 0 3

UNIT I   BIOLOGICAL DATA ACQUISITION   9
The form of biological information. Retrieval methods for DNA sequence, protein sequence and protein structure information

UNIT II   DATABASES   9
Format and Annotation: Conventions for database indexing and specification of search terms, Common sequence file formats. Annotated sequence databases - primary sequence databases, protein sequence and structure databases, Organism specific databases

UNIT III   DATA PROCESSING   9
Data – Access, Retrieval and Submission: Standard search engines; Data retrieval tools – Entrez, DBGET and SRS; Submission of (new and revised) data; Sequence Similarity Searches: Localversus global. Distance metrics. Similarity and homology. Scoring matrices.

UNIT IV   METHODS OF ANALYSIS   9
Dynamic programming algorithms, Needleman-wunsch and Smith-waterman. Heuristic Methods of sequence alignment, FASTA , and PSI BLAST. Multiple Sequence Alignment and software tools for pairwise and multiple sequence alignment

UNIT V   APPLICATIONS   9
Genome Annotation and Gene Prediction; ORF finding; Phylogenetic Analysis : Comparative genomics, orthologs, paralogs. Genome analysis – Genome annotation
                                                                 TOTAL: 45 PERIODS
TEXT BOOKS:
1. Introduction to Bioinformatics by Arthur K. Lesk , Oxford University Press.
2. Algorithms on Strings, Trees and Sequences by Dan Gusfield, Cambridge University Press.
3. Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids by Durbin, S.Eddy, A.Krogh, G.Mitchison.
4. Bioinformatics Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press.
5. Beginning Perl for Bioinformatics: An introduction to Perl for Biologists by James Tindall, O'Reilley Media.

REFERENCE
1. Bioinformatics The Machine Learning Approach by Pierre Baldi and Soren Brunak.

OBJECTIVES:
- To study the structural and functional properties of carbohydrates, proteins, lipids and nucleic acids
- To discuss the impairments in metabolism of the above, including inborn errors of metabolism.

UNIT I   BIOLOGICAL PRINCIPLE   8
Composition & properties of the cell membrane, membrane transports, permeability Coefficient & partition coefficient, body fluids, electrolytes, acid-base balance, blood viscosity and Newtonian nature, colloids, filtration, diffusion, osmosis, dialysis, ultrafiltration, ultracentrifugation, cellular fractionation, electrophoresis, radioimmunoassay, Photochemical reaction, law of photochemistry, fluorescence and phosphorescence.

UNIT II   MACROMOLECULES   10
Classification and functions of carbohydrates, glycolysis, TCA cycle, Blood Sugar analysis and glucose tolerance test, Classification and functions of proteins, architecture of proteins, Classification of amino acids, Oxidative and non oxidative deamination, transamination, decarboxylation, urea cycle, Purification/separation of proteins, Classification and functions of lipids, biosynthesis of long chain fatty acids, oxidation and degradation of fatty acids.

UNIT III   ENZYMES   9
Chemical Nature, General Properties, Spectrophotometric measurement of enzymes, Isolation techniques, Diagnostic enzymes.

Hormones: Chemical Nature, Properties of hormones, Hormonal Assay and their Significance.

UNIT IV   METABOLIC DISORDER   9
Diabetes mellitus, Diabetic ketoacidosis, lactose intolerance, Glycogen storage disorders, Lipid storage disorders, obesity, atherosclerosis, Plasma proteins in health and disease, Inborn error of amino acid metabolism, Disorders associated with abnormalities in the metabolism of bilirubin – Jaundice.

UNIT V   9
Liver Function tests, Renal Function Tests, Blood gas Analysis, Measurement of Electrolytes. Their abnormal and Normal Values and Conditions. Biochemistry of Urine and Stools testing.

                                                                TOTAL: 45 PERIODS

OUTCOMES:
After the successful completion of this course, the students will be able to,
- Explain the fundamentals of biochemistry
- Have in-depth knowledge about the classification, structures and properties of carbohydrates, lipid, protein and amino acid.
- Demonstrate about the mechanism of actions of enzymes and co-enzymes, clinical importance of enzymes, hormonal assay and significance.

TEXT BOOKS:
1. Keith Wilson & John Walker, "Practical Biochemistry - Principles & Techniques", Oxford University Press, 2009.
2. Rafi MD —Text book of biochemistry for Medical Student, Second Edition, University Press, 2014.
3. W. Rodwell, David Bender, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil—Harper's Review of biochemistry, 30 th Edition, LANGE Medical Publications, 2015.
4. Trevor palmer and Philip L Bonner "Enzymes: Biochemistry, Biotechnology, Clinical Chemistry", 2 nd Edition, Woodhead Publishing, 2009.

REFERENCES:
1. Lehninger Principles of Biochemistry, Fourth Edition - by David L. Nelson & Michael M.Cox ,-W. H. Freeman; 4 edition (April 23, 2004)
2. Fundamentals of Biochemistry: Life at the Molecular Level - by Donald J. Voet , Judith G. Voet & Charlotte W. Pratt. - Wiley; 2 edition (March 31, 2005)
3. Pamela.C.Champe & Richard.A.Harvey, —Lippincott Biochemistry Lippincott's Illustrated Reviews, 6 th Edition, LWW publishers, 2013.

OTL552	DIGITAL AUDIO ENGINEERING	L T P C
		3 0 0 3

OBJECTIVES:
- To understand the concept of fundamentals of digital audio.
- To understand the concept of audio in digital TV broadcasting.
- To understand the various codes of digital coding.
- To understand the concept of digital audio tape recorder.
- To analyze the concept internet audio in digital audio engineering.

UNIT I   FUNDAMENTALS OF DIGITAL AUDIO   9
Discrete time sampling - sampling theorem - Nyquist frequency – aliasing – prevention – quantization – signal to error ratio – distortion – other architectures – dithers – types of dither.

UNIT II   RECORDING AND TRANSMISSION PRINCIPLES   9
PCM – record processing – recording oriented codes – transmission oriented codes – audio in digital TV broadcasting – DAB.

UNIT III   DIGITAL CODING & COMPRESSION   9
Block & convolutional codes – cyclic codes – Reed Solomon codes – interleaving – compression principles – lossless & perceptive coding – subband codes – transform coding – compression formats – MPEG audio – Dolby AC 3 – ATRAC.

UNIT IV   DIGITAL AUDIO TECHNIQUES   9
Digital audio tape recorder – cassettes – modes – track format – digital audio editing – editing with random access media & recording media – editor structure – digital audio in optical disks – CD, MD, DVD, playing optical disk – Minidisk.

UNIT V   APPLICATIONS OF DIGITAL AUDIO   9
Internet audio – MP3 – SDMI – audio MPEG 4 – PC – MIDI – sound cards**.**

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, students would be able to
- Analyze the type of dither.
- Analyze the recording and transmission principles in digital audio.
- Analyze the various compression techniques.
- Design and analyze the digital audio editing.
- Analyze the various application of digital audio.

TEXT BOOKS:
1. John Watkinson, "An Introduction to Digital Audio", Focal Press, Second edition. 2013
2. Ken C Pohlmann, "Principles of Digital audio", McGraw Hill, Sixth edition, 2010

REFERENCES:
1. Then Ballin, " Handbook for sound Engineers Taylor & Francis", Fifth edition, 2015
2. John Watkinson, "The art of Digital Audio" Focal Press, Third edition, 2013

OME551   **ENERGY CONSERVATION AND MANAGEMENT**   **L T P C**
                                                                                      3 0 0 3

OBJECTIVES:
At the end of the course, the student is expected to
- Understand and analyse the energy data of industries
- Carryout energy accounting and balancing
- Conduct energy audit and suggest methodologies for energy savings and
- Utilise the available resources in optimal ways

UNIT I   **INTRODUCTION**   **9**
Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT II   **ELECTRICAL SYSTEMS**   **9**
Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT III   **THERMAL SYSTEMS**   **9**
Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories

UNIT IV   **ENERGY CONSERVATION IN MAJOR UTILITIES**   **9**
Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V   **ECONOMICS**   **9**
Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept

                                                    TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the students can able to analyse the energy data of industries.
- Can carryout energy accounting and balancing
- Can suggest methodologies for energy savings

TEXT BOOK:
1. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com,a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

REFERENCES:
1. Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.
3. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982
4. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987.

OBT553   **FUNDAMENTALS OF NUTRITION**   **L T P C**
                                                                     3 0 0 3

OBJECTIVES:

- The course aims to develop the knowledge of students in the basic area of Food Chemistry.
- This is necessary for effective understanding of food processing and technology subjects.
- This course will enable students to appreciate the similarities and complexities of the chemical components in foods.

UNIT I   OVERVIEW OF NUTRITION   9
Definition, six classes of nutrients, calculating energy values from food, using the RDA, nutritional status, nutritional requirement, malnutrition, nutritional assessment of individuals and populations, dietary recommendations, Balanced diet planning: Diet planning principles, dietary guidelines; food groups, exchange lists, personal diet analysis.

UNIT II   DIGESTION   9
Digestion, Absorption and Transport: Anatomy and physiology of the digestive tract, mechanical and chemical digestion, absorption of nutrients.

UNIT III   CARBOHYDRATES   9
Glycemic and Non-glycemic carbohydrates, blood glucose regulation, recommendations of sugar intake for health, health effects of fiber and starch intake, Artificial sweeteners; Importance of blood sugar regulation, Dietary recommendations for NIDDM and IDDM

UNIT IV   PROTEINS & LIPIDS   9
Proteins; Food enzymes ; Texturized proteins; Food sources, functional role and uses in foods. Review of structure, composition & nomenclature of fats. Non-Glyceride components in fats & oils; Fat replacements; Food sources, functional role and uses in foods. Health effects and recommended intakes of lipids. Recommended intakes of proteins, Deficiency- short term and long term effects.

UNIT V   METABOLISM, ENERGY BALANCE AND BODY COMPOSITION   9
Energy Balance; body weight and body composition; health implications; obesity, BMR and BMI calculations; Weight Control: Fat cell development; hunger, satiety and satiation; dangers of unsafe weight loss schemes; treatment of obesity; attitudes and behaviours toward weight control. Food and Pharmaceutical grades; toxicities, deficiencies, factors affecting bioavailability, Stability under food processing conditions.

                                                          TOTAL : 45 PERIODS

TEXT BOOKS:
1. Chopra, H.K. and P.S. Panesar. " Food Chemistry". Narosa, 2010.
2. Vaclavik, V. A. and Christian E. W. "Essentials of Food Science". II Edition, Kluwer-Academic, Springer, 2003.
3. Mann, Jim and Stewart Truswell "Essentials of Human Nutrition". 3rd Edition. Oxford University Press, 2007.
4. Gibney, Michael J., et al., "Introduction to Human Nutrition". 2nd Edition. Blackwell,2009.
5. Gropper, Sareen S. and Jack L.Smith "Advanced Nutrition and Human Metabolism". 5th Edition. Wadsworth Publishing, 2008.

REFERENCES:
1. Gopalan C., B.V. Rama Sastri, and S.C. Balasubramanian S. C. "Nutritive Value of Indian Foods". NIN, ICMR, 2004.
2. Damodaran, S., K.L. Parkin and O.R. Fennema. "Fennema's Food Chemistry". 4th Edition, CRC Press, 2008
3. Belitz,H.-D, Grosch W and Schieberle P. "Food Chemistry", 3rd Rev. Edition, Springer-Verlag, 2004.
4. Walstra, P. " Physical Chemistry of Foods". Marcel Dekker Inc. 2003.
5. Owusu-Apenten, Richard. "Introduction to Food Chemistry". CRC Press, 2005

OCE552   **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 – ER diagram - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models - OGC standards - Data Quality.

UNIT III   DATA INPUT AND TOPOLOGY   9
Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input –Digitiser – Topology - Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping.

UNIT IV   DATA ANALYSIS   9
Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Education models - 3D data collection and utilisation.

UNIT V   APPLICATIONS   9
GIS Applicant - Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies.

TOTAL: 45 PERIODS

OUTCOME:
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

OPY551   **HERBAL TECHNOLOGY**   **L T P C**
                                                                       3 0 0 3

OBJECTIVES:
- To acquire the basic knowledge of Indian system of medicines.
- To enable the students to know about the plant tissue culture techniques and learn about the instruments used in the extraction, isolation, purification and identification of herbal drugs.

UNIT I   INDIAN SYSTEMS OF MEDICINE   9
Introduction, basic principles and treatment modalities of Ayurveda – Unani – Homeopathy – Siddha –naturopathy- Introduction and streams of Yoga. Classification of herbs - Harvesting – Post harvesting – Conditions of storage.-seasonal and geographical variation.

UNIT II   IN-VITRO CULTURE OF MEDICINAL PLANTS   9
Requirements – Setting up a tissue culture lab – Basic laboratory procedure – Processing of plant tissue culture – Growth profile – Growth measurement – Plant tissue culture methods – Callus culture – Types of tissue culture – Tissue culture of medicinal plants – Applications of plant tissue culture.

UNIT III   PHYTO PHARMACEUTICALS   9
Traditional and modern extraction techniques: Successive solvent extraction- Super critical fluid extraction – Steam distillation – Head space techniques – Sepbox –General extraction process: Carbohydrates – Proteins – Alkaloids –Glycosides. Isolation and purification of phytochemicals (Eg. Quinine from cinchona, vincristine from Vinca, sennoside from senna, Euginol from clove oil.)

UNIT IV   SCREENING METHODS FOR HERBAL DRUGS   9
Screening methods for anti-fertility agents – Antidiabetic drugs – Anti anginal drugs – Diuretic – Analgesic activity – Antipyretic activity – Anti cancer activity –Evaluation of hepatoprotective agents – anticonvulsive- Anti ulcer drugs.

UNIT V   STANDARDIZATION AND CONSERVATION OF HERBAL DRUGS   9
Importance of standardization - Standardization of single drugs and compound formulations – WHO guidelines for the quality assessment herbal drugs - Conservation strategies of medicinal plants – Government policies for protecting the traditional knowledge.

                                                                       TOTAL: 45 PERIODS
OUTCOMES:
The student will be able to
- Understand the basic principle, design, control and processing techniques of medicinal plants and their derivatives.
- Find a solution to problems, including social, scientific and ethical issues connected with the use of medicinal plants in the different field of applications.
- Describe the biological effects of medicinal plants with legislation and governmental policies for conserving medicinal plants.

TEXT BOOKS:
1. Agarwal, S.S. & Paridhavi, M., "Herbal Drug Technology" Universities Press,Pvt Limited, 2007.
2. Wallis, T.E., "Textbook of Pharmacognosy" 5th Edition, CBS Publishers and Distributors,2005.
3. Indian System of Medicine and Homeopathy, Planning and Evaluation Cell, Govt.of India, New Delhi, 2001.
4. Yoga- The Science of Holistic Living by V.K.Yoga, VKY Prakashna Publishing, Bangalore, 2005.
5. Quality Control Methods for medicinal plant material, WHO Geneva, 1998.

REFERENCES:
1. Evans, W.C., "Trease and Evans Pharmacognosy" 15th Edition, Elsevier HealthSciences, 2001.
2. Pulok K. Mukherjee., "Quality control of Herbal Drugs" Reprintedn, Business Horizons, New Delhi, 2012.
3. Daniel, M., "Herbal Technology: Concepts and Advances" Satish Serial PublishingHouse, 2008.

OMD552	HOSPITAL WASTE MANAGEMENT	L T P C
		3 0 0 3

OBJECTIVES:
The student should be made to:
- Know about the healthcare hazard control and accidents
- Understand biomedical waste management
- Learn the facility guidelines, infection control and patient safety.

UNIT I   HEALTHCARE HAZARD CONTROL AND UNDERSTANDING ACCIDENTS   9
Healthcare Hazard Control: Introduction, Hazard Control: Management & Responsibilities, Hazard Analysis, Hazard Correction, Personal Protective Equipment, Hazard Control Committees, Accident Causation Theories, Accident Reporting, Accident Investigations, Accident Analysis, Accident Prevention, Workers' Compensation, Orientation, Education, and Training.

UNIT II   BIOMEDICAL WASTE MANAGEMENT   9
Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling and disposal.

UNIT III   HAZARDOUS MATERIALS   9
Hazardous Materials : Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Respiratory Protection.

UNIT IV   FACILITY SAFETY   9
Introduction, Facility Guidelines: Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Tool Safety, Electrical Safety, Control of Hazardous Energy, Landscape and Ground Maintenance, Fleet and Vehicle Safety.

UNIT V   INFECTION CONTROL, PREVENTION AND PATIENT SAFETY   9
Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, OSHA Bloodborne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Healthcare-Associated Infections, Medication Safety.

TOTAL : 45 PERIODS

OUTCOMES:
After successful completion of the course, the students will be able to know the concepts of healthcare waste management, its prevention and safety.

REFERENCES:
1. Tweedy, James T., Healthcare hazard control and safety management-CRC Press_Taylor and Francis (2014).
2. Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd (2012).

OCH551 **INDUSTRIAL NANOTECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES:
- To elucidate on advantages of nanotechnology based applications in each industry
- To provide instances of contemporary industrial applications of nanotechnology
- To provide an overview of future technological advancements and increasing role of nanotechnology in each industry

UNIT I   NANO ELECTRONICS   9
Advantages of nano electrical and electronic devices –Electronic circuit chips – Lasers - Micro and NanoElectromechanical systems – Sensors, Actuators, Optical switches,- Data memory –Lighting and Displays – Batteries - Fuel cells and Photo-voltaic cells – Electric double layer capacitors – Lead-free solder – Nanoparticle coatings for electrical products.

UNIT II   BIONANOTECHNOLOGY   9
Nanoparticles in bone substitutes and dentistry – Implants and Prosthesis – Nanorobotics in Surgery –Nanosensors in Diagnosis– Neuro-electronic Interfaces– Therapeutic applications.

UNIT III   NANOTECHNOLOGY IN CHEMICAL INDUSTRY   9
Nanocatalyts – Smart materials – Heterogenous nanostructures and composites – Nanostructures for Molecular recognition (Quantum dots, Nanorods, Nanotubes) – Molecular Encapsulation and its applications – Nanoporous zeolites – Self-assembled Nanoreactors.

UNIT IV   NANOTECHNOLOGY IN AGRICULTURE AND FOOD TECHNOLOGY   9
Nanotechnology in Agriculture -Precision farming, Smart delivery system – Insecticides using nanotechnology – Potential of nano-fertilizers - Nanotechnology in Food industry

UNIT V   NANOTECHNOLOGY IN TEXTILES AND COSMETICS   9
Nanofibre production - Electrospinning – Controlling morphologies of nanofibers – Tissue engineering application– Polymer nanofibers - Nylon-6 nanocomposites from polymerization - Nano-filled polypropylene fibers - Nano finishing in textiles (UV resistant, antibacterial, hydrophilic, self-cleaning, flame retardant finishes) – Modern textiles Cosmetics – Formulation of Gels, Shampoos, Hair-conditioners

TOTAL: 45 PERIODS

REFERENCES:
1. Neelina H. Malsch (Ed.),Biomedical Nanotechnology, CRC Press (2005)
2. Udo H. Brinker, Jean-Luc Mieusset (Eds.), Molecular Encapsulation: Organic Reactions in Constrained Systems,Wiley Publishers (2010).
3. Jennifer Kuzma and Peter VerHage, Nanotechnology in agriculture and food production, Woodrow Wilson International Center, (2006).
4. Lynn J. Frewer, Willehm Norde, R. H. Fischer and W. H. Kampers, Nanotechnology in the Agri-food sector, Wiley-VCH Verlag, (2011).
5. P. J. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead Publishing Limited, Cambridge, (2007).
6. Y-W. Mai,Polymer Nano composites, Woodhead publishing, (2006).
7. W.N. Chang,Nanofibres fabrication, performance and applications, Nova Science Publishers Inc, (2009)

OBT551 **INTRODUCTION TO BIOENERGY AND BIOFUELS** **L T P C**
3 0 0 3

OBJECTIVES:
- This course will be focussed on achievement, acquisition of knowledge and enhancement of comprehension of information regarding bioenergy and biofuel technologies and their sustainable applications.

UNIT I CONCEPTS 9
Biopower, Bioheat, Biofuesl, advanced liquid fuels, drop-in fuels, biobased products

UNIT II FEEDSTOCKS 9
Harvested Feedstocks: First generation biofuels, Second generation biofuels, third generation biofuels. Residue Feedstocks: Agricultural wastes, forestry wastes, farm waste, organic components of residential, commercial, institutional and insdustrial waste.

UNIT III CONVERSION TECHNOLOGIES 9
Biorefinery concept – biorefineries and end products, Biochemical conversion – hydrolysis, enzyme and acid hydrolysis, fermentation, anaerobic digestion and trans-esterification, Thermochemical conversion – Combustion, Gasification, Pyrolysis, other thermochemical conversion technologies. Scaling up of emerging technologies.

UNIT IV BIOFUELS 9
Pros and cons of Biofuels, Algal biofuels, Cyanobacteria and producers of biofuels, Jatropha as biodiesel producer, Bioethanol, Biomethane, biohydrogen, biobutanol, metabolic engineering of fuel molecules, Engineering aspects of biofuels, Economics of biofuels

UNIT V SUSTAINABILITY & RESILIENCE 9
Environmental Sustainability, bioenergy sustainability, emissions of biomass to power generation applications, emissions from biofuels. ILUC issues, Carbon footprint, Advanced low carbon fuels

TOTAL :45 PERIODS

TEXTBOOKS:
1. Biorenewable Resources – Engieering new products. Robert C Brown. Blackwell Publishing Professional, 2003.
2. Biofuels. Wim Soetaert and Erik Vandamme (Editors) Wiley. 2009.
3. Biomass for Renewable Energy, Fuels and Chemicals. Donald Klass. Academic press. 1998

REFERENCES:
1. Introduction to Bioenergy.Vaughn C. Nelson and Kenneth L. Starcher.
2. Bioenergy: Biomass to Biofuels by by Anju Dahiya
3. Bioenergy: Principles and Applications by Yebo Li and Samir Kumar Khanal
4. Bioenergy by Judy D. Wall and Caroline S. Harwood
5. Bioenergy: Sustainable Perspectives by Ted Weyland

OME553 **INDUSTRIAL SAFETY ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:
- To provide in depth knowledge in Principles of Environmental safety and its applications in various fields.
- To provide the knowledge of air and water pollution and their control.
- To expose the students to the basics in hazardous waste management.

UNIT I   SAFETY IN METAL WORKING AND WOOD WORKING MACHINES   9
General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards. Inspection of material handling equipments.

UNIT II   SAFETY IN WELDING AND GAS CUTTING   9
Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-colour coding – flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders.

UNIT III   SAFETY IN COLD FORMING AND HOT WORKING OF METALS   9
Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes - Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes, hazards and control measures - Safety in Gas Furnace Operation, Cupola, Crucibles, Ovens, Foundry Health Hazards, Work Environment, Material Handling in Foundries, Foundry Production Cleaning And Finishing Foundry Processes.

UNIT IV   SAFETY IN FINISHING, INSPECTION AND TESTING   9
Heat treatment operations, Electro Plating, Paint Shops, Sand And Shot Blasting, Safety In Inspection And Testing, Dynamic Balancing, Hydro Testing, Valves, Boiler Drums And Headers, Pressure Vessels, Air Leak Test, Steam Testing, Safety In Radiography, Personal Monitoring Devices, Radiation Hazards, Engineering And Administrative Controls, Indian Boilers Regulation.

UNIT V   INDUSTRIAL SAFETY   9
Advances in Industrial Ergonomics and safety, Work and protective clothing, Theory and practice of Industrial safety, Industrial Noise and Vibration, Machine Guarding and Industrial machine safety, Manual material handling, Modeling for safety and health.

TOTAL:45 PERIODS

OUTCOMES:
Students will be able to
- Illustrate and familiarize the basic concepts and scope of engineering safety.
- Understand the standards of professional conduct that are published by professional safety organizations and certification bodies.
- Illustrate the importance of safety of employees while working with machineries.

REFERENCES:
1. Philip E. Hagan, John Franklin Montgomery, James T. O'Reilly, Accident Prevention Manual – NSC, Chicago, 2009.
2. Charles D. Reese, Occupational Health and Safety Management, CRC Press, 2003.
3. John V. Grimaldi and Rollin H. Simonds Safety Management by All India Travelers Book seller, New Delhi, 1989.
4. John Davies, Alastair Ross, Brendan Wallace, Safety Management: A Qualitative Systems Approach, CRC Press, 2003.
5. Health and Safety in welding and Allied processes, welding Institute, UK, High Tech. Publishing Ltd., London, 1989.
6. Anil Mital Advances in Industrial Ergonomics and Safety Taylor and Francis Ltd, London, 1989
7. Dr. Vincent Matthew Ciriello (Prediction of the maximum acceptable weight of lift from the frequency of lift, journal of industrial ergonomics,(2014), pg .225–237

OEI551   LOGIC AND DISTRIBUTED CONTROL SYSTEMS   L T P C
                                                        3 0 0 3

OBJECTIVES:

- To give an introductory knowledge on Programmable Logic Controller (PLC) and their programming languages
- To give adequate knowledge about applications of PLC
- To give basic knowledge about Computer Controlled Systems
- To give basic knowledge on the architecture and local control unit of Distributed Control System (DCS)
- To give adequate information with respect to interfaces used in DCS

UNIT I   PROGRAMMABLE LOGIC CONTROLLER   9
Evolution of PLCs – Components of PLC – Architecture of PLC – Discrete and analog I/O modules – Programming languages -Ladder diagram – Function block diagram (FBD) - Programming timers and counters

UNIT II   APPLICATIONS OF PLC   9
Instructions in PLC – Program control instructions, math instructions, data manipulation Instructions, sequencer and shift register instructions – Case studies in PLC

UNIT III   COMPUTER CONTROLLED SYSTEMS   9
Basic building blocks of computer controlled systems – Data acquisition system – Supervisory control – Direct digital control- SCADA:- Hardware and software, Remote terminal units, Master Station and Communication architectures.

UNIT IV   DISTRIBUTED CONTROL SYSTEM   9
DCS – Various Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities

UNIT V   INTERFACES IN DCS   9
Operator interfaces - Low level and high level operator interfaces – Displays - Engineering interfaces – Low level and high level engineering interfaces – Factors to be considered in selecting DCS – Case studies in DCS

                                                    TOTAL: 45 PERIODS
OUTCOMES:

- Ability to understand and analyze Instrumentation systems and their applications to various industries.
- Ability to understand and analyse, linear and digital electronic circuits.

TEXT BOOKS:
1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2010
2. Michael P. Lukas, *Distributed Control Systems: Their Evaluation and Design*, Van Nostrand Reinhold Co., 1986
3. D. Popovic and V.P.Bhatkar,' Distributed computer control for industrial Automation' Marcel Dekker, Inc., Newyork ,1990.

REFERENCES:
1. T.A. Hughes, Programmable Controllers, Fourth edition, ISA press, 2005
2. Krishna Kant, Computer Based Industrial Control, Second edition, Prentice Hall of India, New Delhi, 2010.
3. John W. Webb and Ronald A. Reis, 'Programmable Logic Controllers, Fifth edition, Prentice Hall of India, New Delhi, 2010.
4. John R. Hackworth and Frederick D. Hackworth Jr, Programmable Logic Controllers, Pearson, New Delhi, 2004.
5. Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3,4. 60870.5 and Related Systems", Newnes, 1st Edition, 2004.
6. E.A.Parr, Programmable Controllers, An Engineer's Guide, Elsevier, 2013.

OBM552   **MEDICAL PHYSICS**   **L T P C**
                                                                          3 0 0 3

OBJECTIVES:
- To study the complete non-ionizing radiations including light and its effect in human body.
- To understand the principles of ultrasound radiation and its applications in medicine.
- To learn about radioactive nuclides and also the interactions of radiation with matters and how isotopes are produced.
- To study the harmful effects of radiation and radiation protection regulations.

UNIT I   NON-IONIZING RADIATION AND ITS MEDICAL APPLICATIONS   9

Introduction to EM waves - Tissue as a leaky dielectric - Relaxation processes: Debye model, Cole–Cole model- Overview of non-ionizing radiation effects-Low Frequency Effects- Higher frequency effects. Physics of light-Measurement of light and its unit- limits of vision and color vision an overview - Applications of ultraviolet in medicine, Thermography.

UNIT II   ULTRASOUND IN MEDICINE   9

Ultrasound fundamentals – Generation of ultrasound (Ultrasound Transducer) - Interaction of Ultrasound with matter: Cavitation, Reflection, Transmission- Scanning systems – Artefacts-Ultrasound- Doppler-Double Doppler shift-Clinical Applications- Ultrasonography.

UNIT III   PRINCIPLES OF RADIOACTIVE NUCLIDES AND DECAY   9

Introduction to Radioisotopes - Radioactive decay : Spontaneous Fission, Isomeric Transition, Alpha Decay, Beta Decay, Positron Decay, Electron Capture- Radioactive decay equations – Half life- Mean Life- Effective half-life - Natural and Artificial radioactivity, - Production of radionuclide – Cyclotron produced Radionuclide - Reactor produced Radionuclide: fission and electron Capture reaction, Target and Its Processing Equation for Production of Radionuclide - Radionuclide Generator-Technetium generator.

UNIT IV   INTERACTION OF RADIATION WITH MATTER   9

Interaction of charged particles with matter –Specific ionization, Linear energy transfer, range, Bremsstrahlung, Annihilation - Interaction of X and Gamma radiation with matter: Photoelectric effect, Compton Scattering, Pair production- Attenuation of Gamma Radiation - Interaction of neutron with matter and their clinical significance- Radionuclide used in Medicine and Technology.

UNIT V   RADIATION EFFECTS AND REGULATIONS   9

Classification of Radiation Damage, Stochastic and Deterministic Effects, Acute Effects of Total Body Irradiation, Long-Term Effects of Radiation, Risk Versus Benefit in Diagnostic Radiology and Nuclear Medicine, Risk of Pregnant Women, Nuclear Regulatory Commission, ALARA Program, Medical Uses of Radioactive Materials, Survey for Contamination and Exposure Rate, Dose Calibrators and Survey Meters, Bioassay, Radioactive Waste Disposal.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Analyze the low frequency and high frequency effects of non-ionizing radiation and physics of light.
- Define various clinical applications based on ultrasound wave.
- Explain the process of radioactive nuclide production using different techniques
- Analyze radiation mechanics involved with various physiological systems
- Outline the detrimental effects of radiation and regulations for radiation safety.

TEXT BOOKS:
1. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, Medical Physics and Biomedical Engineering, 2nd Edition, IOP Publishers.2001. (Unit I & II)
2. Gopal B. Saha, Physics and Radiobiology of Nuclear Medicine, 4th Edition, Springer, 2013. (Unit III & IV)
3. R.Hendee and Russell Ritenour "Medical Imaging Physics", Fourth Edition William, Wiley-Liss, 2002. (Unit V)

REFERENCES:
1. S.Webb " The Physics of Medical Imaging", Taylor and Francis, 1988
2. HyltonB.Meire and Pat Farrant "Basic Ultrasound" John Wiley & Sons, 1995
3. John R Cameran , James G Skofronick "Medical Physics" John-Wiley & Sons. 1978
4. W.J.Meredith and J.B. Massey " Fundamental Physics of Radiology" Third edition ,Varghese Publishinghouse. 1992

OML552	MICROSCOPY	L T P C
		3 0 0 3

OBJECTIVE:
This course will cover the basic principles and techniques of optical and electron microscopy. This course also deals with the sample preparation techniques for the microstructural analysis.

UNIT I   INTRODUCTION   9
History of Microscopy, Overview of current microscopy techniques. Light as particles and waves, Fundamental of optics: Diffraction and interference in image formation, real and virtual images, Resolution, Depth of field and focus, Magnification, Numerical aperture, Aberration of lenses. Components of Light Microscopy, Compound light microscopy and its variations.

UNIT II   MICROSCOPY   9
Phase contrast microscopy: optical design, theory, image interpretation, Dark-field microscopy: optical design, theory , image interpretation, Polarization Microscopy: Polarized light, optical design, theory , image interpretation, Differential Interference Contrast (DIC): equipment and optics, image interpretation, Modulation contrast microscopy: contrast methods using oblique illumination.

UNIT III   ELECTRON MICROSCOPY   9
Interaction of electrons with matter, elastic and inelastic scattering, secondary effects, Components of electron microscopy: Electron sources, pumps and holders, lenses, apertures, and resolution. Scanning Electron and Transmission Electron Microscopy: Principle, construction, applications and limitations.

UNIT IV   SAMPLE PREPARATION FOR MICROSTRUCTURAL ANALYSIS   9
Optical Microscopy sample preparation: Grinding, polishing and etching, SEM sample preparation: size constrains, TEM sample preparation: Disk preparation, electro polishing, ion milling, lithography, storing specimens.

UNIT V   CHEMICAL ANALYSIS   9
Surface chemical composition (Principle and applications) - Mass spectroscopy and X-ray emission spectroscopy - Energy Dispersive Spectroscopy- Wave Dispersive Spectroscopy. Electron spectroscopy for chemical analysis (ESCA), Ultraviolet Photo Electron Spectroscopy (UPS), X ray Photoelectron Spectroscopy (XPS), Auger Electron Spectroscopy (AES)- Applications.

TOTAL: 45 PERIODS

OUTCOMES:
- Able to understand the physics behind the microscopy.
- Ability to describe the principle, construction and working of light microscopy.
- Ability to appreciate about electron microscopy.
- Ability to understand about the important of sample preparation technique.
- Ability to identify the appropriate spectroscopy technique for chemical analysis.

TEXT BOOKS:
1. Douglas B. Murphy, Fundamentals of light microscopy and electronic imaging, 2001, Wiley-Liss, Inc. USA
2. David B. Williams and C. Barry Carter, Transmission Electron Microscopy-A Textbook for Materials Science, Springer US, 2nd edition, 2009.

REFERENCES:
1. Brandon D. G, "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA,1986.
2. Whan R E (Ed), ASM Handbook, Volume 10, Materials Characterisation", Nineth Edition, ASM international, USA, 1986.
3. Thomas G., "Transmission electron microscopy of metals", John Wiley, 1996

OBT554   **PRINCIPLES OF FOOD PRESERVATION**   **L T P C**
                                                                     3 0 0 3
OBJECTIVE:
- The course aims to introduce the students to the area of Food Preservation. This is necessary for effective understanding of a detailed study of food processing and technology subjects.

UNIT I   FOOD PRESERVATION AND ITS IMPORTANCE   9
Introduction to food preservation. Wastage of processed foods; Shelf life of food products; Types of food based on its perishability. Traditional methods of preservation

UNIT II   METHODS OF FOOD HANDLING AND STORAGE   9
Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.retort pouch packing, Aseptic packaging.

UNIT III   THERMAL METHODS   9
Newer methods of thermal processing; batch and continuous; In container sterilization- canning; application of infra-red microwaves; ohmic heating; control of water activity; preservation by concentration and dehydration; osmotic methods

UNIT IV   DRYING PROCESS FOR TYPICAL FOODS   9
Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures. Psychrometric chart, freezing and cold storage.freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages.

UNIT V   NON-THERMAL METHODS   9
Super Critical Technology for Preservation - Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology,

                                                              TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course the students are expected to
- Be aware of the different methods applied to preserving foods.

TEXT BOOKS:
1. Karnal, Marcus and D.B. Lund "Physical Principles of Food Preservation". Rutledge, 2003.
2. VanGarde, S.J. and Woodburn. M "Food Preservation and Safety Principles and Practice".Surbhi Publications, 2001.
3. Sivasankar, B. "Food Processing & Preservation", Prentice Hall of India, 2002.
4. Khetarpaul, Neelam, "Food Processing and Preservation", Daya Publications, 2005.

REFERENCES:
1. Rahman, M. Shafiur. "Handbook of Food Preservation". Marcel & Dekker, 2006.
2. Zeuthen, Peter and Bogh-Sarensen, Leif. "Food Preservation Techniques". CRC / Wood Head Publishing, 2003.
3. Ranganna, S. "Handbook of Canning and Aseptic Packaging". Tata McGraw-Hill, 2000.
4. Ranganna, S. "Handbook of Canning and Aseptic Packaging". Tata McGraw-Hill, 2000.

OMF551 **PRODUCT DESIGN AND DEVELOPMENT** **L T P C**
3 0 0 3

OBJECTIVE:
The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

UNIT I **INTRODUCTION** **9**
Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.

UNIT II **CONCEPT GENERATION AND SELECTION** **9**
Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT III **PRODUCT ARCHITECTURE** **9**
Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

UNIT IV **INDUSTRIAL DESIGN** **9**
Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT V   DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT   9

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

TOTAL: 45 PERIODS

OUTCOME:

- The student will be able to design some products for the given set of applications; also the knowledge gained through prototyping technology will help the student to make a prototype of a problem and hence product design and development can be achieved.

TEXT BOOK:

1. Kari T.Ulrich and Steven D.Eppinger, "Product Design and Development", McGraw-Hill International Edns. 1999.

REFERENCES:

1. Kemnneth Crow, "Concurrent Engg./Integrated Product Development", DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Staurt Pugh, "Tool Design –Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New york, NY.

OAN551	ENSORS AND TRANSDUCERS	L T P C
		3 0 0 3

OBJECTIVES:

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

UNIT I   INTRODUCTION   9

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II   MOTION, PROXIMITY AND RANGING SENSORS   9

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III   FORCE, MAGNETIC AND HEADING SENSORS   9

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV   OPTICAL, PRESSURE AND TEMPERATURE SENSORS   9

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V   SIGNAL CONDITIONING and DAQ SYSTEMS   9

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

TOTAL :   45 PERIODS

OUTCOMES:
The students will be able to
CO1. Expertise in various calibration techniques and signal types for sensors.
CO2. Apply the various sensors in the Automotive and Mechatronics applications
CO3. Study the basic principles of various smart sensors.
CO4. Implement the DAQ systems with different sensors for real time applications

TEXT BOOKS:
1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009.

2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCES
1. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
3. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.

OTL551   **SPACE TIME WIRELESS COMMUNICATION**   **L T P C**
                                                       3 0 0 3

OBJECTIVES:
- To understand the concept of multiple antenna propagation.
- To understand the concept of capacity of frequency flat deterministic MIMO channel.
- To understand the concept of transmitter and receiver diversity technique.
- To design the coding for frequency flat channel.
- To analyze the concept of micro multi user detection.

UNIT I   MULTIPLE ANTENNA PROPAGATION AND ST CHANNEL
                          CHARACTERIZATION   9

Wireless channel – Scattering model in macrocells – Channel as a ST random field – Scattering functions, Polarization and field diverse channels – Antenna array topology – Degenerate channels – reciprocity and its implications – Channel definitions – Physical scattering model – Extended channel model – Channel measurements – sampled signal model – ST multiuser and ST interference channels – ST channel estimation.

UNIT II   CAPACITY OF MULTIPLE ANTENNA CHANNELS   9

Capacity of frequency flat deterministic MIMO channel: Channel unknown to the transmitter – Channel known to the transmitter – capacity of random MIMO channels – Influence of ricean fading – fading correlation – XPD and degeneracy on MIMO capacity – Capacity of frequency selective MIMO channels.

UNIT III   SPATIAL DIVERSITY   9

Diversity gain – Receive antenna diversity – Transmit antenna diversity – Diversity order and channel variability – Diversity performance in extended channels – Combined space and path diversity – Indirect transmit diversity – Diversity of a space-time – frequency selective fading channel.

UNIT IV   MULTIPLE ANTENNA CODING AND RECEIVERS   9

Coding and interleaving architecture – ST coding for frequency flat channels – ST coding for frequency selective channels – Receivers–SISO–SIMO–MIMO–Iterative MIMO receivers – Exploiting channel knowledge at the transmitter: linear pre-filtering – optimal pre-filtering for maximum rate – optimal pre-filtering for error rate minimization – selection at the transmitter – Exploiting imperfect channel knowledge

UNIT V   ST OFDM, SPREAD SPECTRUM AND MIMO MULTIUSER DETECTION   9

SISO-OFDM modulation, MIMO-OFDM modulation – Signaling and receivers for MIMO– OFDM – SISO–SS modulation – MIMO-SS modulation – Signaling and receivers for MIMO – S.MIMO – MAC – MIMO – BC – Outage performance for MIMO-MU – MIMO - MU with OFDM – CDMA and multiple antennas.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course , students would be able to
- Design and analyze the channel characterization.
- Analyze the capacity of random MIMO channel.
- Design and analyze the order diversity and channel variability.
- Analyze the multiple antenna coding and receivers.
- Analyze the MIMO multi user detection

TEXT BOOKS:
1. Sergio Verdu, "Multi User Detection" , Cambridge University Press, 2011
2. A. Paulraj, Rohit Nabar, Dhananjay Gore, "Introduction to Space Time Wireless Communication Systems",   Cambridge University Press , 2008

REFERENCES:
1. Don Tarrieri, " Principles of Spread Spectrum Communication systems" ,Springer, Third edition, 2015

OEC552	SOFT COMPUTING	L T P C
		3 0 0 3

OBJECTIVES:
The student should be made to:
- Classify the various soft computing frame works
- Be familiar with the design of neural networks, fuzzy logic and fuzzy systems
- Learn mathematical background for optimized genetic programming
- Be exposed to neuro-fuzzy hybrid systems and its applications

UNIT I   INTRODUCTION TO SOFT COMPUTING   9

Soft Computing Constituents-From Conventional AI to Computational Intelligence- Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks - basic models - important technologies - applications. Fuzzy logic: Introduction - crisp sets- fuzzy sets - crisp relations and fuzzy relations: cartesian product of relation - classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts.

UNIT II   NEURAL NETWORKS   9

McCulloch-Pitts neuron - linear separability - hebb network - supervised learning network: perceptron networks - adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN-associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hopfield networks, iterative auto associative memory network & iterative associative memory network –unsupervised learning networks: Kohonen self-organizing feature maps, LVQ – CP networks, ART network.

UNIT III   FUZZY LOGIC   9

Membership functions: features, fuzzification, methods of membership value assignments-Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.

UNIT IV   GENETIC ALGORITHM   9

Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts - operators – Encoding scheme – Fitness evaluation – crossover - mutation - genetic programming – multilevel optimization – real life problem- advances in GA .

UNIT V   HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS   9

Neuro-fuzzy hybrid systems - genetic neuro hybrid systems - genetic fuzzy hybrid and fuzzy genetic hybrid systems - simplified fuzzy ARTMAP - Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:
- Apply various soft computing concepts for practical applications
- Choose and design suitable neural network for real time problems
- Use fuzzy rules and reasoning to develop decision making and expert system
- Explain the importance of optimization techniques and genetic programming
- Review the various hybrid soft computing techniques and apply in real time problems

TEXT BOOKS:
1. J.S.R.Jang, C.T. Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI / Pearson Education 2004.
2. S.N.Sivanandam and S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt Ltd, 2011.

REFERENCES:
1. S.Rajasekaran and G.A.Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications", Prentice-Hall of India Pvt. Ltd., 2006.
2. George J. Klir, Ute St. Clair, Bo Yuan, "Fuzzy Set Theory: Foundations and Applications" Prentice Hall, 1997.
3. David E. Goldberg, "Genetic Algorithm in Search Optimization and Machine Learning" Pearson Education India, 2013.
4. James A. Freeman, David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education India, 1991.
5. Simon Haykin, "Neural Networks Comprehensive Foundation" Second Edition, Pearson Education, 2005.

OTL553 **TELECOMMUNICATION NETWORK MANAGEMENT** **L T P C**
                                                                                3 0 0 3

OBJECTIVES:
- To understand the concept of network management standards.
- To design the common management information service element model.
- To understand the various concept of information modelling.
- To analyze the concept of SNMPv1 and SNMPv2 protocol.
- To analyze the concept of examples of network management.

UNIT I   **FOUNDATIONS**   **9**
Network management standards–network management model– organization model– information model abstract syntax notation 1 (ASN.1) – encoding structure– macros–functional model. Network management application functional requirements:Configuration management– fault management–performance management–Error correlation technology– security management–accounting management– common management–report management– polity based management–service level management–management service–community definitions–capturing the requirements– simple and formal approaches–semi formal and formal notations.

UNIT II   **COMMON MANAGEMENT INFORMATION SERVICE ELEMENT**   **9**
CMISE model–service definitions–errors–scoping and filtering features– synchronization–functional units– association services– common management information protocol specification.

UNIT III   **INFORMATION MODELING FOR TMN**   **9**
Rationale for information modeling–management information model–object oriented modeling paradigm– structure of management information–managed object class definition–management information base.

UNIT IV   **SIMPLE NETWORK MANAGEMENT PROTOCOL**   **9**
SNMPv1: managed networks–SNMP models– organization model–information model–SNMPv2 communication model–functional model–major changes in SNMPv2–structure of management information, MIB–SNMPv2 protocol– compatibility with SNMPv1– SNMPv3– architecture–applications–MIB security, remote monitoring–SMI and MIB– RMQN1 and RMON2.

UNIT V   **NETWORK MANAGEMENT EXAMPLES**   **9**
ATM integrated local management interface–ATM MIB–M1– M2–M3– M4– interfaces–ATM digital exchange interface management–digita1 subscriber loop and asymmetric DSL technologies–ADSL configuration management–performance management Network management tools: Network statistics management–network management system–management platform case studies: OPENVIEW–ALMAP.

                                                                    TOTAL: 45 PERIODS
OUTCOMES:
At the end of the course , students would be able to
- Design and analyze of fault management.
- Analyze the common management information protocol specifications.
- Design and analyze of management information model.
- Design the simple network management protocol.
- Design the various types of network management tools.

TEXT BOOKS:
1. Mani Subramanian, "Network Management: Principles and Practice" Pearson Education, Second edition, 2010
2. Lakshmi G Raman, "Fundamentals of Telecommunications Network Management" ,Wiley, 1999

REFERENCES:
1. Henry Haojin Wang, "Telecommunication Network Management", Mc- Graw Hill ,1999
2. Salah Aidarous & Thomas Plevyak, "Telecommunication Network Management: Technologies and Implementations" , Wiley,1997

OMD553   **TELEHEALTH TECHNOLOGY**   **L T P C**
                                                         3 0 0 3

OBJECTIVES:
The student should be made to:
- Learn the key principles for telemedicine and health.
- Understand telemedical technology.
- Know telemedical standards, mobile telemedicine and it applications

UNIT I   TELEMEDICINE AND HEALTH   9
History and Evolution of telemedicine, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT II   TELEMEDICAL TECHNOLOGY   9
Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication, Mobile communication.

UNIT III   TELEMEDICAL STANDARDS   9
Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series Video Conferencing, Security and confidentiality of medical records, Cyber laws related to telemedicine

UNIT IV   MOBILE TELEMEDICINE   9
Tele radiology: Image Acquisition system Display system, Tele pathology, Medical information storage and management for telemedicine- patient information, medical history, test reports, medical images, Hospital information system

UNIT V   TELEMEDICAL APPLICATIONS   9
Telemedicine – health education and self care. · Introduction to robotics surgery, Telesurgery. Telecardiology, Teleoncology, Telemedicine in neurosciences, Business aspects - Project planning and costing, Usage of telemedicine.
                                                         TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Apply multimedia technologies in telemedicine.
- Explain Protocols behind encryption techniques for secure transmission of data.
- Apply telehealth in healthcare.

TEXT BOOK:
1. Norris, A.C. "Essentials of Telemedicine and Telecare", Wiley, 2002

REFERENCES:
1. Wootton, R., Craig, J., Patterson, V. (Eds.), "Introduction to Telemedicine. Royal Society of Medicine" Press Ltd, Taylor & Francis 2006
2. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), "Public Health Informatics and Information Systems", Springer, 2003.
3. Ferrer-Roca, O., Sosa - Iudicissa, M. (Eds.), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54, 2002.
4. Simpson, W. Video over IP. A practical guide to technology and applications. Focal Press Elsevier, 2006.
5. Bemmel, J.H. van, Musen, M.A. (Eds.) Handbook of Medical Informatics. Heidelberg, Germany: Springer, 1997
6. Mohan Bansal " Medical Informatics", Tata McGraw-Hill, 2004.

OTL554   **WAVELETS AND ITS APPLICATIONS**   **L T P C**
                                                                                   3 0 0 3

OBJECTIVES:
* To understand the concept of Fourier transform and short time Fourier transform.
* To understand the concept of continuous time wavelet transform,
* To analyze the concept of interpolation and decimation.
* To understand the types of filter bank.
* To analyze the concept of image compression.

UNIT I   **FOURIER ANALYSIS**   **9**
Fourier basis & Fourier Transform – failure of Fourier Transform – Need for Time-Frequency Analysis – Heisenberg's Uncertainty principle – Short time Fourier transform (STFT) – short comings of STFT– Need for Wavelets

UNIT II   **CWT AND MRA**   **9**
Wavelet basis – Continuous time Wavelet Transform (CWT) – need for scaling function – Multi Resolution Analysis – important wavelets: Haar– Mexican hat– Meyer– Shannon– Daubachies.

UNIT III   **INTRODUCTION TO MULTIRATE SYSTEMS**   **9**
Decimation and Interpolation in Time domain - Decimation and Interpolation in Frequency domain – Multi rate systems for a rational factor.

UNIT IV   **FILTER BANKS AND DWT**   **9**
Two channel filter bank – Perfect Reconstruction (PR) condition – relationship between filter banks and wavelet basis – DWT – Filter banks for Daubachies wavelet function.

UNIT V   **APPLICATIONS**   **9**
Feature extraction using wavelet coefficients– Image compression– interference suppression– Microcalification cluster detection– Edge detection–Faulty bearing signature identification.

                                                       TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course , students would be able to
* Analyze the need for time frequency analysis..
* Design the concept of multi resolution analysis.
* Analyze the multirate system for rational factor.
* Analyze the relationship between the filter bank and wavelet.
* Analyze the application of wavelet.

TEXT BOOK:
1.K.P.Soman , K.I. Ramachandran, N.G. Rasmi,"Insight Into Wavelets: From Theory to Practice" PHI Learning Private Limited, Third Edition, 2010

REFERENCE BOOKS:
1.Sidney Burrus C, " An Introduction to Wavelets " Academic press, 2014
2.Stephane G Mallat, A Wavelet Tour of Signal Processing:The sponse way" Academic Press, Third edition, 2008

OIM551	WORLD CLASS MANUFACTURING	L T P C
		3 0 0 3

OBJECTIVES
- Understanding of the concept and importance of strategy planning for manufacturing industries
- To apply principles and techniques in the identifiable formulation and implementation of manufacturing strategy for competitive in global context.

UNIT I   INDUSTRIAL DECLINE AND ASCENDANCY   9
Manufacturing excellence - US Manufacturers - French Manufacturers - Japan decade – American decade - Global decade

UNIT II   BUILDING STRENGTH THROUGH CUSTOMER – FOCUSED PRINCIPLES   9
Customer - Focused principles - General principles - Design - Operations - Human resources - Quality and Process improvement - Promotion and Marketing

UNIT III   VALUE AND VALUATION   9
Product Costing - Motivation to improve - Value of the enterprises QUALITY - The Organization : Bulwark of stability and effectiveness - Employee stability – Quality Individuals Vs. Teams - Team stability and cohesiveness - Project cohesiveness and stability

UNIT IV   STRATEGIC LINKAGES   9
Product decisions and customer service - Multi-company planning - Internal manufacturing planning - Soothing the demand turbulence

UNIT V   IMPEDIMENTS   9
Bad plant design - Mismanagement of capacity - Production Lines - Assembly Lines – Whole Plant Associates - Facilitators - Teamsmanship - Motivation and reward in the age of continuous Improvement

TOTAL : 45 PERIODS

OUTCOMES:
- Able to understand the concept and the importance of manufacturing strategy for industrial enterprise competitiveness.
- Apply appropriate techniques in the analysis an devaluation of company's opportunities for enhancing competitiveness in the local regional and global context.
- Identify formulation and implement strategies for manufacturing and therefore enterprise competitiveness.

TEXT BOOKS:
1. By Richard B. Chase, Nicholas J. Aquilano, F. Robert Jacobs – "Operations Management for Competitive Advantage", McGraw-Hill Irwin, ISBN 0072323159
2. Moore Ran, "Making Common Sense Common Practice: Models for Manufacturing Excellence", Elsevior Multiworth
3. Narayanan V. K., "Managing Technology & Innovation for Competitive Advantage", Pearson Education Inc.
4. Korgaonkar M. G., "Just In Time Manufacturing", MacMillan Publishers India Ltd.,
5. Sahay B. S., Saxena K. B. C., Ashish Kumar, "World Class Manufacturing", MacMillan Publishers

OAI751   AGRICULTURAL FINANCE, BANKING AND COOPERATION   L T P C
                                                                   3 0 0 3

OBJECTIVES:
- To make the students aware about the agricultural Finance, Banking and Cooperation.
- To acquaint the students with the basic concepts, principles and functions of management.
- To understand the process of finance banking and cooperation.

UNIT I   AGRICULTURAL FINANCE - NATURE AND SCOPE   9
Agricultural Finance: Definition, Importance, Nature and Scope - Agricultural Credit: Meaning, Definition, Need and Classification - Sources of credit - Role of institutional and non - Institutional agencies: Advantages and Disadvantages - Rural indebtedness: consequences of rural indebtedness - History and Development of rural credit in India.

UNIT II   FARM FINANCIAL ANALYSIS   9
Principles of Credit - 5C's, 5R's and & 7P's of Credit - Project Cycle and Management - Preparation of bankable projects / Farm credit proposals - Feasibility - Time value of money: Compounding and Discounting - Appraisal of farm credit proposals - Undiscounted and discounted measures - Repayment plans - Farm Financial Statements: Balance Sheet, Income Statement and Cash Flow statement - Financial Ratio Analysis.

UNIT III   FINANCIAL INSTITUTIONS   9
Institutional Lending Agencies - Commercial banks: Nationalization, Agricultural Development Branches - Area Approach - Priority Sector Lending - Regional Rural Banks, Lead bank, Scale of finance - Higher financial institutions: RBI, NABARD, AFC, ADB, World Bank and Deposit Insurance and Credit Guarantee Corporation of India - Microfinance and its role in poverty alleviation - Self-Help Groups - Non -Governmental Organizations - Rural credit policies followed by State and Central Government - Subsidized farm credit, Differential Interest Rate (DIR), Kisan Credit Card (KCC) Scheme - Relief Measures and Loan Waiver Scheme and Know Your Customer (KYC).

UNIT IV   CO-OPERATION   9
Co-operation: Philosophy and Principles - History of Indian Cooperative Credit Movement: Pre and Post-Independence periods and Cooperation in different plan periods - Cooperative credit institutions: Two tier and three tier structure, Functions: provision of short term and long term credit, Strength and weakness of cooperative credit system, Policies for revitalizing cooperative credit: Salient features of Vaithiyananthan Committee Report on revival of rural cooperative credit institutions, Reorganisation of Cooperative credit structure in Andhra Pradesh and single window system and successful cooperative credit systems in Gujarat, Maharashtra, Punjab etc, - Special cooperatives: LAMPS and FSS: Objectives, role and functions - National Cooperative Development Corporation (NCDC) and National Federation of State Cooperative Banks Ltd., (NAFSCOB) - Objectives and Functions.

UNIT V BANKING AND INSURANCE 9

Negotiable Instruments: Meaning, Importance and Types - Central Bank: RBI - functions - credit control - objectives and methods: CRR, SLR and Repo rate - Credit rationing - Dear money and cheap money - Financial inclusion and Exclusion: Credit widening and credit deepening monetary policies. Credit gap: Factors influencing credit gap - Non - Banking Financial Institutions (NBFI) - Assessment of crop losses, Determination of compensation - Crop insurance: Schemes, Coverage, Advantages and Limitations in implementation - Estimation of crop yields - Livestock, insurance schemes - Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

TOTAL: 45 PERIODS

OUTCOME:
After completion of this course, the students will
* Be familiar with agricultural finance, Banking, cooperation and basic concepts, principles and functions of management.

REFERENCES:

1. Muniraj, R., 1987, Farm Finance for Development, Oxford & IBH, New Delhi
2. Subba Reddy. S and P.Raghu Ram 2011, Agricultural Finance and Management, Oxford & IBH, New Delhi.
3. Lee W.F., M.D. Boehlje A.G., Nelson and W.G. Murray, 1998, Agricultural Finance, Kalyani Publishers, New Delhi.
4. Mammoria, C.B., and R.D. Saxena 1973, Cooperation in India, Kitab Mahal, Allahabad.

OEE751 **BASIC CIRCUIT THEORY** **L T P C**
3 0 0 3

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 introduce Phasor diagrams and analysis of three phase circuits

UNIT I BASIC CIRCUITS ANALYSIS 9
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 CIRCUITS 9
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.

UNITIII AC CIRCUITS 9
Introduction to AC circuits , inductance reactance, capacitive reactance, Phasor diagrams, real power, reactive power, apparent power, power factor, R-L R-C , RLC networks, Network reduction: voltage and current division, source transformation –mesh and node analysis, Thevenins and Norton Theorems – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem – Millman's theorem.

UNIT IV THREE PHASE CIRCUITS 9
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   9

Series and parallel resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to introduce electric circuits and its analysis
- Ability to impart knowledge on solving circuit equations using network theorems
- Ability to introduce the phenomenon of resonance in coupled circuits.
- Ability to introduce Phasor diagrams and analysis of three phase circuits

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.

OBM751   BASICS OF HUMAN ANATOMY AND PHYSIOLOGY   L T P C
3 0 0 3

OBJECTIVES
- To learn the basic components of formation of systems
- To identify all the organelles of an animal cell and their function.
- To understand structure and functions of the various types of systems of human body.
- To demonstrate their knowledge of importance of anatomical features and physiology of human systems

UNIT I   INTRODUCTION   9

Level of Organization – Metabolism and Homeostasis – Plan of Body – Body Parts and Areas, Planes and Sections. Elements in the Human Body – Inorganic Compounds and Organic Compounds

UNIT II   BASIC STRUCTURE AND FUNCTION OF ANIMAL CELL   9

Structure of Cell – Structure and Function of Cell Membrane and Sub organelles. Cellular Transport Mechanism – Cell Division – Mitosis and Meiosis

UNIT III   TISSUES, MEMBRANE AND SKELETAL SYSTEM   9

Epithelial tissue – Connective tissue – Muscle tissue – Nerve tissue – Membrane. Types of Bone tissue - Classification of Bones – Functions of the Skeleton system – Skull, Vertebral Column. Joint - Articulation

UNIT IV   NERVOUS AND CARDIOVASCULAR SYSTEMS   10

Nervous system: Types and Structure of Neuron – Mechanism of Nerve Impulse - Structure and Parts of Brain. **Sensory organ:** Eye and Ear.**Cardiovascular:** Composition of Blood and functions – Structure of Heart – Conduction system of Heart – Types of Blood vessel – Blood Pressure.

UNIT V   DIGESTIVE AND URINARY SYSTEMS   8

Digestive: Organs of Digestive system – Digestion and Absorption. **Urinary:** Structure of Kidney and Nephron – Mechanisms of Urine formation – Regulation of Blood pressure by Urinary System.

TOTAL:45 PERIODS

OUTCOMES

At end of the course

- Students would be familiar with the requirements for formation of systems
- Students would be understand the basic structural and functional elements of human body
- Students would have knowledge on Skeletal and muscular systems
- Students would be able to comprehend circulatory and nervous systems and their components
- Students would study importance of digestive and urinary systems in Human body

TEXT BOOKS:

1. Prabhjot Kaur. Text Book of Anatomy and Physiology. Lotus Publsihers. 2014
2. Elaine.N. Marieb , "Essential of Human Anatomy and Physiology", Eight Edition, Pearson Education, New Delhi 2007
3. Valerie C. Scanlon and Tina Sanders, "Essential of Human Anatomy and Physiology", Fifth Edition, F.A. Davis Company, Philadelphia 2007

REFERENCES:

1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, Fundamentals of Anatomy and Physiology. Tenth Edition, Pearson Publishers, 2014
2. William F.Ganong, "Review of Medical Physiology", 22nd Edition, Mc Graw Hill, New Delhi. 2005
3. Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", Third Edition, W.B. Saunders Company, 2008
4. Guyton & Hall, "Medical Physiology", 13th Edition, Elsevier Saunders, 2015.

COURSE OUTCOMES	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Students would be familiar with the requirements for formation of systems	√								√			√
Students would be understand the basic structural and functional elements of human body	√	√										√
Students would have knowledge on Skeletal and muscular systems	√	√	√									√
Students would be able to comprehend circulatory and nervous systems and their	√	√						√				√

components													
Students would study importance of digestive and urinary systems in Human body	√	√											√

OGI751 **CLIMATE CHANGE AND ITS IMPACT** **L T P C**
3 0 0 3

OBJECTIVES:
- To understand the basics of weather and climate
- To have an insight on Atmospheric dynamics and transport of heat
- To develop simple climate models and evaluate climate changes using models

UNIT I BASICS OF WEATHER AND CLIMATE: 9
Shallow film of Air– stratified & disturbed atmosphere – law – atmosphere Engine. Observation of parameters: Temperature – Humidity – Wind - Pressure – precipitation-surface – networks. Constitution of atmosphere: well stirred atmosphere – process around turbopause – in dry air – ozone – carbon Dioxide – Sulphur Dioxide– Aerosol - water. Evolution of Atmosphere. State of atmosphere: Air temperature – pressure – hydrostatic – Chemistry – Distribution – circulation

UNIT II ATMOSPHERIC DYNAMICS: 9
Atmosphere dynamics: law – isobaric heating and cooling – adiabatic lapse rates – equation of motion - solving and forecasting. Forces – Relative and absolute acceleration – Earth's rotation *coriolis* on sphere – full equation of motion – Geostrophy;- Thermal winds –departures – small-scale motion. Radiation, convection and advections: sun & solar radiation – energy balance – terrestrial radiation and the atmosphere – Green house effect- Global warming - Global budget – radiative fluxes - heat transport. Atmosphere and ocean systems convecting & advecting heat. Surface and boundary layer – smaller scale weather system – larger scale weather system.

UNIT III GLOBAL CLIMATE 9
Components and phenomena in the climate system: Time and space scales – interaction and parameterization problem. Gradients of Radiative forcing and energy transports by atmosphere and ocean – atmospheric circulation – latitude structure of the circulation - latitude – longitude dependence of climate features. Ocean circulation: latitude – longitude dependence of climate features – ocean vertical structure – ocean *thermohaline* circulation – land surface processes – carbon cycle.

UNIT IV CLIMATE SYSTEM PROCESSES 9
Conservation of motion: Force – *coriolis* - pressure gradient- velocity equations – Application – geotropic wind – pressure co-ordinates. Equation of State – atmosphere – ocean. Application: thermal circulation – sea level rise. Temperature equation: Ocean – air – Application – decay of sea surface temperature. Continuity equation: ocean – atmosphere. Application: coastal upwelling – equatorial upwelling – conservation of warm water mass.   Moisture and salinity equation: conservation of mass – moisture. Source & sinks – latent heat. Moist processes – saturation – convection – Wave processes in atmosphere and ocean.

UNIT V CLIMATE CHANGE MODELS 9
Constructing a climate model – climate system modeling – climate simulation and drift – Evaluation of climate model simulation – regional (RCM) – global (GCM) – Global average response to warming – climate change observed to date. .

TOTAL:45 PERIODS

At the end of the course the student will be able to understand
- The concepts of weather and climate
- The principles of Atmospheric dynamics and transport of heat and air mass
- The develop simple climate models and to predict climate change

TEXTBOOKS:
1. Fundamentals of weather and climate (2nd Edition) Robin Moilveen (2010), Oxford University Press
2. Climate change and climate modeling, J. David Neelin (2011) Cambridge University press.

OPY751   **CLINICAL TRIALS**   **L T P C**
                                                                 3 0 0 3

OBJECTIVES:
- To highlight the epidemiologic methods, study design, protocol preparation
- To gain knowledge in the basic bio-statistical techniques involved in clinical research.
- To describe the principles involved in ethical, legal and regulatory issues in clinical trials.

UNIT I   ROLE OF CLINICAL TRIALS IN NEW DRUG DEVELOPMENT   9
Drug Discovery, regulatory guidance and governance, pharmaceutical manufacturing, nonclinical research, clinical trials, post-marketing surveillance, ethical conduct during clinical trials.

UNIT II   FUNDAMENTALS OF TRIAL DESIGN   9
Randomised clinical trials, uncontrolled trials. Protocol development, endpoints, patient selection, source and control of bias, randomization, blinding, sample size and power.

UNIT III   ALTERNATE TRIAL DESIGNS   9
Crossover design, factorial design, equivalence trials, bioequivalence trials, non-inferiority trials, cluster randomized trials, multi-center trials.

UNIT IV   BASICS OF STATISTICAL ANALYSIS   9
Types of data and normal distribution, significance tests and confidence intervals, comparison of means, comparison of proportions, analysis of survival data, subgroup analysis, regression analysis, missing data.

UNIT V   REPORTING OF TRIALS   9
Overview of reporting, trial profile, presenting baseline data, use of tables, figures, critical appraisal of report, meta-analysis.

                                                                 TOTAL: 45 PERIODS
OUTCOMES:
The student will be able to
- Explain key concepts in the design of clinical trials.
- Describe study designs used, identify key issues in data management for clinical trials.
- Describe the roles of regulatory affairs in clinical trials.

TEXT BOOKS:
1. Fundamentals of Clinical Trials, Lawrence M. Friedman, Springer Science & Business Media, 2010
2. Textbook of Clinical Trials, David Machin, Simon Day, Sylvan Green, John Wiley & Sons, 2007
3. Clinical Trials: A Practical Approach, Stuart J. Pocock, John Wiley & Sons, 17-Jul-2013

REFERENCES:
1. Clinical trials, A practical guide to design, analysis and reporting. Duolao Wang and AmeetBakhai. Remedica. 2006.
2. Introduction to statistics in pharmaceutical clinical trials. T.A. Durham and J Rick Turner. Pharmaceutical Press.
3. Clinical Trials: Study Design, Endpoints and Biomarkers, Drug Safety, and FDA and ICH Guidelines, Tom Brody, Academic Press, 2016.

OEC751   **ELECTRONIC DEVICES**   **L   T   P   C**
                                                     3   0   0   3

OBJECTIVES:
The student should be made to:
- Introduce the concept of diodes, Bipolar Junction Transistors and FET
- Study the various model parameters of Transistors
- Learn the concept of special semiconductor devices, Power & Display devices
- Impart the knowledge of various configurations, characteristics and applications.

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 -π 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, Point Contact Diode, p-i-n Diode, Avalanche Photodiode, Schottky barrier diode-Zener diode-Varactor diode –Tunnel diode- Gallium Arsenide device, LASER diode, LDR.

UNIT V   POWER DEVICES AND DISPLAY DEVICES   9
UJT, Thyristor - SCR, Diac, Triac, Power BJT- Power MOSFET- DMOS-VMOS.   LED, LCD, Opto Coupler, Solar cell, CCD.

TOTAL: 45   PERIODS

OUTCOMES:
After this course, the student should be able to:
- Analyze the characteristics of semiconductor diodes.
- Analyze and solve problems of Transistor circuits using model parameters.
- Identify and characterize diodes and various types of transistors.
- Analyze the characteristics of special semiconductor devices.
- Analyze the characteristics of Power and Display devices.

TEXT BOOKS:
1. Millman and Halkias, "Electronic Devices and Circuits", 4th Edition, McGraw Hill, 2015.
2. Mohammad Rashid, "Electronic Devices and Circuits", Cengage Learning Pvt. Ltd, 2015.
3. Salivahanan. S, Suresh Kumar. N, "Electronic Devices and circuits", 4th Edition, McGraw Hill, 2016.

REFERENCES:
1. Donald A Neaman, "Semiconductor Physics and Devices", 4th Edition, McGraw Hill, 2012.
2. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory" Pearson Prentice Hall, 11th Edition, 2014.
3. Bhattacharya and Sharma, "Solid State Electronic Devices", 2nd Edition, Oxford University Press, 2014.
4. R.S.Sedha, "A Textbook of Electronic Devices and Circuits", 2nd Edition, S.Chand Publications, 2008.
5. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.

OML752	ELECTRONIC MATERIALS	L T P C
		3 0 0 3

OBJECTIVE:
- Understanding the various materials and its properties contribution towards electrical and electronics field. This course covers the properties of materials behind the electronic applications.

UNIT I   INTRODUCTION   7
Structure: atomic structures and bonding, types of bonding, band formation. Defects and imperfections in solids: Point, Line and Planer defects; Interfacial defects and volume defects. Classification of materials based on bonding: conductors, semiconductors and insulators.

UNIT II   CONDUCTING MATERIALS   9
Introduction, factors affecting the conductivity of materials, classification based on conductivity of materials, temperature dependence of resistivity, Low resistivity materials (graphite, Al, Cu and steel) and its applications, high resistivity materials (manganin, constantin, nichrome, tungsten) and their applications. Superconductors: Meissner effect, classification and applications.

UNIT III   SEMICONDUCTING AND MAGNETIC MATERIALS   10
Semiconductors: Introduction, types of semiconductors, temperature dependence of semiconductors, compound semiconductors, basic ideas of amorphous and organic semiconductors. Magnetic Materials: classification of magnetic materials, ferromagnetism-B-H curve (Qualitative), hard and soft magnetic materials, magneto materials applications.

UNIT IV   DIELECTRIC AND INSULATING MATERIALS   9
Dielectric Materials: Introduction, classification, temperature dependence on polarization, properties,dielectric loss, factors influencing dielectric strength and capacitor materials, applications. Insulators: Introduction, thermal and mechanical properties required for insulators, Inorganic materials, organic materials, liquid insulators, gaseous insulators and ageing of insulators, applications.

UNIT V   OPTOELECTRONIC ANDNANO ELECTRONIC MATERIALS   10

Optoelectronic materials. Introduction, properties, factor affecting optical properties, role of optoelectronic materials in LEDs, LASERs, photodetectors, solar cells.   Nano electronic Materials: Introduction, advantage of nanoelectronic devices, materials, fabrication, challenges in Nano electronic materials.

TOTAL : 45 PERIODS

OUTCOME:

* With the basis, students will be able to have clear concepts on electronic behaviors of materials

TEXT BOOKS:

1. S.O. Kasap "Principles of Electronic Materials and Devices", 3rd edition, McGraw-Hill Education (India) Pvt. Ltd., 2007.
2. W D Callister, "Materials Science & Engineering – An Introduction", Jr., John Willey & Sons, Inc, New York, 7th edition, 2007.

REFERENCES:

1. B.G. Streetman and S. Banerjee, Solid State Electronic Devices, 6th edition, PHI Learning, 2009.
2. Eugene A. Irene, Electronic Materials Science, Wiley, 2005
3. Wei Gao, Zhengwei Li, Nigel Sammes, An Introduction to Electronic Materials for Engineers, 2nd Edition, World Scientific Publishing Co. Pvt. Ltd., 2011

OCH752   **ENERGY TECHNOLOGY**   **L T P C**
                                                                3 0 0 3

OBJECTIVES

* Students will gain knowledge about different energy sources

UNIT I   ENERGY   8

Introduction to energy – Global energy scene – Indian energy scene - Units of energy, conversion factors, general classification of energy, energy crisis, energy alternatives.

UNIT II   CONVENTIONAL ENERGY   8

Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III   NON-CONVENTIONAL ENERGY   10

Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV   BIOMASS ENERGY   10

Biomass origin - Resources – Biomass estimation. Thermochemical conversion – Biological conversion, Chemical conversion – Hydrolysis & hydrogenation, solvolysis, biocrude, biodiesel power generation gasifier, biogas, integrated gasification.

UNIT V ENERGY CONSERVATION 9

Energy conservation - Act; Energy management importance, duties and responsibilities; Energy audit – Types methodology, reports, instruments. Benchmalcing and energy performance, material and energy balance, thermal energy management.

TOTAL : 45 PERIODS

OUTCOMES:

- Understand conventional Energy sources, Non- conventional Energy sources, biomass sources and develop design parameters for equipment to be used in Chemical process industries. Understand energy conservation in process industries

TEXTBOOKS:

1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.
2. Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.
3. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.
4. Energy Management, Paul W.O'Callaghan McGraw – Hill, 1993

REFERENCES:

1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.
2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.
3. Sukhatme. S.P., Solar Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.
4. Handbook of Energy Audit by 7th edition Albert Thumann, P.E., C.E.M & William J Younger C.E.M, Faiment Press 2008

| OCE751 | 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.

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, flora and fauna - Matrices – Networks – Checklist Methods - Mathematical models for Impact prediction.

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 – Public Hearing-Environmental Clearance

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 – Roads and Bridges – Mass Rapid Transport Systems - Airports - Dams and Irrigation projects - Power plants.

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.

OGI752   FUNDAMENTALS OF PLANETARY REMOTE SENSING   L T P C
3 0 0 3

OBJECTIVES:

- To provide an insight to the basics of planetary Remote Sensing
- To demonstrate how the Remote Sensing technique is applied to explore the surface characteristics of the planets and its environ.

UNIT I   PLANETARY SCIENCE   9

History and inventory of solar system – planet-definition –properties – Formation of solar system. Planetary Atmospheres: composition - thermal structure – clouds – meteorology – photo chemistry – Eddy Diffusion. Surfaces and Interiors: Mineralogy and Petrology – Planetary interiors – surface morphology. Terrestrial planets and the Moon: The moon & Mercury – surface – Atmosphere – Interior – Magnetic Field.

UNIT II   SATELLITE ORBIT   9

Equation of 2 body motion: Energy, orbits and energy – Circular Orbits-EOS Terra-Geosynchronous satellite orbit- orbital elements. Launching Satellites and space probes – Retrograde orbits-Inter planetary Transfer – Hohmann Transfer – Gravity Assist-Cassini-Messenger. Breaking into orbit or landing- Retro Rockets-Aerobraking- Parachutes- Impact.

UNIT III PROPERTIES OF EMR 9

Definition of Remote Sensing – Electro Magnetic Radiation: Electromagnetic Spectrum-Development of EM theory – White Light – Excited hydrogen gas – Quantum physics – Definition. EM Radiation: Properties – Radiant energy – Sun's luminosity calculation. Other Energy: Black body radiation – Plank curve of black body. Properties of EMR: Kinetic energy – Polarization, laws of Max Plank, Wien's and Stephen Boltzmann

UNIT IV RADIOMETRY AND SCATTEROMETRY 9

Radiometry – Radar Altimetry – Effect of surface roughness – Altimetry derived data – Reflectivity – Radiometry and Derived emissivity – Incorporation of data set into image analysis – Introduction to SAR – convolution – bidirectional reflectance distribution – Microwave scatterometry - side looking RADAR , SAR – Interferometry.

UNITV PLANETARY APPLICATION 9

Planetary Imaging Spectroscopy- USGS Tetracoder and Expert system - Mars Global Surveyor Mission (MGS) – Digital Elevation Model(DEM) of Mars – Mars Orbiter Camera (MOC) – Stereo and photoclinometric techniques for DEM.

OUTCOMES:
On completion of the course, the students have
- Exposure to fundamentals of planetary science or orbital mechanics
- The principles of observing the planets
- Knowledge of Remote Sensing methods for determining surface elevation and mapping of planets.

REFERENCES:
1. Fundamental Planetary Science : Physics, Chemistry and Habitability, Jack J. Lissauer, Imke de Pater (2013) Cambridge University Press
2. Physical principles of Remote Sensing, Rees, W.G.(2013) 3rd Edn, Cambridge University Press
3. Radar Remote Sensing of Planetary Surfaces, Bruce A Campbell (2011) Cambridge University Press
4. Remote Sensing Application for Planetary Surfaces, Kumar Deepak (2014) Lambert Publication.

| OEN751 | GREEN BUILDING DESIGN | L T P C |
| | | 3 0 0 3 |

UNIT I ENVIRONMENTAL IMPLICATIONS OF BUILDINGS 9

Energy use, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transportation Energy for Building Materials; Maintenance Energy for Buildings.

UNIT II IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY OF BUILDINGS 9

Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

UNIT III COMFORTS IN BUILDING 9

Thermal Comfort in Buildings- Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings-Implications of Geographical Locations.

UNIT IV   UTILITY OF SOLAR ENERGY IN BUILDINGS   9

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.

UNIT V   GREEN COMPOSITES FOR BUILDINGS   9

Concepts of Green Composites. Water Utilisation in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. Alternative Building Materials and Technologies. New Age International, 2007.
2. Low Energy Cooling For Sustainable Buildings. John Wiley and Sons Ltd, 2009.
3. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

REFERENCES:

1. Osman Attmann Green Architecture Advanced Technologies and Materials. McGraw Hill, 2010.
2. Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.
3. Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke

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OBM752   **HOSPITAL MANAGEMENT**   **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the fundamentals of hospital administration and management.
- To know the market related research process
- To explore various information management systems and relative supportive services.
- To learn the quality and safety aspects in hospital.

UNIT I   OVERVIEW OF HOSPITAL ADMINISTRATION   9

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning

UNIT II   HUMAN RESOURCE MANAGEMENT IN HOSPITAL   9

Principles of HRM – Functions of HRM – Profile of HRD Manager –Human Resource Inventory – Manpower Planning.

UNIT III   RECRUITMENT AND TRAINING   9

Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.

UNIT IV   SUPPORTIVE SERVICES   9

Medical Records Department – Central Sterilization and Supply Department – Pharmacy – Food Services - Laundry Services.

UNIT V   COMMUNICATION AND SAFETY ASPECTS IN HOSPITAL   9

Purposes – Planning of Communication, Modes of Communication – Telephone, ISDN, Public Address and Piped Music – CCTV.Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules.

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Explain the principles of Hospital administration.
- Identify the importance of Human resource management.
- List various marketing research techniques.
- Identify Information management systems and its uses.
- Understand safety procedures followed in hospitals

TEXT BOOKS:
1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI – Fourth Edition, 2006.
2. G.D.Kunders, "Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

REFERENCES:
1. Cesar A.Caceres and Albert Zara, "The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, "Handbook of Health Care Human Resources Management", 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman "Health Sector Reform in Developing Countries" - Harvard University Press, 1995.
4. William A. Reinke "Health Planning For Effective Management" - Oxford University Press.1988
5. Blane, David, Brunner, "Health and SOCIAL Organization: Towards a Health Policy for the 21st Century", Eric Calrendon Press 2002.
6. Arnold D. Kalcizony & Stephen M. Shortell, "Health Care Management", 6th Edition Cengage Learning, 2011.

OEE752	INTRODUCTION TO RENEWABLE ENERGY SYSTEMS	L T P C
		3 0 0 3

OBJECTIVES:
To Provide knowledge
- About the stand alone and grid connected renewable energy systems.
- Design of power converters for renewable energy applications.
- Wind electrical generators and solar energy systems.
- Power converters used for renewable energy systems.

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: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT II   ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION   9
Reference theory fundamentals-principle of operation and analysis: IG and PMSG

UNIT III   POWER CONVERTERS   9
Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Wind: Three phase AC voltage controllers

UNIT IV   ANALYSIS OF WIND AND PV SYSTEMS   9

Stand alone operation of fixed and variability speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system

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

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.
- Ability to handle the engineering aspects of electrical energy generation and utilization.
- Ability to understand the stand alone and grid connected renewable energy systems.
- Ability to design of power converters for renewable energy applications.
- Ability to acquire knowledge on wind electrical generators and solar energy systems.
- Ability to design power converters used for hybrid renewable energy systems.

TEXT BOOK:

1. S. N. Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.
2. B.H.Khan Non-conventional Energy sources Tata McGraw-hill Publishing Company, New Delhi,2009.

REFERENCES:

1. Rashid .M. H "power electronics Hand book", Academic press, 2001.
2. Ion Boldea, "Variability speed generators", Taylor & Francis group, 2006.
3. Rai. G.D, "Non conventional energy sources", Khanna publishes, 1993.
4. Gray, L. Johnson, "Wind energy system", prentice hall linc, 1995.
5. Andrzej M. Trzynnadlowski, 'Introduction to Modern Power Electronics', Second edition, wiley India Pvt. Ltd, 2012.

OBT753	INTRODUCTION OF CELL BIOLOGY	L T P C
		3 0 0 3

AIM

- To provide knowledge on cell structure and its function.

UNIT I   CELL STRUCTURE   9

Cell organization, structure of organelles, extra cellular matrix and cell junctions.

UNIT II   CELL ORGANELLE AND FUNCTION   9

Nuclues, Mitochondria, Lysosomes, Endoplasmic reticulum, Golgi apparatus, vesicles, centrosomes, cell membranes, ribosomes, cytosol, chloroplasts, flagella, cell wall.

UNIT III   DIVISION   9

Cell cycle – mitosis, meiosis, cell cycle regulation and apoptosis.

UNIT IV   MACROMOLECULES   9

DNA, RNA and Proteins – basic units, architectural hierarchy and organisation, functions.

UNIT V   ENZYMES   9

Enzymes – Structure, Mechanism of action, Factors that affect enzyme activity, Common enzymes used in industrial setup of plant and animal origin.

TOTAL : 45 PERIODS

TEXT BOOKS
1. Lodish, Harvey etal., "Molecular Cell Biology", 5 th Edition, W.H.Freeman, 2005.
2. Cooper, G.M. and R.E. Hansman "The Cell : A Molecular Approach", 4 th Edition, ASM Press, 2007.
3. Alberts, Bruce etal., "Molecular Biology of the Cell", 4 th Edition, Garland Science (Taylors Francis), 2002.

REFERENCES
1. McDonald, F etal., " Molecular Biology of Cancer" 2nd Edition, Taylor & Francis, 2004.
2. King, Roger J.B. "Cancer Biology" Addison Wesley Longman, 1996.

OMF751	LEAN SIX SIGMA	L T P C
		3 0 0 3

OBJECTIVE:
- To gain insights about the importance of lean manufacturing and six sigma practices.

UNIT I   LEAN & SIX SIGMA BACKGROUND AND FUNDAMENTALS   9
Historical Overview – Definition of quality – What is six sigma -TQM and Six sigma - lean manufacturing and six sigma- six sigma and process tolerance – Six sigma and cultural changes – six sigma capability – six sigma need assessments - implications of quality levels, Cost of Poor Quality (COPQ), Cost of Doing Nothing – assessment questions

UNIT II   THE SCOPE OF TOOLS AND TECHNIQUES   9
Tools for definition – IPO diagram, SIPOC diagram, Flow diagram, CTQ Tree, Project Charter – Tools for measurement – Check sheets, Histograms, Run Charts, Scatter Diagrams, Cause and effect diagram, Pareto charts, Control charts, Flow process charts, Process Capability Measurement, Tools for analysis – Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, Five Whys, interrelationship diagram, overall equipment effectiveness, TRIZ innovative problem solving – Tools for improvement – Affinity diagram, Normal group technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis – Tools for control – Gantt chart, Activity network diagram, Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.

UNIT III   SIX SIGMA METHODOLOGIES   9
Design For Six Sigma (DFSS),Design For Six Sigma Method - Failure Mode Effect Analysis (FMEA), FMEA process - Risk Priority Number (RPN)- Six Sigma and Leadership, committed leadership – Change Acceleration Process (CAP)- Developing communication plan – Stakeholder

UNIT IV   SIX SIGMA IMPLEMENTATION AND CHALLENGES   9
Tools for implementation – Supplier Input Process Output Customer (SIPOC) – Quality Function Deployment or House of Quality (QFD) – alternative approach –implementation – leadership training, close communication system, project selection – project management and team – champion training – customer quality index – challenges – program failure, CPQ vs six sigma, structure the deployment of six sigma – cultural challenge – customer/internal metrics

UNIT V   EVALUATION AND CONTINUOUS IMPROVEMENT METHODS   9
Evaluation strategy – the economics of six sigma quality, Return on six Sigma (ROSS), ROI, poor project estimates – continuous improvement – lean manufacturing – value, customer focus, Perfection, focus on waste, overproduction – waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people – Kaizen – 5S

TOTAL: 45 PERIODS

OUTCOME:
- The student would be able to relate the tools and techniques of lean sigma to increase productivity

REFERENCES:

1. Michael L.George, David Rownalds, Bill Kastle, What is Lean Six Sigma, McGraw – Hill 2003
2. Thomas Pyzdek, The Six Sigma Handbook, McGraw-Hill,2000
3. Fred Soleimannejed , Six Sigma, Basic Steps and Implementation, AuthorHouse, 2004
4. Forrest W. Breyfogle, III, James M. Cupello, Becki Meadows, Managing Six Sigma:A Practical Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line Success, John Wiley & Sons, 2000
5. James P. Womack, Daniel T.Jones, Lean Thinking, Free Press Business, 2003

OAN751	LOW COST AUTOMATION	L T P C
		3 0 0 3

OBJECTIVES
- To give basic knowledge about automation
- To understand the basic hydraulics and pneumatics systems for automation
- To understand the assembly automation

UNIT I   AUTOMATION OF ASSEMBLY LINES   9
Concept of automation - mechanization and automation - Concept of automation in industry - mechanization and automation - classification, balancing of assembly line using available algorithms - Transfer line-monitoring system (TLMS) using Line Status - Line efficiency - Buffer stock Simulation in assembly line

UNIT II   AUTOMATION USING HYDRAULIC SYSTEMS   9
Design aspects of various elements of hydraulic systems such as pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc. - Selection of hydraulic fluid, practical case studied on hydraulic circuit design and performance analysis - Servo valves, electro hydraulic valves, proportional valves and their applications.

UNIT III   AUTOMATION USING PNEUMATIC SYSTEMS   9
Pneumatic fundamentals - control elements, position and pressure sensing -logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods – step counter method - compound circuit design - combination circuit design. Pneumatic equipments - selection of components - design calculations -application - fault finding – hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

UNIT IV   AUTOMATION USING ELECTRONIC SYSTEMS   9
Introduction - various sensors – transducers - signal processing - servo systems - programming of microprocessors using 8085 instruction - programmable logic controllers

UNIT V   ASSEMBLY AUTOMATION   9
Types and configurations - Parts delivery at workstations - Various vibratory and non vibratory devices for feeding - hopper feeders, rotary disc feeder, centrifugal and orientation - Product design for automated assembly.

TOTAL : 45 PERIODS

OUTCOMES:
- Upon completion of this course, the students can able to do low cost automation systems
- Students can do some assembly automation

TEXT BOOKS:
1. Anthony Esposito, "Fluid Power with applications", Prentice Hall international, 2009.
2. Mikell P Groover, "Automation, Production System and Computer Integrated
3. Manufacturing", Prentice Hall Publications, 2007.

REFERENCES
1. Kuo .B.C, "Automatic control systems", Prentice Hall India, New Delhi, 2007.
2. Peter Rohner, "Industrial hydraulic control", Wiley Edition, 1995.
3. Mujumdar.S.R, "Pneumatic System", Tata McGraw Hill 2006

OEC754	MEDICAL ELECTRONICS	L	T	P	C
		3	0	0	3

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, PO2, PCO2, 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. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TATA Mc Graw-Hill, New Delhi, 2003.

REFERENCES:
1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.
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.

OEC756   **MEMS AND NEMS**   **L T P C**
                                                                                       3 0 0 3

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 nanosystems

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

OBT752	MICROBIOLOGY	L T P C
		3 0 0 3

OBJECTIVE
*   To introduce students to the principles of Microbiology ,to emphasize the structure and biochemical aspects of various microbes.

UNIT I   INTRODUCTION TO MICROBIOLOGY   9
classification and nomenclature of microorganisms, microscopic examination of microorganisms: light, fluorescent, dark field, phase contrast, and electron microscopy.

UNIT II   MICROBES- STRUCTURE AND REPRODUCTION   9
Structural organization and multiplication of bacteria, viruses (TMV, Hepatitis B), algae (cyanophyta, rhodophyta) and fungi (Neurospora), life history of actinomycetes (Streptomyces), yeast (Sacharomyces), mycoplasma (M. pneumoniae) and bacteriophages (T4 phage, ʎ phage)

UNIT III   MICROBIAL NUTRITION, GROWTH AND METABOLISM   9
Nutritional classification of microorganisms based on carbon, energy and electron sourcesDefinition of growth, balanced and unbalanced growth, growth curve and different methods to quantify bacterial growth:(counting chamber, viable count method, counting without equipment,different media used for bacterial culture (defined, complex, selective, differential, enriched) themathematics of growth-generation time, specific growth rate.

UNIT IV   CONTROL OF MICROORGANISMS   9
Physical and chemical control of microorganisms Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation, ultrasonication, filtration. Disinfection sanitization, antiseptics sterilants and fumigation. mode of action and resistance to antibiotics; clinically important microorganisms

UNIT V   INDUSTRIAL MICROBIOLOGY   9
Microbes involved in preservation (Lactobacillus,bacteriocins), spoilage of food and food borne pathogens *(E.coli, S.aureus, Bacillus, Clostridium)*. Industrial use of microbes (production of penicillin, alcohol, vitamin B-12); biogas; bioremediation(oil spillage leaching of ores by microorganisms ,pollution control); biofertilizers, biopesticides. Biosensors.

TOTAL: 45 PERIODS

OUTCOMES:
*   To provide to the students the fundamentals of Microbiology , the scope of microbiology and solve the problems in microbial infection and their control,

TEXT BOOKS:
1. Pelczar, M.J. "Microbiology", 5th Edition, Tata McGraw-Hill, 1993.
2. Prescot. Harley, Klein. " Microbiology ": McGraw-Hill Higher Education, 2008
3. Ananthanarayanan, R. and C.K. Jayaram Paniker, "Textbook of Microbiology",4th Edition, Orient Longman, 1990.

OCH751   **PROCESS MODELING AND SIMULATION**   **L T P C**
                                                                             3 0 0 3

OBJECTIVE:
- To give an overview of various methods of process modeling, different computational techniques for simulation.

UNIT I   INTRODUCTION   7
Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.

UNIT II   STEADY STATE LUMPED SYSTEMS   9
Degree of freedom analysis, single and network of process units, systems yielding linear and non-linear algebraic equations, flow sheeting – sequential modular and equation oriented approach, tearing, partitioning and precedence ordering, solution of linear and non-linear algebraic equations.

UNIT III   UNSTEADY STATE LUMPED SYSTEMS   9
Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash and distillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems.

UNIT IV   STEADY STATE DISTRIBUTED SYSTEM   7
Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.

UNIT V   UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER
**   MODELLING APPROACHES   13**
Analysis laminar flow in pipe, sedimentation, boundary layer flow, conduction, heat exchanger, heat transfer in packed bed, diffusion, packed bed adsorption, plug flow reactor. Empirical modeling, parameter estimation, population balance and stochastic modeling.

                                                                    TOTAL : 45 PERIODS
OUTCOME:
- Upon completing the course, the student should have understood the development of process models based on conservation principles and process data and computational techniques to solve the process models.

TEXT BOOKS:
1. Ramirez, W.; " Computational Methods in Process Simulation ", 2nd Edn., Butterworths Publishers, New York, 2000.
2. Luyben, W.L., " Process Modelling Simulation and Control ",2nd Edn, McGraw-Hill Book Co., 1990

REFERENCES:
1. Felder, R. M. and Rousseau, R. W., " Elementary Principles of Chemical Processes ", John Wiley, 2000.
2. Franks, R. G. E., " Mathematical Modelling in Chemical Engineering ", John Wiley, 1967.
3. Amiya K. Jana,"Process Simulation and Control Using ASPEN", 2nd Edn,PHI Learning Ltd (2012).
4. Amiya K. Jana,"ChemicalProcess Modelling and Computer Simulation" 2nd Edn,PHI Learning Ltd,(2012).

OIE751   **ROBOTICS**   **L T P C**
                                                                                                      3 0 0 3

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   6
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   12
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   13
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   5
RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

                                                                           TOTAL: 45 PERIODS
OUTCOME:
- Upon completion of this course, the students can able to apply the basic engineering knowledge for the design of robotics

TEXT BOOKS:
1. Klafter R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall, 2003.
2. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2001.

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., 1994.
3. Koren Y., "Robotics for Engineers", Mc Graw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.
5. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill, 1995.
6. Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company, 2008.
7. Surender Kumar, "Industrial Robots and Computer Integrated Manufacturing", Oxford and IBH Publishing Co. Pvt. Ltd., 1991.

OEC753	SIGNALS AND SYSTEMS	L	T	P	C
		4	0	0	4

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: (L:45+T:15): 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.

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.

OME752	**SUPPLY CHAIN MANAGEMENT**	L	T	P	C
		3	0	0	3

OBJECTIVE:
- To provide an insight on the fundamentals of supply chain networks, tools and techniques.

UNIT I   INTRODUCTION   9
Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain - Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles.

UNIT II   SUPPLY CHAIN NETWORK DESIGN   9
Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions.

UNIT III   LOGISTICS IN SUPPLY CHAIN   9
Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation.

UNIT IV   SOURCING AND COORDINATION IN SUPPLY CHAIN   9
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.

UNIT V   SUPPLY CHAIN AND INFORMATION TECHNOLOGY   9
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

OUTCOME:
- The student would understand the framework and scope of supply chain networks and functions.

TEXTBOOK:
1. Sunil Chopra, Peter Meindl and Kalra, "Supply Chain Management, Strategy, Planning, and Operation", Pearson Education, 2010.

REFERENCES:
1. Jeremy F.Shapiro, "Modeling the Supply Chain", Thomson Duxbury, 2002.
2. Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management, PHI, 2010
3. David J.Bloomberg , Stephen Lemay and Joe B.Hanna, "Logistics", PHI 2002.
4. James B.Ayers, "Handbook of Supply Chain Management", St.Lucle press, 2000.

OME753   **SYSTEMS ENGINEERING**   **L T P C**
                                                                      3 0 0 3

OBJECTIVE:
- To introduce system engineering concepts to design the manufacturing system for optimum utilization of source for effective functioning.

UNIT I   INTRODUCTION   9
Definitions of Systems Engineering, Systems Engineering Knowledge, Life cycles, Life-cycle phases, logical steps of systems engineering, Frame works for systems engineering.

UNIT II   SYSTEMS ENGINEERING PROCESSES   9
Formulation of issues with a case study, Value system design, Functional analysis, Business Process Reengineering, Quality function deployment, System synthesis, Approaches for generation of alternatives.

UNIT III   ANALYSIS OF ALTERNATIVES- I   9
Cross-impact analysis, Structural modeling tools, System Dynamics models with case studies, Economic models: present value analysis – NPV, Benefits and costs over time, ROI, IRR; Work and Cost breakdown structure,

UNIT IV   ANALYSIS OF ALTERNATIVES–II   9
Reliability, Availability, Maintainability, and Supportability models; Stochastic networks and Markov models, Queuing network optimization, Time series and Regression models, Evaluation of large scale models

UNIT V   DECISION ASSESSMENT   9
Decision assessment types, Five types of decision assessment efforts, Utility theory, Group decision making and Voting approaches, Social welfare function; Systems Engineering methods for Systems Engineering Management,

                                                          TOTAL : 45 PERIODS

OUTCOMES:
- The Student must be able to apply systems engineering principles ot make decision for optimization.
- Hence an understanding of the systems engineering discipline and be able to use the core principles and processes for designing effective system.

TEXT BOOK:
1.   Andrew P. Sage, James E. Armstrong Jr. "Introduction to Systems Engineering", John Wiley and Sons, Inc,2000.

OTL751   TELECOMMUNICATION SYSTEM MODELING AND SIMULATION   L T P C
                                                                    3 0 0 3

OBJECTIVES:
- To gain knowledge in modeling of different communication systems.
- To know the techniques involved in performance estimation of telecommunication systems.
- To learn the use of random process concepts in telecommunication system simulation.
- To study the modeling methodologies of a telecommunication system.
- To study about the QAM digital radio link environment.

UNIT I   SIMULATION OF RANDOM VARIABLES RANDOM PROCESS   9
Generation of random numbers and sequence – Gaussian and uniform random numbers
Correlated random sequences – Testing of random numbers generators – Stationary and
uncorrelated noise – Goodness of fit test.

UNIT II   MODELING OF COMMUNICATION SYSTEMS   9
Radio frequency and optical sources – Analog and Digital signals – Communication channel
and model – Free space channels – Multipath channel and discrete channel noise and
interference.

UNIT III   ESTIMATION OF PERFORMANCE MEASURE FOR SIMULATION   9
Quality of estimator – Estimation of SNR – Probability density function and bit error rate – Monte
Carlo method – Importance sampling method – Extreme value theory.

UNIT IV   SIMULATION AND MODELING METHODOLOGY   9
Simulation environment – Modeling considerations – Performance evaluation techniques – Error
source simulation – Validation.

UNIT V   CASE STUDIES   9
Simulations of QAM digital radio link environment – Light wave communication link – Satellite
system**.**

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course , students would be able to
- Apply the constituents of a telecommunication systems.
- Analyze various modeling methodologies and simulation techniques.
- Estimate the performance measures of telecommunication systems.
- Apply system modeling in telecommunication.
- Demonstrate light wave communication and satellite communication systems.

TEXTBOOKS:
1. Jeruchim MC   Balaban P Sam K Shanmugam, " Simulation of communication Systems:
   Modeling, Methodology and Techniques", Plenum press , New York,2002
2. Jerry banks & John S Carson, " Discrete Event System Simulation",Prentice Hall of
   India,1996

REFERENCES:
1. Averill M Law, "Simulation Modeling and Analysis",McGraw-Hill Inc,2007
   Geoffrey Gorden, "System Simulation",Prentice Hall of India,1992
2.Turin W, "Performance Analysis of Digital Communication Systems", Computer Science
   Press, New York,1990

OCY751   WASTE WATER TREATMENT   L T P C
3 0 0 3
OBJECTIVES
- To make the student conversant with the water treatment methods including adsorption and
  oxidation process.
- To provide basic under standings about the requirements of water, its preliminary treatment.

UNIT I   WATER QUALITY AND PRELIMINARY TREATMENT   9
Water Quality-physical- chemical and biological parameters of water- water quality requirement -
potable water standards -wastewater effluent standards -water quality indices. Water purification
systems in natural systems- physical processes-chemical processes and biological processes-
primary, secondary and tertiary treatment-Unit operations-unit processes. Mixing, clarification -
sedimentation; Types; aeration and gas transfer – coagulation and flocculation, coagulation
processes - stability of colloids - destabilization of colloids- transport of colloidal particles,
clariflocculation.

UNIT II INDUSTRIAL WATER TREATMENT 9

Filtration – size and shape characteristics of filtering media – sand filters hydraulics of filtration – design considerations – radial, upflow, highrate and multimedia filters, pressure filter. Water softening – lime soda, zeolite and demineralization processes – industrial water treatment for boilers.

UNIT III CONVENTIONAL TREATMENT METHODS 9

Taste and odour control – adsorption – activated carbon treatment – removal of color – iron and manganese removal – aeration, oxidation, ion exchange and other methods – effects of fluorides – fluoridation and defluoridation –desalination - corrosion prevention and control – factors influencing corrosion – Langelier index – corrosion control measures.

UNIT IV WASTEWATER TREATMENT 9

Wastewater treatment – pre and primary treatment – equalization neutralization – screening and grid removal – sedimentation – oil separation gas stripping of volatile organics – biological oxidation – lagoons and stabilization basins – aerated lagoons – activated sludge process – trickling filtration – anaerobic decomposition.

UNIT V ADSORPTION AND OXIDATION PROCESSES 9

Chemical process – adsorption – theory of adsorption – ion exchange process – chemical oxidation – advanced oxidation process – sludge handling and disposal – miscellaneous treatment processes.

TOTAL: 45 PERIODS

OUTCOMES

- Will have knowledge about adsorption and oxidation process.
- Will gain idea about various methods available for water treatment.
- Will appreciate the necessity of water and acquire knowledge of preliminary treatment.

TEXTBOOKS:

1. Metcalf and Eddy, "Wastewater Engineering", 4th ed., McGraw Hill Higher Edu., 2002.
2. W. Wesley Eckenfelder, Jr., "Industrial Water Pollution Control", 2nd Edn., McGraw Hill Inc., 1989.

REFERENCES:

1. S.P. Mahajan, "Pollution control in process industries", 27th Ed. Tata McGraw Hill Publishing Company Ltd., 2012.
2. M. Lancaster, "Green Chemistry: An Introductory Text", 2nd edition, RSC publishing, 2010.
3. C.S. Rao, "Environmental Pollution Control Engineering", New Age International, 2007.

ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
B.E. ELECTRICAL AND ELECTRONICS ENGINEERING
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM
OPEN ELECTIVES (Offered by Other Branches)

V SEMESTER
OPEN ELECTIVE I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OCY551	Advanced Engineering Chemistry	OE	3	3	0	0	3
2.	OCE551	Air Pollution and Control Engineering	OE	3	3	0	0	3
3.	OAT551	Automotive Systems	OE	3	3	0	0	3
4.	OIT551	Database Management Systems	OE	3	3	0	0	3
5.	OIT552	Cloud Computing	OE	3	3	0	0	3
6.	OMF551	Product Design and Development	OE	3	3	0	0	3
7.	OAN551	Sensors and Transducers	OE	3	3	0	0	3
8.	OME552	Vibration and Noise Control	OE	3	3	0	0	3
9.	OMD551	Basics of Biomedical Instrumentation	OE	3	3	0	0	3

VII SEMESTER
OPEN ELECTIVE II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OBT751	Analytical Methods and Instrumentation	OE	3	3	0	0	3
2.	OME751	Design of Experiments	OE	3	3	0	0	3
3.	OCS752	Introduction to C Programming	OE	3	3	0	0	3
4.	OCH751	Process Modeling and Simulation	OE	3	3	0	0	3
5.	OEC753	Signals and Systems	OE	4	4	0	0	4
6.	OML751	Testing of Materials	OE	3	3	0	0	3

OCY551   **ADVANCED ENGINEERING CHEMISTRY**   **L T P C**
                                                                      3 0 0 3

OBJECTIVES:

- To make the students conversant with basics of polymer chemistry
- Principles of electrochemical reactions, redox reactions in corrosion of materials and methods for corrosion prevention and protection of materials.
- To acquaint the student with concepts of important photophysical and photochemical processes and spectroscopy.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To acquaint the students with the basics of nano materials, their properties and applications.

UNIT I   **POLYMERS AND SPECIALITY POLYMER**   **9**
Polymers – Types of polymerization – degree of polymerization – plastics and types – mechanism of polymerization (free radical mechanism) properties of polymers - Tg and tacticity – compounding of plastics – fabrication of plastics – Blow and extrusion mouldings. Speciality polymers-conducting polymers: polyacetylene, polyaniline, synthesis, mechanism of conduction – applications of conducting polymers. Bio-degradable polymers: requirements, factors affecting degradation – PLA– preparation, properties –applications.

UNIT II   **ELECTROCHEMISTRY, CORROSION AND PROTECTIVE COATINGS**   **9**
Electrode potential – Nernst equation, numerical problems – Emf series, applications, electrochemical cells, galvanic cells, electrolytic concentration cells – Emf measurement problems. Corrosion: dry & wet corrosion – mechanism, factors affecting corrosion - corrosion control, material selection and design aspects – corrosion protection – sacrificial anode and impressed current methods. Protective coatings: Metallic coatings – electroplating of Cu - electroless plating of Ni. Organic coatings: Paints - constituents and function, special paints – water repellant, heat resistant and luminous paints.

UNIT III   **PHOTOCHEMISTRY & ANALYTICAL TECHNIQUES**   **9**
Photochemistry: Laws of photochemistry - Grothuss–Draper law, Stark–Einstein law and Beer-Lambert's Law. Quantum efficiency – determination - photophysical processes (Jablonski diagram) - photosensitization - chemiluminescence and bioluminescence. Analytical techniques: IR, UV – principle, Instrumentation and applications.Thermal analysis: TGA & DTA - principle, instrumentation and applications.
Chromatography: Basic principles of column & TLC – principles and applications.

UNIT IV   **THERMODYNAMICS**   **9**
Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function- Helmholtz and Gibbs free energy functions (problems); criteria of spontaneity; Gibbs-Helmholtz equation (problems); Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore (problems).

UNIT V   **NANOCHEMISTRY**   **9**
Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties (surface to volume ratio, melting point, optical and electrical). nanoparticles, nanocluster, nanorod, nanotube (CNT: SWNT and MWNT) and nanowire, synthesis - precipitation, thermolysis,

hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation, sol-gel process and applications (electronic and biomedical). Fullerenes: Types - C_{60} - preparation, properties and applications.

TOTAL: 45 PERIODS

OUTCOMES

- The knowledge gained on polymer chemistry, thermodynamics. spectroscopy, phase rule and nano materials will provide a strong platform to understand the concepts on these subjects for further learning.

TEXT BOOKS
1. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.
2. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013
3. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd.,2012.

REFERENCES
1. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
2. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015
3. B. K. Sharma, "Engineering Chemistry", Krishna Prakashan Media (P) Ltd, Meerut, 2012

OCE551   **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.

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 - Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators.

UNIT IV   CONTROL OF GASEOUS CONTAMINANTS   11
Factors affecting Selection of Control Equipment – Working principle - absorption, Adsorption, condensation, Incineration, Bio filters – Process control and Monitoring.

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.

**OAT551   AUTOMOTIVE SYSTEMS   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

UNITI   AUTOMOTIVE ENGINE AUXILIARY SYSTEMS   9
Automotive engines- External combustion engines –Internal combustion engines -classification of engines- SI Engines- CI Engines- two stroke engines -four stroke engines- construction and working principles - IC engine components- functions and materials -valve timing –port timing diagram- Injection system -Unit injector system- Rotary distributor type - Electronically

controlled injection system for SI engines-CI engines-Ignition system - Electronic ignition system -Transistorized ignition system, capacitive discharge ignition system.

UNIT II   VEHICLE FRAMES AND STEERING SYSTEM   9
Vehicle construction and different Chassis layouts –classifications of chassis- types of frames- frameless chassis construction –articulated vehicles- vehicle body - Vehicle aerodynamics-various resistances and its effects - steering system –conventional – sophisticated vehicle- and types of steering gear box-Power Steering- Steering geometry-condition for true rolling motion-Ackermann's- Devi's steering system - types of stub axle – Types of rear axles.

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 –- Hotchkiss Drive and Torque Tube Drive- rear axle- Differential-wheels and tyres.

UNIT IV   SUSPENSION AND BRAKES SYSTEMS   9
 Suspension Systems- conventional Suspension Systems -independent Suspension Systems –leaf spring – coil spring –taper-lite - eligo,s spring Types of brakes -Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control. Derive the equation of Forces acting while applying a brakes on plain surface - inclined road-gradient .

UNITV   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. Turbo chargers -Engine emission control by three way catalytic converter system.
Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

TOTAL: 45 PERIODS

OUTCOMES:
- Upon completion of this course, the students will be able to identify the different components in automobile engineering.
- Have clear understanding on different auxiliary and transmission systems usual.

TEXT BOOKS:
1. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2007.
2. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.
3. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 1997.

REFERENCES:
1.Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
2.Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.
3.Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart –Will Cox Company Inc, USA ,1978.
4.Newton ,Steeds and Garet, "Motor Vehicles", Butterworth Publishers,1989.

OIT551   **DATABASE MANAGEMENT SYSTEMS**   **L T P C**
                                                                                    3 0 0 3

OBJECTIVES
- To learn the fundamentals of data models
- To learn conceptual modeling using ER diagrams.
- To study SQL queries and database programming
- To learn proper designing of relational database.
- To understand database security concepts
- To understand Information retrieval techniques

UNIT I   DBMS AND CONCEPTUAL DATA MODELING   9
Purpose of Database System – Data independence - Data Models – Database System Architecture –
Conceptual Data modeling: ER models - Enhanced-ER Model. Introduction to relational databases –
Relational Model – Keys – ER-to-Relational Mapping. Modeling of a library management system.

UNIT II   DATABASE QUERYING   11
Relational Algebra – SQL: fundamentals – DDL – Specifying integrity constraints - DML – Basic
retrieval queries in SQL - Complex SQL retrieval queries – nested queries – correlated queries – joins
- aggregate functions. Creating a table, populating data, adding integrity constraints, querying tables
with simple and complex queries.

UNIT III   DATABASE PROGRAMMING   7
Database programming with function calls, stored procedures - views – triggers. Embedded SQL.
ODBC connectivity with front end tools. Implementation using ODBC/JDBC and SQL/PSM,
implementing functions, views, and triggers in MySQL / Oracle.

UNIT IV   DATABASE DESIGN   9
Functional Dependencies – Design guidelines –   Normal Forms: first, second, third – Boyce/Codd
Normal Form –   Normalization algorithms. Design of a banking database system / university
database system.

UNIT V   ADVANCED TOPICS   9
Database security issues – Discretionary access control – role based access – Encryption and public
key infrastructures – challenges. 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:
- understand relational data model, evolve conceptual model of a given problem, its mapping to
  relational model and Normalization
- query the relational database and write programs with database connectivity
- understand the concepts of database security and information retrieval systems

TEXT BOOKS:
1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems",   Sixth Edition ,
   Pearson, 2011.
2. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Sixth
   Edition, Tata McGraw Hill, 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 Systems‖, Fourth Edition, McGraw-Hill College Publications, 2015.

OIT552	CLOUD COMPUTING	LT P C
		3 0 0 3

OBJECTIVES:
- To learn about the concept of cloud and utility computing.
- 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 TO CLOUD COMPUTING   9
Introduction to Cloud Computing – Roots of Cloud Computing – Desired Features of Cloud Computing – Challenges and Risks – Benefits and Disadvantages of Cloud Computing.

UNIT II   VIRTUALIZATION   9
Introduction to Virtualization Technology – Load Balancing and Virtualization – Understanding Hypervisor – Seven Layers of Virtualization – Types of Virtualization – Server, Desktop, Application Virtualization.

UNIT III   CLOUD ARCHITECTURE, SERVICES AND STORAGE   9
NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage.

UNIT IV   RESOURCE MANAGEMENT AND SECURITY IN CLOUD   9
Inter Cloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Challenges – Data Security –Application Security – Virtual Machine Security.

UNIT V   CASE STUDIES   9
Google App Engine(GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services(AWS) – GAE Applications – Cloud Software Environments – Eucalyptus – Open Nebula – Open Stack.

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.
- Choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

TEXT BOOKS:
1. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", First Edition, John Wiley & Sons, 2011.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. 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.

OMF551 **PRODUCT DESIGN AND DEVELOPMENT** **L T P C**
3 0 0 3

OBJECTIVE:
  ☐The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

UNIT I **INTRODUCTION** **9**
Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.

UNIT II **CONCEPT GENERATION AND SELECTION** **9**
Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT III **PRODUCT ARCHITECTURE** **9**
Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

UNIT IV **INDUSTRIAL DESIGN** **9**
Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial

design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT V   DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT   9
Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

TOTAL: 45 PERIODS

OUTCOME:
- The student will be able to design some products for the given set of applications; also the knowledge gained through prototyping technology will help the student to make a prototype of a problem and hence product design and development can be achieved.

TEXT BOOK:
1. Kari T.Ulrich and Steven D.Eppinger, "Product Design and Development", McGraw-Hill International Edns. 1999.

REFERENCES:
1. Kemnneth Crow, "Concurrent Engg./Integrated Product Development", DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Staurt Pugh, "Tool Design –Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New york, NY.

      OAN551   **SENSORS AND TRANSDUCERS**   **L T P C**
                                                                                3 0 0 3

OBJECTIVES:
- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

UNIT I   INTRODUCTION   9
Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II   MOTION, PROXIMITY AND RANGING SENSORS   9
Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III   FORCE, MAGNETIC AND HEADING SENSORS   9
Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto

resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV   OPTICAL, PRESSURE AND TEMPERATURE SENSORS   9
Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V   SIGNAL CONDITIONING and DAQ SYSTEMS   9
Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

TOTAL :   45 PERIODS

OUTCOMES:
The students will be able to
CO1. Expertise in various calibration techniques and signal types for sensors.
CO2. Apply the various sensors in the Automotive and Mechatronics applications
CO3. Study the basic principles of various smart sensors.
CO4. Implement the DAQ systems with different sensors for real time applications

TEXT BOOKS:
1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCES
1. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
3. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.

OME552   **VIBRATION AND NOISE CONTROL**   **L T P C**
3 0 0 3

OBJECTIVES:
The student will be able to understand
- Basic about the noise and its control methods
- the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components
- About the noise in the automotive sources
- Various control techniques in controlling noise and vibrations.
- Know about the source of noise

UNIT I   BASICS OF VIBRATION   9
Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force,

analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

UNIT II   BASICS OF NOISE   9
Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT III   AUTOMOTIVE NOISE SOURCES   9
Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tire noise, brake noise.

UNIT IV   CONTROL TECHNIQUES   9
Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT V   SOURCE OF NOISE AND CONTROL   9
Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

TOTAL: 45 PERIODS

OUTCOMES:
- Understand the basic of noise and vibrations.
- Understanding causes, source and types of vibrations in machineries
- Gaining knowledge in sources and measurement standard of noise
- Ability to design and develop vibrations and noise control systems.
- Ability to know techniques in controlling the noise and vibrations.

TEXT BOOK:
1. Singiresu S.Rao, "Mechanical Vibrations", 5th Edition, Pearson Education, 2010

REFERENCES:
1. Benson H. Tongue, "Principles of Vibrations", 2nd Edition, Oxford University, 2007
2. David Bies and Colin Hansen, "Engineering Noise Control – Theory and Practice",4th Edition, E and FN Spon, Taylore & Francise e-Library, 2009
3. William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, "Theory of Vibration with Application", 5th Edition Pearson Education, 2011
4. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros., 1996
5. Bernard Challen and Rodica Baranescu - "Diesel Engine Reference Book", Second Edition, SAE International, 1999.
6. Julian Happian-Smith - "An Introduction to Modern Vehicle Design"- Butterworth-Heinemann, 2004
7. Rao, J.S and Gupta, K., "Introductory course on Theory and Practice of Mechanical Vibration", 2nd Edition, New Age International Publications, 2010
8. Shabana. A.A., "Theory of vibrations – An introduction", 2nd Edition, Springer, 2010
9. Balakumar Balachandran and Edward B. Magrab, "Fundamentals of Vibrations", 1st Editon, Cengage Learning, 2009
10. John Fenton, "Handbook of Automotive body Construction and Design Analysis – Professional Engineering Publishing, 1998

OMD551   **BASICS OF BIOMEDICAL INSTRUMENTATION**   **L T P C**
                                                                              3 0 0 3
OBJECTIVES:
   • To study about the different bio potential and its propagation
   • To understand the different types of electrodes and its placement for various recording
   • To study the design of bio amplifier for various physiological recording
   • To learn the different measurement techniques for non-physiological parameters.
   • To familiarize the different biochemical measurements.

CO-PO MAPPING:

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				✓		✓					
CO2				✓		✓					
CO3	✓	✓	✓	✓	✓	✓					
CO4			✓	✓	✓	✓					
CO5			✓	✓	✓	✓					

UNIT I   BIO POTENTIAL GENERATION AND ELECTRODES TYPES   9
Origin of bio potential and its propagation. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes

UNIT II   BIOSIGNAL CHARACTERISTICS AND ELECTRODECONFIGURATIONS   9
Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode.

UNIT III   SIGNAL CONDITIONING CIRCUITS   9
Need for bio-amplifier - differential bio-amplifier, Impedance matching circuit, isolation amplifiers, Power line interference, Right leg driven ECG amplifier, Band pass filtering

UNIT IV   MEASUREMENT OF NON-ELECTRICALPARAMETERS   10
Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, direct methods: electronic manometer, Systolic, diastolic pressure, Blood flow and cardiac output measurement: Indicator dilution, and dye dilution method, ultrasound blood flow measurement.

UNIT V   BIO-CHEMICAL MEASUREMENT   8
Blood gas analyzers and Non-Invasive monitoring, colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

                                                                TOTAL: 45 PERIODS
OUTCOMES:
At the end of the course, the student should be able to:
   CO1: To Learn the different bio potential and its propagation.
   CO2: To get Familiarize the different electrode placement for various physiological
          recording
   CO3: Students will be able design bio amplifier for various physiological recording
   CO4: Students will understand various technique non electrical physiological measurements

CO5: Understand the different biochemical measurements

TEXT BOOKS:
1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
2. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2004. (Units I, II & V)

REFERENCES:
1. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill Publisher, 2003.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.(Units II & IV)
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

OBT751   ANALYTICAL METHODS AND INSTRUMENTATION   L T P C
3 0 0 3

UNIT I   SPECTROMETRY   9
Properties of electromagnetic radiation- wave properties – components of optical instruments– Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Applications.

UNIT II   MOLECULAR SPECTROSCOPY   9
Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence –Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications.

UNIT III   NMR AND MASS SPECTROMETRY   9
Theory of NMR — chemical shift- NMR-spectrometers – applications of 1H and 13C NMR- Molecular mass spectra – ion sources.

Mass spectrometer. Applications of molecular mass - Electron paramagnetic resonance- g values – instrumentation.

UNIT IV   SEPARATION METHODS   9
General description of chromatography – Band broadening and optimization of column performance- Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography- principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

13

UNIT V   ELECTRO ANALYSIS AND SURFACE MICROSCOPY   9

Electrochemical cells- Electrode potential cell potentials – p**otentiometry**- reference electrode – ion selective and molecular selective electrodes – Instrument for potentiometric studies – **Voltametry** – Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – **Scanning probe microscopes – AFM and STM**.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch "Instrumental Methods of Analysis".Cengage Learning , 2007.
2. Willard, Hobart, etal., "Instrumental Methods of Analysis". VIIth Edition, CBS, 1986.
3. Braun, Robert D. " Introduction to Instrumental Analysis". Pharma Book Syndicate, 1987.
4. Ewing,G.W. "Instrumental Methods of Chemical Analysis", Vth Edition, McGraw-Hill, 1985

REFERENCE

1. Sharma, B.K. "Instrumental Methods of Chemical Analysis : Analytical Chemistry" GoelPublishing House, 1972.
2. Haven, Mary C., etal., "Laboratory Instrumentation ". IVth Edition, John Wiley, 1995.

OME751   DESIGN OF EXPERIMENTS   L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge on various types of experimental designs conduct of experiments and data analysis techniques.

UNIT I   FUNDAMENTALS OF EXPERIMENTAL DESIGNS   9
Hypothesis testing – single mean, two means, dependant/ correlated samples – confidence intervals, Experimentation – need, Conventional test strategies, Analysis of variance, F-test, terminology, basic principles of design, steps in experimentation – choice of sample size – Normal and half normal probability plot – simple linear and multiple linear regression, testing using Analysis of variance.

UNIT II   SINGLE FACTOR EXPERIMENTS   9
Completely Randomized Design- effect of coding the observations- model adequacy checking- estimation of model parameters, residuals analysis- treatment comparison methods-Duncan's multiple range test, Newman-Keuel's test, Fisher's LSD test, Tukey's test- testing using contrasts- Randomized Block Design – Latin Square Design- Graeco Latin Square Design – Applications.

UNIT III   FACTORIAL DESIGNS   9
Main and Interaction effects - Two and three factor full factorial designs- Fixed effects and random effects model - Rule for sum of squares and Expected Mean Squares- 2^K Design with two and three factors- Yate's Algorithm- fitting regression model- Randomized Block Factorial Design - Practical applications.

UNIT IV   SPECIAL EXPERIMENTAL DESIGN   9

Blocking and Confounding in 2^K Designs- blocking in replicated design- 2^K Factorial Design in two blocks- Complete and partial confounding- Confounding 2^K Design in four blocks- Two level Fractional Factorial Designs- one-half fraction of 2^K Design, design resolution, Construction of one-half fraction with highest design resolution, one-quarter fraction of 2^K Design

UNIT V   TAGUCHI METHODS   9

Design of experiments using Orthogonal Arrays, Data analysis from Orthogonal experiments- Response Graph Method, ANOVA- attribute data analysis- Robust design- noise factors, Signal to noise ratios, Inner/outer OA design.

TOTAL: 45 PERIODS

OUTCOME:
- Able to apply experimental techniques to practical problems to improve quality of processes / products by optimizing the process / product parameters.

TEXT BOOK:
1. Krishnaiah K, and Shahabudeen P, "Applied Design of Experiments and Taguchi Methods", PHI, India, 2011.

REFERENCES:
1. Douglas C. Montgomery, "Design and Analysis of Experiments", John Wiley & sons, 2005
2. Phillip J. Ross, "Taguchi Techniques for Quality Engineering", Tata McGraw-Hill, India, 2005.

OCS752	**INTRODUCTION TO C PROGRAMMING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES
- To develop C Programs using basic programming constructs
- To develop C programs using arrays and strings
- To develop applications in C using functions and structures

UNIT I   INTRODUCTION   9

Structure of C program – Basics: Data Types – Constants –Variables - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements – Decision-making statements - Switch statement - Looping statements – Pre-processor directives - Compilation process – Exercise Programs: Check whether the required amount can be withdrawn based on the available amount – Menu-driven program to find the area of different shapes – Find the sum of even numbers
Text Book: Reema Thareja (Chapters 2,3)

UNIT II   ARRAYS   9

Introduction to Arrays – One dimensional arrays: Declaration – Initialization - Accessing elements – Operations: Traversal, Insertion, Deletion, Searching - Two dimensional arrays: Declaration – Initialization - Accessing elements – Operations: Read – Print – Sum – Transpose – Exercise Programs: Print the number of positive and negative values present in the array – Sort the numbers using bubble sort - Find whether the given is matrix is diagonal or not.
Text Book: Reema Thareja (Chapters 5)

UNIT III   STRINGS   9
Introduction to Strings - Reading and writing a string - String operations (without using built-in string functions): Length – Compare – Concatenate – Copy – Reverse – Substring – Insertion – Indexing – Deletion – Replacement – Array of strings – Introduction to Pointers – Pointer operators – Pointer arithmetic - Exercise programs: To find the frequency of a character in a string - To find the number of vowels, consonants and white spaces in a given text - Sorting the names.
Text Book: Reema Thareja (Chapters 6 & 7)

UNIT IV   FUNCTIONS   9
Introduction to Functions – Types: User-defined and built-in functions - Function prototype - Function definition - Function call - Parameter passing: Pass by value - Pass by reference - Built-in functions (string functions) – Recursive functions – Exercise programs: Calculate the total amount of power consumed by 'n' devices (passing an array to a function) – Menu-driven program to count the numbers which are divisible by 3, 5 and by both (passing an array to a function) – Replace the punctuations from a given sentence by the space character (passing an array to a function)
Text Book: Reema Thareja (Chapters 4)

UNIT V   STRUCTURES   9
Introduction to structures – Declaration – Initialization – Accessing the members – Nested Structures – Array of Structures – Structures and functions – Passing an entire structure – Exercise programs: Compute the age of a person using structure and functions (passing a structure to a function) – Compute the number of days an employee came late to the office by considering his arrival time for 30 days (Use array of structures and functions)
Text Book: Reema Thareja (Chapters 8)

                                                                                              TOTAL:45 PERIODS
OUTCOMES
Upon completion of this course, the students will be able to
- Develop simple applications using basic constructs
- Develop applications using arrays and strings
- Develop applications using functions and structures

TEXT BOOK
1. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016

REFERENCES:
1. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
2. Paul Deitel and Harvey Deitel, "C How to Program", Seventh edition, Pearson Publication
3. Juneja, B. L and Anita Seth, "Programming in C", CENGAGE Learning India pvt. Ltd., 2011
4. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009

OCH751   **PROCESS MODELING AND SIMULATION**   **L T P C**
                                                                                     3 0 0 3
OBJECTIVE:
- To give an overview of various methods of process modeling, different computational techniques for simulation.

UNIT I   INTRODUCTION   7
Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.

UNIT II   STEADY STATE LUMPED SYSTEMS   9
Degree of freedom analysis, single and network of process units, systems yielding linear and non-linear algebraic equations, flow sheeting – sequential modular and equation oriented approach, tearing, partitioning and precedence ordering, solution of linear and non-linear algebraic equations.

UNIT III   UNSTEADY STATE LUMPED SYSTEMS   9
Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash and distillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems.

UNIT IV   STEADY STATE DISTRIBUTED SYSTEM   7
Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.

UNIT V   UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER
**   MODELLING APPROACHES   13**
Analysis laminar flow in pipe, sedimentation, boundary layer flow, conduction, heat exchanger, heat transfer in packed bed, diffusion, packed bed adsorption, plug flow reactor. Empirical modeling, parameter estimation, population balance and stochastic modeling.

                                                                        TOTAL : 45 PERIODS
OUTCOME:
- Upon completing the course, the student should have understood the development of process models based on conservation principles and process data and computational techniques to solve the process models.

TEXT BOOKS:
1. Ramirez, W.; " Computational Methods in Process Simulation ", 2nd Edn., Butterworths Publishers, New York, 2000.
2. Luyben, W.L., " Process Modelling Simulation and Control ",2nd Edn, McGraw-Hill Book Co., 1990

REFERENCES:
1. Felder, R. M. and Rousseau, R. W., " Elementary Principles of Chemical Processes ", John

Wiley, 2000.
2. Franks, R. G. E., " Mathematical Modelling in Chemical Engineering ", John Wiley, 1967.
3. Amiya K. Jana,"Process Simulation and Control Using ASPEN", 2nd Edn,PHI Learning Ltd (2012).
4. Amiya K. Jana,"ChemicalProcess Modelling and Computer Simulation" 2nd Edn,PHI Learning Ltd,(2012).

OEC753	SIGNALS AND SYSTEMS	L	T	P	C
		4	0	0	4

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: (L:45+T:15): 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

18

TEXT BOOK:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, 2015.

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.

OML751   **TESTING OF MATERIALS**   **L T P C**
                                                                                      3 0 0 3

OBJECTIVE:
To understand the various destructive and non destructive testing methods of materials and its industrial applications.

UNIT I   INTRODUCTION TO MATERIALS TESTING   9
Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.

UNIT II   MECHANICAL TESTING   9
Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT III   NON DESTRUCTIVE TESTING   9
Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT IV   MATERIAL CHARACTERIZATION TESTING   9
Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT V   OTHER TESTING   9
Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo-mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.

                                                                      TOTAL: 45 PERIODS
OUTCOMES:
1. Identify suitable testing technique to inspect industrial component

2. Ability to use the different technique and know its applications and limitations

TEXT BOOKS:
1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Cullity, B. D., "Elements of X-ray diffraction", 3rd Edition, Addison-Wesley Company Inc., New York, 2000.
3. P. Field Foster, "The Mechanical Testing of Metals and Alloys" 7th Edition, Cousens Press, 2007.

REFERENCES:
1. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.
2. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA.
3. Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.

ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
B.E. ELECTRONICS AND COMMUNICATION ENGINEERING
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM
OPEN ELECTIVES(Offered by Other Branches)
SEMESTER V
OPEN ELECTIVE - I

SL. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OCE551	Air Pollution and Control Engineering	OE	3	3	0	0	3
2.	OMD551	Basic of Biomedical Instrumentation	OE	3	3	0	0	3
3.	OBM551	Bio Chemistry	OE	3	3	0	0	3
4.	OIT552	Cloud Computing	OE	3	3	0	0	3
5.	OIT551	Database Management Systems	OE	3	3	0	0	3
6.	OTL552	Digital Audio Engineering	OE	3	3	0	0	3
7.	OME551	Energy Conservation and Management	OE	3	3	0	0	3
8.	OBT553	Fundamentals of Nutrition	OE	3	3	0	0	3
9.	OCE552	Geographic Information System	OE	3	3	0	0	3
10.	OPY551	Herbal Technology	OE	3	3	0	0	3
11.	OMD552	Hospital Waste Management	OE	3	3	0	0	3
12.	OCH551	Industrial Nanotechnology	OE	3	3	0	0	3
13.	OBT551	Introduction to Bioenergy and Biofuels	OE	3	3	0	0	3
14.	OEI551	Logic and Distributed Control Systems	OE	3	3	0	0	3
15.	OBM552	Medical Physics	OE	3	3	0	0	3
16.	OML552	Microscopy	OE	3	3	0	0	3
17.	OEI552	SCADA System and Applications Management	OE	3	3	0	0	3
18.	OBT554	Principles of Food Preservation	OE	3	3	0	0	3
19.	OMF551	Product Design and Development	OE	3	3	0	0	3
20.	ORO551	Renewable Energy Sources	OE	3	3	0	0	3
21.	OCS551	Software Engineering	OE	3	3	0	0	3
22.	OTL551	Space Time Wireless Communication	OE	3	3	0	0	3
23.	OTL553	Telecommunication Network Management	OE	3	3	0	0	3
24.	OMD553	Telehealth Technology	OE	3	3	0	0	3
25.	OTL554	Wavelets and its Applications	OE	3	3	0	0	3
26.	OIM551	World Class Manufacturing	OE	3	3	0	0	3

SEMESTER VII

OPEN ELECTIVE - II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OAI751	Agricultural Finance, Banking and Co-operation	OE	3	3	0	0	3
2.	OBM751	Basics of Human Anatomy and Physiology	OE	3	3	0	0	3
3.	OGI751	Climate Change and its Impact	OE	3	3	0	0	3
4.	OPY751	Clinical Trials	OE	3	3	0	0	3
5.	OCS751	Data Structures and Algorithms	OE	3	3	0	0	3
6.	OME751	Design of Experiments	OE	3	3	0	0	3
7.	OCH752	Energy Technology	OE	3	3	0	0	3
8.	OCE751	Environmental and Social Impact Assessment	OE	3	3	0	0	3
9.	OGI752	Fundamentals of Planetary Remote Sensing	OE	3	3	0	0	3
10.	OEN751	Green Building Design	OE	3	3	0	0	3
11.	OBM752	Hospital Management	OE	3	3	0	0	3
12.	OME754	Industrial Safety	OE	3	3	0	0	3
13.	OCS752	Introduction to C Programming	OE	3	3	0	0	3
14.	OBT753	Introduction of Cell Biology	OE	3	3	0	0	3
15.	OMF751	Lean Six Sigma	OE	3	3	0	0	3
16.	OAN751	Low Cost Automation	OE	3	3	0	0	3
17.	OBT752	Microbiology	OE	3	3	0	0	3
18.	OMV751	Marine Vehicles	OE	3	3	0	0	3
19.	OAE752	Principles of Flight Mechanics	OE	3	3	0	0	3
20.	OIE751	Robotics	OE	3	3	0	0	3
21.	OME752	Supply Chain Management	OE	3	3	0	0	3
22.	OME753	Systems Engineering	OE	3	3	0	0	3
23.	OTL751	Telecommunication System Modeling and Simulation	OE	3	3	0	0	3
24.	OML751	Testing of Materials	OE	3	3	0	0	3
25.	OIC751	Transducer Engineering	OE	3	3	0	0	3
26.	OCY751	Waste Water Treatment	OE	3	3	0	0	3

OCE551   **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.

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 - Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators.

UNIT IV   CONTROL OF GASEOUS CONTAMINANTS   11
Factors affecting Selection of Control Equipment – Working principle - absorption, Adsorption, condensation, Incineration, Bio filters – Process control and Monitoring.

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.

OMD551   **BASICS OF BIOMEDICAL INSTRUMENTATION**   **L T P C**
                                                                                          3 0 0 3

OBJECTIVES:
- To study about the different bio potential and its propagation
- To understand the different types of electrodes and its placement for various recording
- To study the design of bio amplifier for various physiological recording
- To learn the different measurement techniques for non-physiological parameters.
- To familiarize the different biochemical measurements.

CO-PO MAPPING:

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				✓		✓					
CO2				✓		✓					
CO3	✓	✓	✓	✓	✓	✓					
CO4			✓	✓	✓	✓					
CO5			✓	✓	✓	✓					

UNIT I   BIO POTENTIAL GENERATION AND ELECTRODES TYPES   9
Origin of bio potential and its propagation. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes

UNIT II   BIOSIGNAL CHARACTERISTICS AND ELECTRODECONFIGURATIONS   9
Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode.

UNIT III   SIGNAL CONDITIONING CIRCUITS   9
Need for bio-amplifier - differential bio-amplifier, Impedance matching circuit, isolation amplifiers, Power line interference, Right leg driven ECG amplifier, Band pass filtering

UNIT IV   MEASUREMENT OF NON-ELECTRICALPARAMETERS   10
Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, direct methods: electronic manometer, Systolic, diastolic pressure, Blood flow and cardiac output measurement: Indicator dilution, and dye dilution method, ultrasound blood flow measurement.

UNIT V   BIO-CHEMICAL MEASUREMENT   8
Blood gas analyzers and Non-Invasive monitoring, colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

                                                               TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- CO1: To Learn the different bio potential and its propagation.
- CO2: To get Familiarize the different electrode placement for various physiological recording
- CO3: Students will be able design bio amplifier for various physiological recording
- CO4: Students will understand various technique non electrical physiogical measurements
- CO5: Understand the different biochemical measurements

TEXT BOOKS:
1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice hall of India, New Delhi, 2007.
2. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, New York, 2004. (Units I, II & V)

REFERENCES:
1. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill Publisher, 2003.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, New Delhi, 2003.(Units II & IV)
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

OBM551   **BIO CHEMISTRY**   **L T P C**
3 0 0 3

OBJECTIVE:
- To study the structural and functional properties of carbohydrates, proteins, lipids and nucleic acids
- To discuss the impairments in metabolism of the above, including inborn errors of metabolism.

UNIT I   BIOLOGICAL PRINCIPLE   8
Composition & properties of the cell membrane, membrane transports, permeability Coefficient & partition coefficient, body fluids, electrolytes, acid-base balance, blood viscosity and Newtonian nature, colloids, filtration, diffusion, osmosis, dialysis, ultrafiltration, ultracentrifugation, cellular fractionation, electrophoresis, radioimmunoassay, Photochemical reaction, law of photochemistry, fluorescence and phosphorescence.

UNIT II   MACROMOLECULES   10
Classification and functions of carbohydrates, glycolysis, TCA cycle, Blood Sugar analysis and glucose tolerance test, Classification and functions of proteins, architecture of proteins, Classification of amino acids, Oxidative and non oxidative deamination, transamination, decarboxylation, urea cycle, Purification/separation of proteins, Classification and functions of lipids, biosynthesis of long chain fatty acids, oxidation and degradation of fatty acids.

UNIT III   ENZYMES   9
Chemical Nature, General Properties, Spectrophotometric measurement of enzymes, Isolation techniques, Diagnostic enzymes.

Hormones: Chemical Nature, Properties of hormones, Hormonal Assay and their Significance.

UNIT IV   METABOLIC DISORDER   9

Diabetes mellitus, Diabetic ketoacidosis, lactose intolerance, Glycogen storage disorders, Lipid storage disorders, obesity, atherosclerosis, Plasma proteins in health and disease, Inborn error of amino acid metabolism, Disorders associated with abnormalities in the metabolism of bilirubin – Jaundice.

UNIT V   9

Liver Function tests, Renal Function Tests, Blood gas Analysis, Measurement of Electrolytes. Their abnormal and Normal Values and Conditions. Biochemistry of Urine and Stools testing.

TOTAL: 45 PERIODS

OUTCOMES:
After the successful completion of this course, the students will be able to,
- Explain the fundamentals of biochemistry
- Have in-depth knowledge about the classification, structures and properties of carbohydrates, lipid, protein and amino acid.
- Demonstrate about the mechanism of actions of enzymes and co-enzymes, clinical importance of enzymes, hormonal assay and significance.

TEXT BOOKS:
1. Keith Wilson & John Walker, "Practical Biochemistry - Principles & Techniques", Oxford University Press, 2009.
2. Rafi MD —Text book of biochemistry for Medical Student, Second Edition, University Press, 2014.
3. W. Rodwell, David Bender, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil—Harper's Review of biochemistry, 30 th Edition, LANGE Medical Publications, 2015.
4. Trevor palmer and Philip L Bonner "Enzymes: Biochemistry, Biotechnology, Clinical Chemistry", 2 nd Edition, Woodhead Publishing, 2009.

REFERENCES:
1. Lehninger Principles of Biochemistry, Fourth Edition - by David L. Nelson & Michael M.Cox , - W. H. Freeman; 4 edition (April 23, 2004)
2. Fundamentals of Biochemistry: Life at the Molecular Level - by Donald J. Voet , Judith G. Voet & Charlotte W. Pratt. - Wiley; 2 edition (March 31, 2005)
3. Pamela.C.Champe & Richard.A.Harvey, —Lippincott Biochemistry Lippincott's Illustrated Reviews, 6 th Edition, LWW publishers, 2013.

OIT552	CLOUD COMPUTING	L T P C
		3 0 0 3

OBJECTIVES:
- To learn about the concept of cloud and utility computing.
- 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 TO CLOUD COMPUTING   9

Introduction to Cloud Computing – Roots of Cloud Computing – Desired Features of Cloud Computing – Challenges and Risks – Benefits and Disadvantages of Cloud Computing.

UNIT II   VIRTUALIZATION   9
Introduction to Virtualization Technology – Load Balancing and Virtualization – Understanding Hypervisor – Seven Layers of Virtualization – Types of Virtualization – Server, Desktop, Application Virtualization.

UNIT III   CLOUD ARCHITECTURE, SERVICES AND STORAGE   9
NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage.

UNIT IV   RESOURCE MANAGEMENT AND SECURITY IN CLOUD   9
Inter Cloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Challenges – Data Security –Application Security – Virtual Machine Security.

UNIT V   CASE STUDIES   9
Google App Engine(GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services(AWS) – GAE Applications – Cloud Software Environments – Eucalyptus – Open Nebula – Open Stack.

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.
- Choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

TEXT BOOKS:
1. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", First Edition, John Wiley & Sons, 2011.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. 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.

OIT551   **DATABASE MANAGEMENT SYSTEMS**   **L T P C**
                                                                                3 0 0 3

OBJECTIVES
- To learn the fundamentals of data models
- To learn conceptual modeling using ER diagrams.
- To study SQL queries and database programming
- To learn proper designing of relational database.
- To understand database security concepts
- To understand Information retrieval techniques

UNIT I   DBMS AND CONCEPTUAL DATA MODELING   9
Purpose of Database System – Data independence - Data Models – Database System Architecture – Conceptual Data modeling: ER models - Enhanced-ER Model. Introduction to relational databases – Relational Model – Keys – ER-to-Relational Mapping. Modeling of a library management system.

UNIT II   DATABASE QUERYING   11
Relational Algebra – SQL: fundamentals – DDL – Specifying integrity constraints - DML – Basic retrieval queries in SQL - Complex SQL retrieval queries – nested queries – correlated queries – joins - aggregate functions. Creating a table, populating data, adding integrity constraints, querying tables with simple and complex queries.

UNIT III   DATABASE PROGRAMMING   7
Database programming with function calls, stored procedures - views – triggers. Embedded SQL. ODBC connectivity with front end tools. Implementation using ODBC/JDBC and SQL/PSM, implementing functions, views, and triggers in MySQL / Oracle.

UNIT IV   DATABASE DESIGN   9
Functional Dependencies – Design guidelines –   Normal Forms: first, second, third – Boyce/Codd Normal Form –   Normalization algorithms. Design of a banking database system / university database system.

UNIT V   ADVANCED TOPICS   9
Database security issues – Discretionary access control – role based access – Encryption and public key infrastructures – challenges. 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:
- Understand relational data model, evolve conceptual model of a given problem, its mapping to relational model and Normalization
- Query the relational database and write programs with database connectivity
- Understand the concepts of database security and information retrieval systems

TEXT BOOKS:
1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems",   Sixth Edition , Pearson, 2011.
2. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill, 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 Systemsǁ, Fourth Edition, McGraw-Hill College Publications, 2015.

OTL552   **DIGITAL AUDIO ENGINEERING**   **L T P C**
                                                                              3 0 0 3

OBJECTIVES:
- To understand the concept of fundamentals of digital audio.
- To understand the concept of audio in digital TV broadcasting.
- To understand the various codes of digital coding.
- To understand the concept of digital audio tape recorder.
- To analyze the concept internet audio in digital audio engineering.

UNIT I   FUNDAMENTALS OF DIGITAL AUDIO   9
Discrete time sampling - sampling theorem - Nyquist frequency – aliasing – prevention – quantization – signal to error ratio – distortion – other architectures – dithers – types of dither.

UNIT II   RECORDING AND TRANSMISSION PRINCIPLES   9
PCM – record processing – recording oriented codes – transmission oriented codes – audio in digital TV broadcasting – DAB.

UNIT III   DIGITAL CODING & COMPRESSION   9
Block & convolutional codes – cyclic codes – Reed Solomon codes – interleaving – compression principles – lossless & perceptive coding – subband codes – transform coding – compression formats – MPEG audio – Dolby AC 3 – ATRAC.

UNIT IV   DIGITAL AUDIO TECHNIQUES   9
Digital audio tape recorder – cassettes – modes – track format – digital audio editing – editing with random access media & recording media – editor structure – digital audio in optical disks – CD, MD, DVD, playing optical disk – Minidisk.

UNIT V   APPLICATIONS OF DIGITAL AUDIO   9
Internet audio – MP3 – SDMI – audio MPEG 4 – PC – MIDI – sound cards**.**

                                                                    TOTAL: 45 PERIODS
OUTCOMES:
At the end of the course, students would be able to
- Analyze the type of dither.
- Analyze the recording and transmission principles in digital audio.
- Analyze the various compression techniques.
- Design and analyze the digital audio editing.
- Analyze the various application of digital audio.

TEXT BOOKS:
1. John Watkinson, "An Introduction to Digital Audio", Focal Press, Second edition. 2013
2. Ken C Pohlmann, "Principles of Digital audio", McGraw Hill, Sixth edition, 2010

REFERENCES:
1. Then Ballin, " Handbook for sound Engineers Taylor & Francis", Fifth edition, 2015
2. John Watkinson, "The art of Digital Audio" Focal Press, Third edition, 2013

OME551   **ENERGY CONSERVATION AND MANAGEMENT**   **L T P C**
                                                                             3　0　0　3

OBJECTIVES:
At the end of the course, the student is expected to
- Understand and analyse the energy data of industries
- Carryout energy accounting and balancing
- Conduct energy audit and suggest methodologies for energy savings and
- Utilise the available resources in optimal ways

UNIT I   INTRODUCTION   9
Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT II   ELECTRICAL SYSTEMS   9
Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT III   THERMAL SYSTEMS   9
Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam
Utilization, Insulators & Refractories

UNIT IV   ENERGY CONSERVATION IN MAJOR UTILITIES   9
Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V   ECONOMICS   9
Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept

                                                        TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the students can able to analyse the energy data of industries.
- Can carryout energy accounting and balancing
- Can suggest methodologies for energy savings

TEXT BOOKS:
1. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com,a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

REFERENCES:
1. Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.
3. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982
4. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987.

OBT553　　　　　　　**FUNDAMENTALS OF NUTRITION**　　　　　　**L T P C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　3 0 0 3

OBJECTIVES:
- The course aims to develop the knowledge of students in the basic area of Food Chemistry.
- This is necessary for effective understanding of food processing and technology subjects.
- This course will enable students to appreciate the similarities and complexities of the chemical components in foods.

UNIT I　　　OVERVIEW OF NUTRITION　　　　　　　　　　　　　　9
Definition, six classes of nutrients, calculating energy values from food, using the RDA, nutritional status, nutritional requirement, malnutrition, nutritional assessment of individuals and populations, dietary recommendations, Balanced diet planning: Diet planning principles, dietary guidelines; food groups, exchange lists, personal diet analysis;

UNIT II　　　DIGESTION　　　　　　　　　　　　　　　　　　9
Digestion, Absorption and Transport: Anatomy and physiology of the digestive tract, mechanical and chemical digestion, absorption of nutrients.

UNIT III　　　CARBOHYDRATES　　　　　　　　　　　　　　9
Glycemic and Non-glycemic carbohydrates, blood glucose regulation, recommendations of sugar intake for health, health effects of fiber and starch intake, Artificial sweeteners; Importance of blood sugar regulation, Dietary recommendations for NIDDM and IDDM

UNIT IV　　　PROTEINS & LIPIDS　　　　　　　　　　　　　9
Proteins; Food enzymes ; Texturized proteins; Food sources, functional role and uses in foods. Review of structure, composition & nomenclature of fats. Non-glyceride components in fats & oils; Fat replacements; Food sources, functional role and uses in foods. Health effects and recommended intakes of lipids. Recommended intakes of proteins, Deficiency- short term and long term effects.

UNIT V　　　METABOLISM, ENERGY BALANCE AND BODY COMPOSITION　　9
Energy Balance; body weight and body composition; health implications; obesity, BMR and BMI calculations; Weight Control: Fat cell development; hunger, satiety and satiation; dangers of unsafe weight loss schemes; treatment of obesity; attitudes and behaviours toward weight control. Food and Pharmaceutical grades; toxicities, deficiencies, factors affecting bioavailability, Stability under food processing conditions.

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　TOTAL : 45 PERIODS

TEXT BOOKS:
1. Chopra, H.K. and P.S. Panesar. " Food Chemistry". Narosa, 2010.
2. Vaclavik, V. A. and Christian E. W. "Essentials of Food Science". II Edition, Kluwer- Academic, Springer, 2003.
3. Mann, Jim and Stewart Truswell "Essentials of Human Nutrition". 3rd Edition. Oxford University Press, 2007.
4. Gibney, Michael J., et al., "Introduction to Human Nutrition". 2nd Edition. Blackwell,2009.
5. Gropper, Sareen S. and Jack L.Smith "Advanced Nutrition and Human Metabolism". 5th Edition. Wadsworth Publishing, 2008.

REFERENCES:
1. Gopalan C., B.V. Rama Sastri, and S.C. Balasubramanian S. C. "Nutritive Value of Indian Foods". NIN, ICMR, 2004.
2. Damodaran, S., K.L. Parkin and O.R. Fennema. "Fennema's Food Chemistry". 4th Edition, CRC Press, 2008
3. Belitz,H.-D, Grosch W and Schieberle P. "Food Chemistry", 3rd Rev. Edition, Springer- Verlag, 2004.
4. Walstra, P. " Physical Chemistry of Foods". Marcel Dekker Inc. 2003.
5. Owusu-Apenten, Richard. "Introduction to Food Chemistry". CRC Press, 2005

OCE552   **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 – ER diagram - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models - OGC standards - Data Quality.

UNIT III   DATA INPUT AND TOPOLOGY   9
Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input –Digitiser –Topology - Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping.

UNIT IV   DATA ANALYSIS   9
Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Education models - 3D data collection and utilisation.

UNIT V   APPLICATIONS   9
GIS Applicant - Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies.

TOTAL: 45 PERIODS

OUTCOME:
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

HERBAL TECHNOLOGY

OBJECTIVES:
- To acquire the basic knowledge of Indian system of medicines.
- To enable the students to know about the plant tissue culture techniques and learn about the instruments used in the extraction, isolation, purification and identification of herbal drugs.

UNIT I   INDIAN SYSTEMS OF MEDICINE   9
Introduction, basic principles and treatment modalities of Ayurveda – Unani – Homeopathy – Siddha – naturopathy- Introduction and streams of Yoga. Classification of herbs - Harvesting – Post harvesting – Conditions of storage.-seasonal and geographical variation.

UNIT II   IN-VITRO CULTURE OF MEDICINAL PLANTS   9
Requirements – Setting up a tissue culture lab – Basic laboratory procedure – Processing of plant tissue culture – Growth profile – Growth measurement – Plant tissue culture methods – Callus culture – Types of tissue culture – Tissue culture of medicinal plants – Applications of plant tissue culture.

UNIT III   PHYTO PHARMACEUTICALS   9
Traditional and modern extraction techniques: Successive solvent extraction- Super critical fluid extraction – Steam distillation – Head space techniques – Sepbox –General extraction process: Carbohydrates – Proteins – Alkaloids –Glycosides. Isolation and purification of phytochemicals (Eg. Quinine from cinchona, vincristine from Vinca, sennoside from senna, Euginol from clove oil.)

UNIT IV   SCREENING METHODS FOR HERBAL DRUGS   9
Screening methods for anti-fertility agents – Antidiabetic drugs – Anti anginal drugs – Diuretic – Analgesic activity – Antipyretic activity – Anti cancer activity –Evaluation of hepatoprotective agents – anticonvulsive- Anti ulcer drugs.

UNIT V   STANDARDIZATION AND CONSERVATION OF HERBAL DRUGS   9
Importance of standardization - Standardization of single drugs and compound formulations – WHO guidelines for the quality assessment herbal drugs - Conservation strategies of medicinal plants – Government policies for protecting the traditional knowledge.

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to
- Understand the basic principle, design, control and processing techniques of medicinal plants and their derivatives.
- Find a solution to problems, including social, scientific and ethical issues connected with the use of medicinal plants in the different field of applications.
- Describe the biological effects of medicinal plants with legislation and governmental policies for conserving medicinal plants.

TEXT BOOKS:
1. Agarwal, S.S. & Paridhavi, M., "Herbal Drug Technology" Universities Press,Pvt Limited, 2007.
2. Wallis, T.E., "Textbook of Pharmacognosy" 5th Edition, CBS Publishers and Distributors,2005.
3. Indian System of Medicine and Homeopathy, Planning and Evaluation Cell, Govt.of India, New Delhi, 2001.
4. Yoga- The Science of Holistic Living by V.K.Yoga, VKY Prakashna Publishing, Bangalore, 2005.
5. Quality Control Methods for medicinal plant material, WHO Geneva, 1998.

REFERENCES:
1. Evans, W.C., "Trease and Evans Pharmacognosy" 15th Edition, Elsevier HealthSciences, 2001.
2. Pulok K. Mukherjee., "Quality control of Herbal Drugs"Reprintedn, Business Horizons, New Delhi, 2012.
3. Daniel, M., "Herbal Technology: Concepts and Advances" Satish Serial PublishingHouse, 2008.

OMD552	**HOSPITAL WASTE MANAGEMENT**	**L T P C**
		3 0 0 3

OBJECTIVES:
The student should be made to:
- Know about the healthcare hazard control and accidents
- Understand biomedical waste management
- Learn the facility guidelines, infection control and patient safety.

UNIT I   HEALTHCARE HAZARD CONTROL AND UNDERSTANDING ACCIDENTS   9
Healthcare Hazard Control: Introduction, Hazard Control: Management & Responsibilities, Hazard Analysis, Hazard Correction, Personal Protective Equipment, Hazard Control Committees, Accident Causation Theories, Accident Reporting, Accident Investigations, Accident Analysis, Accident Prevention, Workers' Compensation, Orientation, Education, and Training.

UNIT II   BIOMEDICAL WASTE MANAGEMENT   9
Biomedical Waste Management : Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling and disposal.

UNIT III   HAZARDOUS MATERIALS   9
Hazardous Materials : Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Respiratory Protection.

UNIT IV   FACILITY SAFETY   9
Introduction, Facility Guidelines: Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Tool Safety, Electrical Safety, Control of Hazardous Energy, Landscape and Ground Maintenance, Fleet and Vehicle Safety.

UNIT V   INFECTION CONTROL, PREVENTION AND PATIENT SAFETY   9
Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, OSHA Bloodborne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Healthcare-Associated Infections, Medication Safety.

TOTAL : 45 PERIODS

OUTCOMES:
- After successful completion of the course, the students will be able to know the concepts of healthcare waste management, its prevention and safety.

REFERENCES:
1. Tweedy, James T., Healthcare hazard control and safety management-CRC Press_Taylor and Francis (2014).
2. Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd (2012).

OCH551   **INDUSTRIAL NANOTECHNOLOGY**   **L T P C**
                                                                                3 0 0 3

OBJECTIVES
- To elucidate on advantages of nanotechnology based applications in each industry
- To provide instances of contemporary industrial applications of nanotechnology
- To provide an overview of future technological advancements and increasing role of nanotechnology in each industry

UNIT I   NANO ELECTRONICS   9
Advantages of nano electrical and electronic devices –Electronic circuit chips – Lasers - Micro and NanoElectromechanical systems – Sensors, Actuators, Optical switches,- Data memory –Lighting and Displays – Batteries - Fuel cells and Photo-voltaic cells – Electric double layer capacitors – Lead-free solder – Nanoparticle coatings for electrical products

UNIT II   BIONANOTECHNOLOGY   9
Nanoparticles in bone substitutes and dentistry – Implants and Prosthesis – Nanorobotics in Surgery –Nanosensors in Diagnosis– Neuro-electronic Interfaces– Therapeutic applications

UNIT III   NANOTECHNOLOGY IN CHEMICAL INDUSTRY   9
Nanocatalyts – Smart materials – Heterogenous nanostructures and composites – Nanostructures for Molecular recognition (Quantum dots, Nanorods, Nanotubes) – Molecular Encapsulation and its applications – Nanoporous zeolites – Self-assembled Nanoreactors

UNIT IV   NANOTECHNOLOGY IN AGRICULTURE AND FOOD TECHNOLOGY   9
Nanotechnology in Agriculture -Precision farming, Smart delivery system – Insecticides using nanotechnology – Potential of nano-fertilizers - Nanotechnology in Food industry

UNIT V   NANOTECHNOLOGY IN TEXTILES AND COSMETICS   9
Nanofibre production - Electrospinning – Controlling morphologies of nanofibers – Tissue engineering application– Polymer nanofibers - Nylon-6 nanocomposites from polymerization - Nano-filled polypropylene fibers - Nano finishing in textiles (UV resistant, antibacterial, hydrophilic, self-cleaning, flame retardant finishes) – Modern textiles Cosmetics – Formulation of Gels, Shampoos, Hair-conditioners

                                                                        TOTAL: 45 PERIODS

REFERENCES:
1. Neelina H. Malsch (Ed.),Biomedical Nanotechnology, CRC Press (2005)
2. Udo H. Brinker, Jean-Luc Mieusset (Eds.), Molecular Encapsulation: Organic Reactions in Constrained Systems,Wiley Publishers (2010).
3. Jennifer Kuzma and Peter VerHage, Nanotechnology in agriculture and food production, Woodrow Wilson International Center, (2006).
4. Lynn J. Frewer, Willehm Norde, R. H. Fischer and W. H. Kampers, Nanotechnology in the Agri-food sector, Wiley-VCH Verlag, (2011).
5. P. J. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead Publishing Limited, Cambridge, (2007).
6. Y-W. Mai,Polymer Nano composites, Woodhead publishing, (2006).
7. W.N. Chang,Nanofibres fabrication, performance and applications, Nova Science Publishers Inc, (2009)

OBT551   **INTRODUCTION TO BIOENERGY AND BIOFUELS**   **L T P C**
                                                                                3 0 0 3

OBJECTIVES
- This course will be focussed on achievement, acquisition of knowledge and enhancement of comprehension of information regarding bioenergy and biofuel technologies and their sustainable applications.

UNIT I   CONCEPTS   9
Biopower, Bioheat, Biofuesl, advanced liquid fuels, drop-in fuels, biobased products

UNIT II   FEEDSTOCKS   9
Harvested Feedstocks: First generation biofuels, Second generation biofuels, third generation biofuels. Residue Feedstocks: Agricultural wastes, forestry wastes, farm waste, organic components of residential, commercial, institutional and insdustrial waste.

UNIT III   CONVERSION TECHNOLOGIES   9
Biorefinery concept – biorefineries and end products, Biochemical conversion – hydrolysis, enzyme and acid hydrolysis, fermentation, anaerobic digestion and trans-esterification, Thermochemical conversion – Combustion, Gasification, Pyrolysis, other thermochemical conversion technologies. Scaling up of emerging technologies.

UNIT IV   BIOFUELS   9
Pros and cons of Biofuels, Algal biofuels, Cyanobacteria and producers of biofuels, Jatropha as biodiesel producer, Bioethanol, Biomethane, biohydrogen, biobutanol, metabolic engineering of fuel molecules, Engineering aspects of biofuels, Economics of biofuels

UNIT V   SUSTAINABILITY & RESILIENCE   9
Environmental Sustainability, bioenergy sustainability, emissions of biomass to power generation applications, emissions from biofuels. ILUC issues, Carbon footprint, Advanced low carbon fuels

                                                                TOTAL :45 PERIODS
TEXTBOOKS:
1. Biorenewable Resources – Engieering new products. Robert C Brown. Blackwell Publishing Professional, 2003.
2. Biofuels. Wim Soetaert and Erik Vandamme (Editors) Wiley. 2009.
3. Biomass for Renewable Energy, Fuels and Chemicals. Donald Klass. Academic press. 1998

REFERENCES:
1. Introduction to Bioenergy.Vaughn C. Nelson and Kenneth L. Starcher.
2. Bioenergy: Biomass to Biofuels by by Anju Dahiya
3. Bioenergy: Principles and Applications by Yebo Li and Samir Kumar Khanal
4. Bioenergy by Judy D. Wall and Caroline S. Harwood
5. Bioenergy: Sustainable Perspectives by Ted Weyland

OEI551　　　　　　**LOGIC AND DISTRIBUTED CONTROL SYSTEMS**　　　**L T P C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　3 0 0 3

OBJECTIVES:
- To give an introductory knowledge on Programmable Logic Controller (PLC) and their programming languages
- To give adequate knowledge about applications of PLC
- To give basic knowledge about Computer Controlled Systems
- To give basic knowledge on the architecture and local control unit of Distributed Control System (DCS)
- To give adequate information with respect to interfaces used in DCS

UNIT I　　　**PROGRAMMABLE LOGIC CONTROLLER**　　　　　　　　**9**
Evolution of PLCs – Components of PLC – Architecture of PLC – Discrete and analog I/O modules – Programming languages -Ladder diagram – Function block diagram (FBD) - Programming timers and counters

UNIT II　　　**APPLICATIONS OF PLC**　　　　　　　　　　　　　　**9**
Instructions in PLC – Program control instructions, math instructions, data manipulation Instructions, sequencer and shift register instructions – Case studies in PLC

UNIT III　　　**COMPUTER CONTROLLED SYSTEMS**　　　　　　　　**9**
Basic building blocks of computer controlled systems – Data acquisition system – Supervisory control – Direct digital control- SCADA:- Hardware and software, Remote terminal units, Master
Station and Communication architectures.

UNIT IV　　　**DISTRIBUTED CONTROL SYSTEM**　　　　　　　　　**9**
DCS – Various Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities

UNIT V　　　**INTERFACES IN DCS**　　　　　　　　　　　　　　**9**
Operator interfaces - Low level and high level operator interfaces – Displays - Engineering interfaces – Low level and high level engineering interfaces – Factors to be considered in selecting DCS – Case studies in DCS

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to understand and analyze Instrumentation systems and their applications to various industries.
- Ability to understand and analyse, linear and digital electronic circuits.

TEXT BOOKS:
1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2010
2. Michael P. Lukas, *Distributed Control Systems: Their Evaluation and Design*, Van Nostrand Reinhold Co., 1986
3. D. Popovic and V.P.Bhatkar,' Distributed computer control for industrial Automation' Marcel Dekker, Inc., Newyork ,1990.

REFERENCES:
1. T.A. Hughes, Programmable Controllers, Fourth edition, ISA press, 2005
2. Krishna Kant, Computer Based Industrial Control, Second edition, Prentice Hall of India, New Delhi, 2010.
3. John W. Webb and Ronald A. Reis, 'Programmable Logic Controllers, Fifth edition, Prentice Hall of India, New Delhi, 2010.
4. John R. Hackworth and Frederick D. Hackworth Jr, Programmable Logic Controllers, Pearson, New Delhi, 2004.
5. Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3,4. 60870.5 and Related Systems", Newnes, 1st Edition, 2004.
6. E.A.Parr, Programmable Controllers, An Engineer's Guide, Elsevier, 2013

OBM552   **MEDICAL PHYSICS**   **L T P C**
                                                                         3 0 0 3
OBJECTIVES:
- To study the complete non-ionizing radiations including light and its effect in human body.
- To understand the principles of ultrasound radiation and its applications in medicine.
- To learn about radioactive nuclides and also the interactions of radiation with matters and how isotopes are produced.
- To study the harmful effects of radiation and radiation protection regulations.

UNIT I   NON-IONIZING RADIATION AND ITS MEDICAL APPLICATIONS   9
Introduction to EM waves - Tissue as a leaky dielectric - Relaxation processes: Debye model, Cole–Cole model- Overview of non-ionizing radiation effects-Low Frequency Effects- Higher frequency effects. Physics of light-Measurement of light and its unit- limits of vision and color vision an overview - Applications of ultraviolet in medicine, Thermography.

UNIT II   ULTRASOUND IN MEDICINE   9
Ultrasound fundamentals – Generation of ultrasound (Ultrasound Transducer) - Interaction of Ultrasound with matter: Cavitation, Reflection, Transmission- Scanning systems – Artefacts-Ultrasound- Doppler-Double Doppler shift-Clinical Applications- Ultrasonography.

UNIT III   PRINCIPLES OF RADIOACTIVE NUCLIDES AND DECAY   9
Introduction to Radioisotopes - Radioactive decay : Spontaneous Fission, Isomeric Transition, Alpha Decay, Beta Decay, Positron Decay, Electron Capture- Radioactive decay equations – Half life- Mean Life- Effective half-life - Natural and Artificial radioactivity, - Production of radionuclide – Cyclotron produced Radionuclide - Reactor produced Radionuclide: fission and electron Capture reaction, Target and Its Processing Equation for Production of Radionuclide - Radionuclide Generator-Technetium generator.

UNIT IV   INTERACTION OF RADIATION WITH MATTER   9
Interaction of charged particles with matter –Specific ionization, Linear energy transfer, range, Bremsstrahlung, Annihilation - Interaction of X and Gamma radiation with matter: Photoelectric effect, Compton Scattering, Pair production- Attenuation of Gamma Radiation - Interaction of neutron with matter and their clinical significance- Radionuclide used in Medicine and Technology.

UNIT V   RADIATION EFFECTS AND REGULATIONS   9
Classification of Radiation Damage, Stochastic and Deterministic Effects, Acute Effects of Total Body Irradiation, Long-Term Effects of Radiation, Risk Versus Benefit in Diagnostic Radiology and Nuclear Medicine, Risk of Pregnant Women, Nuclear Regulatory Commission, ALARA Program, Medical Uses of Radioactive Materials, Survey for Contamination and Exposure Rate, Dose Calibrators and Survey Meters, Bioassay, Radioactive Waste Disposal.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Analyze the low frequency and high frequency effects of non-ionizing radiation and physics of light.
- Define various clinical applications based on ultrasound wave.
- Explain the process of radioactive nuclide production using different techniques
- Analyze radiation mechanics involved with various physiological systems
- Outline the detrimental effects of radiation and regulations for radiation safety.

TEXT BOOKS:
1. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, Medical Physics and Biomedical Engineering, 2nd Edition, IOP Publishers.2001. (Unit I & II)
2. Gopal B. Saha, Physics and Radiobiology of Nuclear Medicine, 4th Edition, Springer, 2013. (Unit III & IV)
3. R.Hendee and Russell Ritenour "Medical Imaging Physics", Fourth Edition William, Wiley-Liss, 2002. (Unit V)

REFERENCES:
1. S.Webb " The Physics of Medical Imaging", Taylor and Francis, 1988
2. HyltonB.Meire and Pat Farrant "Basic Ultrasound" John Wiley & Sons, 1995
3. John R Cameran , James G Skofronick "Medical Physics" John-Wiley & Sons. 1978
4. W.J.Meredith and J.B. Massey " Fundamental Physics of Radiology" Third edition ,Varghese Publishinghouse. 1992

OML552	MICROSCOPY	L T P C
		3 0 0 3

OBJECTIVE:
This course will cover the basic principles and techniques of optical and electron microscopy. This course also deals with the sample preparation techniques for the microstructural analysis.

UNIT I   INTRODUCTION   9
History of Microscopy, Overview of current microscopy techniques. Light as particles and waves, Fundamental of optics: Diffraction and interference in image formation, real and virtual images, Resolution, Depth of field and focus, Magnification, Numerical aperture, Aberration of lenses. Components of Light Microscopy, Compound light microscopy and its variations.

UNIT II   MICROSCOPY   9
Phase contrast microscopy: optical design, theory, image interpretation, Dark-field microscopy: optical design, theory , image interpretation, Polarization Microscopy: Polarized light, optical design, theory , image interpretation, Differential Interference Contrast (DIC): equipment and optics, image interpretation, Modulation contrast microscopy: contrast methods using oblique illumination.

UNIT III   ELECTRON MICROSCOPY   9
Interaction of electrons with matter, elastic and inelastic scattering, secondary effects, Components of electron microscopy: Electron sources, pumps and holders, lenses, apertures, and resolution. Scanning Electron and Transmission Electron Microscopy: Principle, construction, applications and limitations.

UNIT IV   SAMPLE PREPARATION FOR MICROSTRUCTURAL ANALYSIS   9

Optical Microscopy sample preparation: Grinding, polishing and etching, SEM sample preparation: size constrains, TEM sample preparation: Disk preparation, electro polishing, ion milling, lithography, storing specimens.

UNIT V   CHEMICAL ANALYSIS   9

Surface chemical composition (Principle and applications) - Mass spectroscopy and X-ray emission spectroscopy - Energy Dispersive Spectroscopy- Wave Dispersive Spectroscopy. Electron spectroscopy for chemical analysis (ESCA), Ultraviolet Photo Electron Spectroscopy (UPS), X ray Photoelectron Spectroscopy (XPS), Auger Electron Spectroscopy (AES)- Applications.

TOTAL: 45 PERIODS

OUTCOMES:
- Able to understand the physics behind the microscopy.
- Ability to describe the principle, construction and working of light microscopy.
- Ability to appreciate about electron microscopy.
- Ability to understand about the important of sample preparation technique.
- Ability to identify the appropriate spectroscopy technique for chemical analysis.

TEXT BOOKS
1. Douglas B. Murphy, Fundamentals of light microscopy and electronic imaging, 2001, Wiley-Liss, Inc. USA
2. David B. Williams and C. Barry Carter, Transmission Electron Microscopy-A Textbook for Materials Science, Springer US, 2nd edition, 2009.

REFERENCES:
1. Brandon D. G, "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA,1986.
2. Whan R E (Ed), ASM Handbook, Volume 10, Materials Characterisation", Nineth Edition, ASM international, USA, 1986.
3. Thomas G., "Transmission electron microscopy of metals", John Wiley, 1996

OEI552	SCADA SYSTEM AND APPLICATIONS MANAGEMENT	L T P C
		3 0 0 3

COURSE OBJECTIVE:
- To understand about the SCADA system components and SCADA communication protocols
- To provide knowledge about SCADA applicatios in power system

UNIT I   INTRODUCTION TO SCADA   9

Evolution of SCADA, SCADA definitions, SCADA Functional requirements and Components, SCADA Hierarchical concept, SCADA architecture, General features, SCADA Applications, Benefits

UNIT II   SCADA SYSTEM COMPONENTS   9

Remote Terminal Unit (RTU), Interface units, Human- Machine Interface Units (HMI), Display Monitors/Data Logger Systems, Intelligent Electronic Devices (IED), Communication Network, SCADA Server, SCADA Control systems and Control panels

UNIT III   SCADA COMMUNICATION   9

SCADA Communication requirements, Communication protocols: Past, Present and Future, Structure of a SCADA Communications Protocol, Comparison of various communication protocols, IEC61850 based communication architecture, Communication media like Fiber optic, PLCC etc. Interface provisions and communication extensions, synchronization with NCC, DCC.

UNIT IV   SCADA MONITORING AND CONTROL   9

Online monitoring the event and alarm system, trends and reports, Blocking list, Event disturbance recording. Control function: Station control, bay control, breaker control and disconnector control.

UNIT V   SCADA APPLICATIONS IN POWER SYSTEM   9

Applications in Generation, Transmission and Distribution sector, Substation SCADA system Functional description, System specification, System selection such as Substation configuration, IEC61850 ring configuration, SAS cubicle concepts, gateway interoperability list, signal naming concept. System Installation, Testing and Commissioning.

CASE STUDIES:

SCADA Design for 66/11KV and 132/66/11KV or 132/66 KV any utility Substation and IEC 61850 based SCADA Implementation issues in utility Substations,

TOTAL: 45 PERIODS

OUTCOME:

- This course gives knowledge about various system components and communication protocols of SCADA system and its applications.

REFERENCES:

1. Stuart A. Boyer: SCADA-Supervisory Control and Data Acquisition, Instrument Society of America Publications,USA,2004
2. Gordon Clarke, Deon Reynders: Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes Publications, Oxford, UK,2004
3. William T. Shaw, Cybersecurity for SCADA systems, PennWell Books, 2006
4. David Bailey, Edwin Wright, Practical SCADA for industry, Newnes, 2003
5. Michael Wiebe, A guide to utility automation: AMR, SCADA, and IT systems for electric Power, PennWell 1999
6. Dieter K. Hammer, Lonnie R. Welch, Dieter K. Hammer, "Engineering of Distributed Control Systems", Nova Science Publishers, USA, 1st Edition, 2001

     OBT554   **PRINCIPLES OF FOOD PRESERVATION**   **L T P C**
     3 0 0 3

OBJECTIVE:

- The course aims to introduce the students to the area of Food Preservation. This is necessary for effective understanding of a detailed study of food processing and technology subjects.

UNIT I   FOOD PRESERVATION AND ITS IMPORTANCE   9

Introduction to food preservation. Wastage of processed foods; Shelf life of food products; Types of food based on its perishability. Traditional methods of preservation

UNIT II   METHODS OF FOOD HANDLING AND STORAGE   9

Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.retort pouch packing, Aseptic packaging.

UNIT III   **THERMAL METHODS**   **9**
Newer methods of thermal processing; batch and continuous; In container sterilization- canning; application of infra-red microwaves; ohmic heating; control of water activity; preservation by concentration and dehydration; osmotic methods

UNIT IV   **DRYING PROCESS FOR TYPICAL FOODS**   **9**
Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures. Psychrometric chart, freezing and cold storage.freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages.

UNIT V   **NON-THERMAL METHODS**   **9**
Super Critical Technology for Preservation - Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology,
                                                                                          TOTAL: 45 PERIODS
OUTCOMES:
On completion of the course the students are expected to
- Be aware of the different methods applied to preserving foods.

TEXT BOOKS:
1. Karnal, Marcus and D.B. Lund "Physical Principles of Food Preservation". Rutledge, 2003.
2. VanGarde, S.J. and Woodburn. M "Food Preservation and Safety Principles and Practice".Surbhi Publications, 2001.
3. Sivasankar, B. "Food Processing & Preservation", Prentice Hall of India, 2002.
4. Khetarpaul, Neelam, "Food Processing and Preservation", Daya Publications, 2005.

REFERENCES:
1. Rahman, M. Shafiur. "Handbook of Food Preservation". Marcel & Dekker, 2006.
2. Zeuthen, Peter and Bogh-Sarensen, Leif. "Food Preservation Techniques". CRC / Wood Head Publishing, 2003.
3. Ranganna, S. "Handbook of Canning and Aseptic Packaging". Tata McGraw-Hill, 2000.
4. Ranganna, S. "Handbook of Canning and Aseptic Packaging". Tata McGraw-Hill, 2000.

OMF551   **PRODUCT DESIGN AND DEVELOPMENT**   **L T P C**
                                                                                          3 0 0 3
OBJECTIVE:
  The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

UNIT I   **INTRODUCTION**   **9**
Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.

UNIT II   CONCEPT GENERATION AND SELECTION   9
Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT III   PRODUCT ARCHITECTURE   9
Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

UNIT IV   INDUSTRIAL DESIGN   9
Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT V   DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT   9
Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

TOTAL: 45 PERIODS

OUTCOME:
- The student will be able to design some products for the given set of applications; also the knowledge gained through prototyping technology will help the student to make a prototype of a problem and hence product design and development can be achieved.

TEXT BOOK:
1. Kari T.Ulrich and Steven D.Eppinger, "Product Design and Development", McGraw-Hill International Edns. 1999.

REFERENCES:
1. Kemnneth Crow, "Concurrent Engg./Integrated Product Development", DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Staurt Pugh, "Tool Design –Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New york, NY.

ORO551   **RENEWABLE ENERGY SOURCES**   **L T P C**
                                                                    3 0 0 3
OBJECTIVES:
- To get exposure on solar radiation and its environmental impact to power.
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar energy.
- To learn about the wind energy and biomass and its economic aspects.
- To know about geothermal energy with other energy sources.

UNIT I   PRINCIPLES OF SOLAR RADIATION   10
Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT II   SOLAR ENERGY COLLECTION   8
Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT III   SOLAR ENERGY STORAGE AND APPLICATIONS   7
Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT IV   WIND ENERGY   10
Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

UNIT V   GEOTHERMAL ENERGY: 9
Resources, types of wells, methods of harnessing the energy, potential in India. OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics. DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, principles of DEC.
                                                          TOTAL : 45 PERIODS
OUTCOMES:
- Understanding the physics of solar radiation.
- Ability to classify the solar energy collectors and methodologies of storing solar energy.
- Knowledge in applying solar energy in a useful way.
- Knowledge in wind energy and biomass with its economic aspects.
- Knowledge in capturing and applying other forms of energy sources like wind, biogas and geothermal energies.

TEXT BOOKS:
1. Rai G.D. , "Non-Conventional Energy Sources", Khanna Publishers, 2011
2. Twidell & Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2011

REFERENCES:
1. Tiwari and Ghosal, "Renewable energy resources", Narosa Publishing House, 2007
2. Ramesh R & Kumar K.U , "Renewable Energy Technologies",Narosa Publishing House, 2004
3. Mittal K M , "Non-Conventional Energy Systems", Wheeler Publishing Co. Ltd, New Delhi, 2003
4. Kothari D.P, Singhal ., K.C., "Renewable energy sources and emerging technologies", P.H.I, New Delhi, 2010

OCS551   **SOFTWARE ENGINEERING**   **L T P C**
                                                                         3 0 0 3

OBJECTIVES:
- To understand the phases in a software development project
- To learn project management concepts
- To understand the concepts of requirements analysis and modeling.
- To understand software design methodologies
- To learn various testing methodologies
- To be familiar with issues related to software maintenance

UNIT I   SOFTWARE PROCESS   9
Introduction to Software Engineering, scope – software crisis – principles of software engineering - Software process – Life cycle models – Traditional and Agile Models - Team organization.

UNIT II   PLANNING AND ESTIMATION   9
Planning and the software process – cost estimation: LOC, FP Based Estimation, COCOMO I & II Models – Duration estimation and tracking – Gantt chart - Software Project Management – plan – risk analysis and management.

UNIT III   REQUIREMENTS ANALYSIS AND SPECIFICATION   9
Software Requirements: Functional and Non-Functional, Software Requirements specification– Structured system Analysis – modeling: UML based tools, DFD - Requirement Engineering Process.

UNIT IV   SOFTWARE DESIGN AND IMPLEMENTATION   9
Design process – Design principles and guidelines – design techniques – coupling and cohesion - metrics – tools. Implementation: choice of programming language, programming practices – coding standards – code walkthroughs and inspections.

UNIT V   TESTING AND MAINTENANCE   9
Software testing fundamentals- Testing techniques: white box, black box, glass box testing - unit testing – integration testing –system testing – acceptance testing – debugging. Post-delivery maintenance: Types – objectives - metrics - Reverse Engineering.

                                                                TOTAL: 45 PERIODS
OUTCOMES:
At the end of this course, the students will be able to
- Understand different software life cycle models.
- Perform software requirements analysis
- Apply systematic methodologies for software design and deployment.
- Understand various testing approaches and maintenance related issues.
- Plan project schedule, and 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 PrivateLimited, 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/.

OTL551   **SPACE TIME WIRELESS COMMUNICATION**   **L T P C**
                                                                  3 0 0 3

OBJECTIVES:
- To understand the concept of multiple antenna propagation.
- To understand the concept of capacity of frequency flat deterministic MIMO channel.
- To understand the concept of transmitter and receiver diversity technique.
- To design the coding for frequency flat channel.
- To analyze the concept of micro multi user detection.

**UNIT I   MULTIPLE ANTENNA PROPAGATION AND ST CHANNEL
                  CHARACTERIZATION   9**
Wireless channel – Scattering model in macrocells – Channel as a ST random field – Scattering functions, Polarization and field diverse channels – Antenna array topology – Degenerate channels – reciprocity and its implications – Channel definitions – Physical scattering model – Extended channel model – Channel measurements – sampled signal model – ST multiuser and ST interference channels – ST channel estimation.

UNIT II   CAPACITY OF MULTIPLE ANTENNA CHANNELS   9
Capacity of frequency flat deterministic MIMO channel: Channel unknown to the transmitter – Channel known to the transmitter – capacity of random MIMO channels – Influence of ricean fading – fading correlation – XPD and degeneracy on MIMO capacity – Capacity of frequency selective MIMO channels.

UNIT III   SPATIAL DIVERSITY   9
Diversity gain – Receive antenna diversity – Transmit antenna diversity – Diversity order and channel variability – Diversity performance in extended channels – Combined space and path diversity – Indirect transmit diversity – Diversity of a space-time – frequency selective fading channel.

UNIT IV   MULTIPLE ANTENNA CODING AND RECEIVERS   9
Coding and interleaving architecture – ST coding for frequency flat channels – ST coding for frequency selective channels – Receivers–SISO–SIMO–MIMO–Iterative MIMO receivers – Exploiting channel knowledge at the transmitter: linear pre-filtering – optimal pre-filtering for maximum rate – optimal pre-filtering for error rate minimization – selection at the transmitter – Exploiting imperfect channel knowledge

UNIT V   ST OFDM, SPREAD SPECTRUM AND MIMO MULTIUSER DETECTION   9
SISO-OFDM modulation, MIMO-OFDM modulation – Signaling and receivers for MIMO–OFDM – SISO–SS modulation – MIMO-SS modulation – Signaling and receivers for MIMO – S.MIMO –MAC – MIMO – BC – Outage performance for MIMO-MU – MIMO - MU with OFDM – CDMA and multiple antennas.

OUTCOMES:
At the end of the course , students would be able to
- Design and analyze the channel characterization.
- Analyze the capacity of random MIMO channel.
- Design and analyze the order diversity and channel variability.
- Analyze the multiple antenna coding and receivers.
- Analyze the MIMO multi user detection

TEXT BOOKS:
1. Sergio Verdu, "Multi User Detection" , Cambridge University Press, 2011
2. A. Paulraj, Rohit Nabar, Dhananjay Gore, "Introduction to Space Time Wireless Communication Systems",   Cambridge University Press , 2008

REFERENCE:
1. Don Tarrieri, " Principles of Spread Spectrum Communication systems" ,Springer, Third edition, 2015

OTL553   **TELECOMMUNICATION NETWORK MANAGEMENT**   **L T P C**
                                                                                              3 0 0 3
OBJECTIVES:
- To understand the concept of network management standards.
- To design the common management information service element model.
- To understand the various concept of information modelling.
- To analyze the concept of SNMPv1 and SNMPv2 protocol.
- To analyze the concept of examples of network management.

UNIT I   FOUNDATIONS   9
Network management standards–network management model– organization model– information model abstract syntax notation 1 (ASN.1) – encoding structure– macros–functional model. Network management application functional requirements:Configuration management– fault management–performance management–Error correlation technology– security management–accounting management– common management–report management– polity based management–service level management–management service–community definitions– capturing the requirements– simple and formal approaches–semi formal and formal notations.

UNIT II   COMMON MANAGEMENT INFORMATION SERVICE ELEMENT   9
CMISE model–service definitions–errors–scoping and filtering features– synchronization–functional units– association services– common management information protocol specification.

UNIT III   INFORMATION MODELING FOR TMN   9
Rationale for information modeling–management information model–object oriented modeling paradigm– structure of management information–managed object class definition–management information base.

UNIT IV   SIMPLE NETWORK MANAGEMENT PROTOCOL   9
SNMPv1: managed networks–SNMP models– organization model–information model–SNMPv2 communication model–functional model–major changes in SNMPv2–structure of management information, MIB–SNMPv2 protocol– compatibility with SNMPv1– SNMPv3– architecture–applications–MIB security, remote monitoring–SMI and MIB– RMQN1 and RMON2.

UNIT V   NETWORK MANAGEMENT EXAMPLES   9

ATM integrated local management interface–ATM MIB–M1– M2–M3– M4– interfaces–ATM digital exchange interface management–digita1 subscriber loop and asymmetric DSL technologies–ADSL configuration management–performance management Network management tools: Network statistics management–network management system–management platform case studies: OPENVIEW–ALMAP.

                                                                      TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course , students would be able to

- Design and analyze of fault management.
- Analyze the common management information protocol specifications.
- Design and analyze of management information model.
- Design the simple network management protocol.
- Design the various types of network management tools.

TEXT BOOKS:

1. Mani Subramanian, "Network Management: Principles and Practice" Pearson Education, Second edition, 2010
2. Lakshmi G Raman, "Fundamentals of Telecommunications Network Management" ,Wiley, 1999

REFERENCES:

1. Henry Haojin Wang, "Telecommunication Network Management", Mc- Graw Hill ,1999
2. Salah Aidarous & Thomas Plevyak, "Telecommunication Network Management: Technologies and Implementations" , Wiley,1997

TELEHEALTH TECHNOLOGY   **L T P C**
                                                                                3 0 0 3

OBJECTIVES:
The student should be made to:
- Learn the key principles for telemedicine and health.
- Understand telemedical technology.
- Know telemedical standards, mobile telemedicine and it applications

UNIT I   TELEMEDICINE AND HEALTH   9
History and Evolution of telemedicine, Organs of telemedicine, Global and Indian scenario, Ethical and legal aspects of Telemedicine - Confidentiality, Social and legal issues, Safety and regulatory issues, Advances in Telemedicine.

UNIT II   TELEMEDICAL TECHNOLOGY   9
Principles of Multimedia - Text, Audio, Video, data, Data communications and networks, PSTN, POTS, ANT, ISDN, Internet, Air/ wireless communications Communication infrastructure for telemedicine – LAN and WAN technology. Satellite communication, Mobile communication.

UNIT III   TELEMEDICAL STANDARDS   9
Data Security and Standards: Encryption, Cryptography, Mechanisms of encryption, phases of Encryption. Protocols: TCP/IP, ISO-OSI, Standards to followed DICOM, HL7, H. 320 series Video Conferencing, Security and confidentiality of medical records, Cyber laws related to telemedicine

UNIT IV   MOBILE TELEMEDICINE   9
Tele radiology: Image Acquisition system Display system, Tele pathology, Medical information storage and management for telemedicine- patient information, medical history, test reports, medical images, Hospital information system

UNIT V   TELEMEDICAL APPLICATIONS   9
Telemedicine – health education and self care. · Introduction to robotics   surgery,   Telesurgery. Telecardiology,   Teleoncology,   Telemedicine   in   neurosciences, Business aspects - Project planning and costing, Usage of telemedicine.

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Apply multimedia technologies in telemedicine.
- Explain Protocols behind encryption techniques for secure transmission of data.
- Apply telehealth in healthcare.

TEXT BOOK:
1. Norris, A.C. "Essentials of Telemedicine and Telecare", Wiley, 2002

REFERENCES:
1. Wootton, R., Craig, J., Patterson, V. (Eds.), "Introduction to Telemedicine. Royal Society of Medicine" Press Ltd, Taylor & Francis 2006
2. O'Carroll, P.W., Yasnoff, W.A., Ward, E., Ripp, L.H., Martin, E.L. (Eds), "Public Health Informatics and Information Systems", Springer, 2003.
3. Ferrer-Roca, O., Sosa - Iudicissa, M. (Eds.), Handbook of Telemedicine. IOS Press (Studies in Health Technology and Informatics, Volume 54, 2002.
4. Simpson, W. Video over IP. A practical guide to technology and applications. Focal Press Elsevier, 2006.

5. Bemmel, J.H. van, Musen, M.A. (Eds.) Handbook of Medical Informatics. Heidelberg, Germany: Springer, 1997
6. Mohan Bansal " Medical Informatics", Tata McGraw-Hill, 2004.

OTL554	WAVELETS AND ITS APPLICATIONS	L T P C
		3 0 0 3

OBJECTIVES:
- To understand the concept of Fourier transform and short time Fourier transform.
- To understand the concept of continuous time wavelet transform,
- To analyze the concept of interpolation and decimation.
- To understand the types of filter bank.
- To analyze the concept of image compression.

UNIT I   **FOURIER ANALYSIS**   **9**
Fourier basis & Fourier Transform – failure of Fourier Transform – Need for Time-Frequency Analysis – Heisenberg's Uncertainty principle – Short time Fourier transform (STFT) – short comings of STFT– Need for Wavelets

UNIT II   **CWT AND MRA**   **9**
Wavelet basis – Continuous time Wavelet Transform (CWT) – need for scaling function – Multi Resolution Analysis – important wavelets: Haar– Mexican hat– Meyer– Shannon– Daubachies.

UNIT III   **INTRODUCTION TO MULTIRATE SYSTEMS**   **9**
Decimation and Interpolation in Time domain - Decimation and Interpolation in Frequency domain – Multi rate systems for a rational factor.

UNIT IV   **FILTER BANKS AND DWT**   **9**
Two channel filter bank – Perfect Reconstruction (PR) condition – relationship between filter banks and wavelet basis – DWT – Filter banks for Daubachies wavelet function.

UNIT V   **APPLICATIONS**   **9**
Feature extraction using wavelet coefficients– Image compression– interference suppression– Microcalification cluster detection– Edge detection–Faulty bearing signature identification.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course , students would be able to
- Analyze the need for time frequency analysis..
- Design the concept of multi resolution analysis.
- Analyze the multirate system for rational factor.
- Analyze the relationship between the filter bank and wavelet.
- Analyze the application of wavelet.

TEXT BOOK:
1.K.P.Soman , K.I. Ramachandran, N.G. Rasmi,"Insight Into Wavelets: From Theory to Practice" PHI Learning Private Limited, Third Edition, 2010

REFERENCE BOOKS:
1.Sidney Burrus C, " An Introduction to Wavelets " Academic press, 2014
2.Stephane G Mallat, A Wavelet Tour of Signal Processing:The sponse way" Academic Press, Third edition, 2008

OIM551   **WORLD CLASS MANUFACTURING**   **L T P C**
                                                                           3 0 0 3

OBJECTIVES
- Understanding of the concept and importance of strategy planning for manufacturing industries
- To apply principles and techniques in the identifiable formulation and implementation of manufacturing strategy for competitive in global context.

UNIT I   **INDUSTRIAL DECLINE AND ASCENDANCY**   **9**
Manufacturing excellence - US Manufacturers - French Manufacturers - Japan decade – American decade - Global decade

UNIT II   **BUILDING STRENGTH THROUGH CUSTOMER – FOCUSED PRINCIPLES**   **9**
Customer - Focused principles - General principles - Design - Operations - Human resources - Quality and Process improvement - Promotion and Marketing

UNIT III   **VALUE AND VALUATION**   **9**
Product Costing - Motivation to improve - Value of the enterprises QUALITY - The Organization : Bulwark of stability and effectiveness - Employee stability – Quality Individuals Vs. Teams - Team stability and cohesiveness - Project cohesiveness and stability

UNIT IV   **STRATEGIC LINKAGES**   **9**
Product decisions and customer service - Multi-company planning - Internal manufacturing planning - Soothing the demand turbulence

UNIT V   **IMPEDIMENTS**   **9**
Bad plant design - Mismanagement of capacity - Production Lines - Assembly Lines – Whole Plant Associates - Facilitators - Teamsmanship - Motivation and reward in the age of continuous Improvement.

                                                        TOTAL : 45 PERIODS

OUTCOMES:
- Able to understand the concept and the importance of manufacturing strategy for industrial enterprise competitiveness.
- Apply appropriate techniques in the analysis an devaluation of company's opportunities for enhancing competitiveness in the local regional and global context.
- Identify formulation and implement strategies for manufacturing and therefore enterprise competitiveness.

TEXT BOOKS:
1. By Richard B. Chase, Nicholas J. Aquilano, F. Robert Jacobs – "Operations Management for Competitive Advantage", McGraw-Hill Irwin, ISBN 0072323159
2. Moore Ran, "Making Common Sense Common Practice: Models for Manufacturing Excellence", Elsevior Multiworth
3. Narayanan V. K., "Managing Technology & Innovation for Competitive Advantage", Pearson Education Inc.
4. Korgaonkar M. G., "Just In Time Manufacturing", MacMillan Publishers India Ltd.,
5. Sahay B. S., Saxena K. B. C., Ashish Kumar, "World Class Manufacturing", MacMillan Publishers

OAI751   AGRICULTURAL FINANCE, BANKING AND CO-OPERATION   L T P C
                                                                          3 0 0 3

OBJECTIVES:
- To make the students aware about the agricultural Finance, Banking and Cooperation.
- To acquaint the students with the basic concepts, principles and functions of management.
- To understand the process of finance banking and cooperation.

UNIT I   AGRICULTURAL FINANCE - NATURE AND SCOPE   9
Agricultural Finance: Definition, Importance, Nature and Scope - Agricultural Credit: Meaning, Definition, Need and Classification - Sources of credit - Role of institutional and non - Institutional agencies: Advantages and Disadvantages - Rural indebtedness: consequences of rural indebtedness - History and Development of rural credit in India.

UNIT II   FARM FINANCIAL ANALYSIS   9
Principles of Credit - 5C's, 5R's and & 7P's of Credit - Project Cycle and Management - Preparation of bankable projects / Farm credit proposals - Feasibility - Time value of money: Compounding and Discounting - Appraisal of farm credit proposals - Undiscounted and discounted measures - Repayment plans - Farm Financial Statements: Balance Sheet, Income Statement and Cash Flow statement - Financial Ratio Analysis.

UNIT III   FINANCIAL INSTITUTIONS   9
Institutional Lending Agencies - Commercial banks: Nationalization, Agricultural Development Branches - Area Approach - Priority Sector Lending - Regional Rural Banks, Lead bank, Scale of finance - Higher financial institutions: RBI, NABARD, AFC, ADB, World Bank and Deposit Insurance and Credit Guarantee Corporation of India - Microfinance and its role in poverty alleviation - Self-Help Groups - Non -Governmental Organizations - Rural credit policies followed by State and Central Government - Subsidized farm credit, Differential Interest Rate (DIR), Kisan Credit Card (KCC) Scheme - Relief Measures and Loan Waiver Scheme and Know Your Customer (KYC).

UNIT IV   CO-OPERATION   9
Co-operation: Philosophy and Principles - History of Indian Cooperative Credit Movement: Pre and Post-Independence periods and Cooperation in different plan periods - Cooperative credit institutions: Two tier and three tier structure, Functions: provision of short term and long term credit, Strength and weakness of cooperative credit system, Policies for revitalizing cooperative credit: Salient features of Vaithiyananthan Committee Report on revival of rural cooperative credit institutions, Reorganisation of Cooperative credit structure in Andhra Pradesh and single window system and successful cooperative credit systems in Gujarat, Maharashtra, Punjab etc, - Special cooperatives: LAMPS and FSS: Objectives, role and functions - National Cooperative Development Corporation (NCDC) and National Federation of State Cooperative Banks Ltd., (NAFSCOB) - Objectives and Functions.

UNIT V   BANKING AND INSURANCE   9
Negotiable Instruments: Meaning, Importance and Types - Central Bank: RBI - functions - credit control - objectives and methods: CRR, SLR and Repo rate - Credit rationing - Dear money and cheap money - Financial inclusion and Exclusion: Credit widening and credit deepening monetary policies. Credit gap: Factors influencing credit gap - Non - Banking Financial Institutions (NBFI) - Assessment of crop losses, Determination of compensation - Crop insurance: Schemes, Coverage, Advantages and Limitations in implementation - Estimation of crop yields - Livestock, insurance schemes - Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

                                                                 TOTAL: 45 PERIODS
OUTCOME:
After completion of this course, the students will
- Be familiar with agricultural finance, Banking, cooperation and basic concepts, principles and functions of management.

REFERENCES:
1. Muniraj, R., 1987, Farm Finance for Development, Oxford & IBH, New Delhi
2. Subba Reddy. S and P.Raghu Ram 2011, Agricultural Finance and Management, Oxford & IBH, New Delhi.
3. Lee W.F., M.D. Boehlje A.G., Nelson and W.G. Murray, 1998, Agricultural Finance, Kalyani Publishers, New Delhi.
4. Mammoria, C.B., and R.D. Saxena 1973, Cooperation in India, Kitab Mahal, Allahabad.

OBM751 **BASICS OF HUMAN ANATOMY AND PHYSIOLOGY** **L T P C**
3 0 0 3

OBJECTIVES
- To learn the basic components of formation of systems
- To identify all the organelles of an animal cell and their function.
- To understand structure and functions of the various types of systems of human body.
- To demonstrate their knowledge of importance of anatomical features and physiology of human systems

UNIT I **INTRODUCTION** **9**
Level of Organization – Metabolism and Homeostasis – Plan of Body – Body Parts and Areas, Planes and Sections. Elements in the Human Body – Inorganic Compounds and Organic Compounds

UNIT II **BASIC STRUCTURE AND FUNCTION OF ANIMAL CELL** **9**
Structure of Cell – Structure and Function of Cell Membrane and Sub organelles. Cellular Transport Mechanism – Cell Division – Mitosis and Meiosis

UNIT III **TISSUES, MEMBRANE AND SKELETAL SYSTEM** **9**
Epithelial tissue – Connective tissue – Muscle tissue – Nerve tissue – Membrane. Types of Bone tissue - Classification of Bones – Functions of the Skeleton system – Skull, Vertebral Column. Joint - Articulation

UNIT IV **NERVOUS AND CARDIOVASCULAR SYSTEMS** **10**
Nervous system: Types and Structure of Neuron – Mechanism of Nerve Impulse - Structure and Parts of Brain. **Sensory organ:** Eye and Ear.**Cardiovascular:** Composition of Blood and functions – Structure of Heart – Conduction system of Heart – Types of Blood vessel – Blood Pressure.

UNIT V **DIGESTIVE AND URINARY SYSTEMS** **8**
Digestive: Organs of Digestive system – Digestion and Absorption. **Urinary:** Structure of Kidney and Nephron – Mechanisms of Urine formation – Regulation of Blood pressure by Urinary System.

TOTAL:45 PERIODS

OUTCOMES
At end of the course
- Students would be familiar with the requirements for formation of systems
- Students would be understand the basic structural and functional elements of human body
- Students would have knowledge on Skeletal and muscular systems
- Students would be able to comprehend circulatory and nervous systems and their components
- Students would study importance of digestive and urinary systems in Human body

TEXT BOOKS:
1. Prabhjot Kaur. Text Book of Anatomy and Physiology. Lotus Publsihers. 2014
2. Elaine.N. Marieb , "Essential of Human Anatomy and Physiology", Eight Edition, Pearson Education, New Delhi 2007
3. Valerie C. Scanlon and Tina Sanders, "Essential of Human Anatomy and Physiology", Fifth Edition, F.A. Davis Company, Philadelphia 2007

REFERENCES:
1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, Fundamentals of Anatomy and Physiology. Tenth Edition, Pearson Publishers, 2014
2. William F.Ganong, "Review of Medical Physiology", 22nd Edition, Mc Graw Hill, New Delhi. 2005
3. Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", Third Edition, W.B. Saunders Company, 2008
4. Guyton & Hall, "Medical Physiology", 13th Edition, Elsevier Saunders, 2015.

COURSE OUTCOMES	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Students would be familiar with the requirements for formation of systems	√								√			√
Students would be understand the basic structural and functional elements of human body	√	√										√
Students would have knowledge on Skeletal and muscular systems	√	√	√									√
Students would be able to comprehend circulatory and nervous systems and their components	√	√						√				√
Students would study importance of digestive and urinary systems in Human body	√	√										√

OGI751 **CLIMATE CHANGE AND ITS IMPACT** **L T P C**
3 0 0 3

OBJECTIVES:
- To understand the basics of weather and climate
- To have an insight on Atmospheric dynamics and transport of heat
- To develop simple climate models and evaluate climate changes using models

UNIT I BASICS OF WEATHER AND CLIMATE: 9
Shallow film of Air– stratified & disturbed atmosphere – law – atmosphere Engine. Observation of parameters: Temperature – Humidity – Wind - Pressure – precipitation-surface – networks. Constitution of atmosphere: well stirred atmosphere – process around turbopause – in dry air – ozone – carbon Dioxide – Sulphur Dioxide– Aerosol - water. Evolution of Atmosphere. State of atmosphere: Air temperature – pressure – hydrostatic – Chemistry – Distribution – circulation

UNIT II   ATMOSPHERIC DYNAMICS: 9

Atmosphere dynamics: law – isobaric heating and cooling – adiabatic lapse rates – equation of motion - solving and forecasting. Forces – Relative and absolute acceleration – Earth's rotation *coriolis* on sphere – full equation of motion – Geostrophy;- Thermal winds –departures – small-scale motion. Radiation, convection and advections: sun & solar radiation – energy balance – terrestrial radiation and the atmosphere – Green house effect- Global warming - Global budget – radiative fluxes - heat transport. Atmosphere and ocean systems convecting & advecting heat. Surface and boundary layer – smaller scale weather system – larger scale weather system.

UNIT III   GLOBAL CLIMATE   9

Components and phenomena in the climate system: Time and space scales – interaction and parameterization problem. Gradients of Radiative forcing and energy transports by atmosphere and ocean – atmospheric circulation – latitude structure of the circulation - latitude – longitude dependence of climate features.   Ocean circulation: latitude – longitude dependence of climate features – ocean vertical structure – ocean *thermohaline* circulation – land surface processes – carbon cycle.

UNIT IV   CLIMATE SYSTEM PROCESSES   9

Conservation of motion: Force – *coriolis* - pressure gradient- velocity equations – Application – geotropic wind – pressure co-ordinates. Equation of State – atmosphere – ocean. Application: thermal circulation – sea level rise. Temperature equation: Ocean – air – Application – decay of sea surface temperature. Continuity equation: ocean – atmosphere. Application: coastal upwelling – equatorial upwelling – conservation of warm water mass.   Moisture and salinity equation: conservation of mass – moisture. Source & sinks – latent heat. Moist processes – saturation – convection – Wave processes in atmosphere and ocean.

UNIT V   CLIMATE CHANGE MODELS   9

Constructing a climate model – climate system modeling – climate simulation and drift – Evaluation of climate model simulation – regional (RCM) – global (GCM) – Global average response to warming – climate change observed to date. .

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course the student will be able to understand
- The concepts of weather and climate
- The principles of Atmospheric dynamics and transport of heat and air mass
- The develop simple climate models and to predict climate change

TEXTBOOKS:
1. Fundamentals of weather and climate (2nd Edition) Robin Moilveen (2010), Oxford University Press
2. Climate change and climate modeling, J. David Neelin (2011) Cambridge University press.

OPY751   CLINICAL TRIALS   L T P C
                                                                      3 0 0 3
 OBJECTIVES:
- To highlight the epidemiologic methods, study design, protocol preparation
- To gain knowledge in the basic bio-statistical techniques involved in clinical research.
- To describe the principles involved in ethical, legal and regulatory issues in clinical trials.

UNIT I   ROLE OF CLINICAL TRIALS IN NEW DRUG DEVELOPMENT   9
Drug Discovery, regulatory guidance and governance, pharmaceutical manufacturing, nonclinical research, clinical trials, post-marketing surveillance, ethical conduct during clinical trials.

UNIT II   FUNDAMENTALS OF TRIAL DESIGN   9
Randomised clinical trials, uncontrolled trials. Protocol development, endpoints, patient selection, source and control of bias, randomization, blinding, sample size and power.

UNIT III   ALTERNATE TRIAL DESIGNS   9
Crossover design, factorial design, equivalence trials, bioequivalence trials, non-inferiority trials, cluster randomized trials, multi-center trials.

UNIT IV   BASICS OF STATISTICAL ANALYSIS   9
Types of data and normal distribution, significance tests and confidence intervals, comparison of means, comparison of proportions, analysis of survival data, subgroup analysis, regression analysis, missing data.

UNIT V   REPORTING OF TRIALS   9
Overview of reporting, trial profile, presenting baseline data, use of tables, figures, critical appraisal of report, meta-analysis.

TOTAL: 45 PERIODS

OUTCOMES:
The student will be able to
- Explain key concepts in the design of clinical trials.
- Describe study designs used, identify key issues in data management for clinical trials.
- Describe the roles of regulatory affairs in clinical trials.

TEXT BOOKS:
1. Fundamentals of Clinical Trials, Lawrence M. Friedman, Springer Science & Business Media, 2010
2. Textbook of Clinical Trials, David Machin, Simon Day, Sylvan Green, John Wiley & Sons, 2007
3. Clinical Trials: A Practical Approach, Stuart J. Pocock, John Wiley & Sons, 17-Jul-2013

REFERENCES:
1. Clinical trials, A practical guide to design, analysis and reporting. Duolao Wang and Ameet Bakhai. Remedica. 2006.
2. Introduction to statistics in pharmaceutical clinical trials. T.A. Durham and J Rick Turner. Pharmaceutical Press.
3. Clinical Trials: Study Design, Endpoints and Biomarkers, Drug Safety, and FDA and ICH Guidelines, Tom Brody, Academic Press, 2016.

OCS751   DATA STRUCTURES AND ALGORITHMS   L T P C
3 0 0 3

OBJECTIVES:
- To understand the various algorithm design and analysis techniques
- To learn linear data structures – lists, stacks, and queues
- To learn different sorting and searching algorithms
- To understand Tree and Graph data structures

UNIT I   ALGORITHM ANALYSIS, LIST ADT   11

Algorithms: Notation - analysis – running time calculations. Abstract Data Types (ADTs): List ADT – array-based implementation – linked list implementation – singly linked lists- applications of lists: Polynomial Manipulation. Implementation of List ADT using an array and using a linked list in C.

UNIT II   STACKS AND QUEUES   7

Stack ADT - Applications - Evaluating arithmetic expressions- Conversion of Infix to Postfix- Recursion. Queue ADT – Priority Queue - applications of queues. Implementation of Stack ADT and palindrome checking using C.   Implementation of Queue operations using arrays in C.

UNIT III   SEARCHING AND SORTING ALGORITHMS   10

Divide and conquer methodology - Searching: Linear Search - Binary Search. Sorting: Insertion sort – Merge sort – Quick sort – Heap sort. Analysis of searching and sorting techniques. Implementation of linear search, binary search, insertion sort, merge sort and quick sort algorithms in C.

UNIT IV   TREES   9

Tree ADT – tree traversals - Binary Tree ADT – expression trees – binary search tree ADT – applications of trees. Heap – applications of heap. Implementation of Binary search tree and its operations, tree traversal methods, finding height of the tree using C. Implementation of heap and heap sorting using arrays in C.

UNIT V   GRAPHS   8

Definition – Representation of Graph – Breadth-first traversal - Depth-first traversal – Dynamic programming Technique – Warshall's and Floyd's algorithm – Greedy method - Dijkstra's algorithm – applications of graphs. Implementation of graph, graph traversal methods, finding shortest path using Dijkstra's algorithm in C

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course, the students should be able to:
- Implement linear data structures and solve problems using them.
- Implement and apply trees and graphs to solve problems.
- Implement the various searching and sorting algorithms.

TEXT BOOKS:
1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education,1997.
2. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", 2nd Edition, Pearson Education, 1988.

REFERENCES:
1. Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education,1983.
2. S.Sridhar, "Design and Analysis of Algorithms", First Edition, Oxford University Press. 2014
3. Byron Gottfried, Jitender Chhabra, "Programming with C" (Schaum's Outlines Series), Mcgraw Hill Higher Ed., III Edition, 2010
4. Yashvant Kanetkar, "Data Structures Through C", BPB publications, II edition, 2003

OME751   **DESIGN OF EXPERIMENTS**   **L T P C**
                                                                          3 0 0 3

OBJECTIVE:
- To impart knowledge on various types of experimental designs conduct of experiments and data analysis techniques.

UNIT I   FUNDAMENTALS OF EXPERIMENTAL DESIGNS   9
Hypothesis testing – single mean, two means, dependant/ correlated samples – confidence intervals, Experimentation – need, Conventional test strategies, Analysis of variance, F-test, terminology, basic principles of design, steps in experimentation – choice of sample size – Normal and half normal probability plot – simple linear and multiple linear regression, testing using Analysis of variance.

UNIT II   SINGLE FACTOR EXPERIMENTS   9
Completely Randomized Design- effect of coding the observations- model adequacy checking- estimation of model parameters, residuals analysis- treatment comparison methods-Duncan's multiple range test, Newman-Keuel's test, Fisher's LSD test, Tukey's test- testing using contrasts- Randomized Block Design – Latin Square Design- Graeco Latin Square Design – Applications.

UNIT III   FACTORIAL DESIGNS   9
Main and Interaction effects - Two and three factor full factorial designs- Fixed effects and random effects model - Rule for sum of squares and Expected Mean Squares- 2^K Design with two and three factors- Yate's Algorithm- fitting regression model- Randomized Block Factorial Design - Practical applications.

UNIT IV   SPECIAL EXPERIMENTAL DESIGN   9
Blocking and Confounding in 2^K Designs- blocking in replicated design- 2^K Factorial Design in two blocks- Complete and partial confounding- Confounding 2^K Design in four blocks- Two level Fractional Factorial Designs- one-half fraction of 2^K Design, design resolution, Construction of one-half fraction with highest design resolution, one-quarter fraction of 2^K Design.

UNIT V   TAGUCHI METHODS   9
Design of experiments using Orthogonal Arrays, Data analysis from Orthogonal experiments- Response Graph Method, ANOVA- attribute data analysis- Robust design- noise factors, Signal to noise ratios, Inner/outer OA design.

**   TOTAL: 45 PERIODS**
OUTCOME:
- Able to apply experimental techniques to practical problems to improve quality of processes / products by optimizing the process / product parameters.

TEXT BOOK:
 1. Krishnaiah K, and Shahabudeen P, "Applied Design of Experiments and Taguchi Methods", PHI, India, 2011.

REFERENCES:
1. Douglas C. Montgomery, "Design and Analysis of Experiments", John Wiley & sons, 2005
2. Phillip J. Ross, "Taguchi Techniques for Quality Engineering", Tata McGraw-Hill, India, 2005.

OCH752   **ENERGY TECHNOLOGY**   **L T P C**
                                                                                      3 0 0 3

OBJECTIVES
- Students will gain knowledge about different energy sources

UNIT I   ENERGY   8
Introduction to energy – Global energy scene – Indian energy scene - Units of energy, conversion factors, general classification of energy, energy crisis, energy alternatives.

UNIT II   CONVENTIONAL ENERGY   8
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III   NON-CONVENTIONAL ENERGY   10
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV   BIOMASS ENERGY   10
Biomass origin - Resources – Biomass estimation. Thermochemical conversion – Biological conversion, Chemical conversion – Hydrolysis & hydrogenation, solvolysis, biocrude, biodiesel power generation gasifier, biogas, integrated gasification.

UNIT V   ENERGY CONSERVATION   9
Energy conservation - Act; Energy management importance, duties and responsibilities; Energy audit – Types methodology, reports, instruments. Benchmalcing and energy performance, material and energy balance, thermal energy management.

                                                                       TOTAL : 45 PERIODS

OUTCOMES:
- Understand conventional Energy sources, Non- conventional Energy sources, biomass sources and develop design parameters for equipment to be used in Chemical process industries. Understand energy conservation in process industries

TEXTBOOKS:
1. Rao, S. and Parulekar, B.B., Energy Technology, Khanna Publishers, 2005.
2. Rai, G.D., Non-conventional Energy Sources, Khanna Publishers, New Delhi, 1984.
3. Nagpal, G.R., Power Plant Engineering, Khanna Publishers, 2008.
4. Energy Management, Paul W.O'Callaghan McGraw – Hill, 1993

REFERENCES:
1. Nejat Vezirog, Alternate Energy Sources, IT, McGraw Hill, New York.
2. El. Wakil, Power Plant Technology, Tata McGraw Hill, New York, 2002.
3. Sukhatme. S.P., Solar Enery - Thermal Collection and Storage, Tata McGraw hill, New Delhi, 1981.
4. Handbook of Energy Audit by 7th edition Albert Thumann, P.E., C.E.M & William J Younger C.E.M, Faiment Press 2008

OCE751   **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.

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, flora and fauna - Matrices – Networks – Checklist Methods - Mathematical models for Impact prediction.

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 – Public Hearing-Environmental Clearance

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 – Roads and Bridges – Mass Rapid Transport Systems - Airports - Dams and Irrigation projects - Power plants.

                                                                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.

OGI752   **FUNDAMENTALS OF PLANETARY REMOTE SENSING**   **L T P C**
                                                                        3 0 0 3

OBJECTIVES:
- To provide an insight to the basics of planetary Remote Sensing
- To demonstrate how the Remote Sensing technique is applied to explore the surface characteristics of the planets and its environ.

UNIT I   PLANETARY SCIENCE   9
History and inventory of solar system – planet-definition –properties – Formation of solar system. Planetary Atmospheres: composition - thermal structure – clouds – meteorology – photo chemistry – Eddy Diffusion. Surfaces and Interiors: Mineralogy and Petrology – Planetary interiors – surface morphology. Terrestrial planets and the Moon: The moon & Mercury – surface – Atmosphere – Interior – Magnetic Field.

UNIT II   SATELLITE ORBIT   9
Equation of 2 body motion: Energy, orbits and energy – Circular Orbits-EOS Terra-Geosynchronous satellite orbit- orbital elements. Launching Satellites and space probes – Retrograde orbits-Inter planetary Transfer – Hohmann Transfer – Gravity Assist-Cassini-Messenger. Breaking into orbit or landing- Retro Rockets-Aerobraking- Parachutes- Impact.

UNIT III   PROPERTIES OF EMR   9
Definition of Remote Sensing – Electro Magnetic Radiation: Electromagnetic Spectrum-Development of EM theory – White Light – Excited hydrogen gas – Quantum physics – Definition. EM Radiation: Properties – Radiant energy – Sun's luminosity calculation. Other Energy: Black body radiation – Plank curve of black body. Properties of EMR: Kinetic energy – Polarization, laws of Max Plank, Wien's and Stephen Boltzmann

UNIT IV   RADIOMETRY AND SCATTEROMETRY   9
Radiometry – Radar Altimetry – Effect of surface roughness – Altimetry derived data – Reflectivity – Radiometry and Derived emissivity – Incorporation of data set into image analysis – Introduction to SAR – convolution – bidirectional reflectance distribution – Microwave scatterometry - side looking RADAR , SAR – Interferometry.

UNITV   PLANETARY APPLICATION   9
Planetary Imaging Spectroscopy- USGS Tetracoder and Expert system - Mars Global Surveyor Mission (MGS) – Digital Elevation Model(DEM) of Mars – Mars Orbiter Camera (MOC) – Stereo and photoclinometric techniques for DEM.

TOTAL : 45 PERIODS

OUTCOMES:
On completion of the course, the students have
- Exposure to fundamentals of planetary science or orbital mechanics
- The principles of observing the planets
- Knowledge of Remote Sensing methods for determining surface elevation and mapping of planets.

REFERENCES:
1. Fundamental Planetary Science : Physics, Chemistry and Habitability, Jack J. Lissauer, Imke de Pater (2013) Cambridge University Press
2. Physical principles of Remote Sensing, Rees, W.G.(2013) 3rd Edn, Cambridge University Press
3. Radar Remote Sensing of Planetary Surfaces, Bruce A Campbell (2011) Cambridge University Press
4. Remote Sensing Application for Planetary Surfaces, Kumar Deepak (2014) Lambert Publication.

OEN751   **GREEN BUILDING DESIGN**   **L T P C**
                                                                  3 0 0 3

UNIT I   ENVIRONMENTAL IMPLICATIONS OF BUILDINGS   9
Energy use, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transportation Energy for Building Materials; Maintenance Energy for Buildings.

**UNIT II   IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY OF
                  BUILDINGS   9**
Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

UNIT III   COMFORTS IN BUILDING   9
Thermal Comfort in Buildings- Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings-Implications of Geographical Locations.

UNIT IV   UTILITY OF SOLAR ENERGY IN BUILDINGS   9
Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.

UNIT V   GREEN COMPOSITES FOR BUILDINGS   9
Concepts of Green Composites. Water Utilisation in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

                                                TOTAL: 45 PERIODS

TEXT BOOKS:
  1. K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. Alternative Building Materials and Technologies. New Age International, 2007.
  2. Low Energy Cooling For Sustainable Buildings. John Wiley and Sons Ltd, 2009.
  3. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

REFERENCES:
  1. Osman Attmann Green Architecture Advanced Technologies and Materials. McGraw Hill, 2010.
  2. Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.
  3. Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke

OBM752   **HOSPITAL MANAGEMENT**   **L T P C**
                                                                  3 0 0 3
OBJECTIVES:
  • To understand the fundamentals of hospital administration and management.
  • To know the market related research process
  • To explore various information management systems and relative supportive services.
  • To learn the quality and safety aspects in hospital.

UNIT I   OVERVIEW OF HOSPITAL ADMINISTRATION   9

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning

UNIT II   HUMAN RESOURCE MANAGEMENT IN HOSPITAL   9

Principles of HRM – Functions of HRM – Profile of HRD Manager –Human Resource Inventory – Manpower Planning.

UNIT III   RECRUITMENT AND TRAINING   9

Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.

UNIT IV   SUPPORTIVE SERVICES   9

Medical Records Department – Central Sterilization and Supply Department – Pharmacy – Food Services - Laundry Services.

UNIT V   COMMUNICATION AND SAFETY ASPECTS IN HOSPITAL   9

Purposes – Planning of Communication, Modes of Communication – Telephone, ISDN, Public Address and Piped Music – CCTV.Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules.

TOTAL : 45 PERIODS

OUTCOMES:
At the end of the course, the student should be able to:
- Explain the principles of Hospital administration.
- Identify the importance of Human resource management.
- List various marketing research techniques.
- Identify Information management systems and its uses.
- Understand safety procedures followed in hospitals

TEXT BOOKS:
1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI – Fourth Edition, 2006.
2. G.D.Kunders, "Hospitals – Facilities Planning and Management – TMH, New Delhi – Fifth Reprint 2007.

REFERENCES:
1. Cesar A.Caceres and Albert Zara, "The Practice of Clinical Engineering, Academic Press, New York, 1977.
2. Norman Metzger, "Handbook of Health Care Human Resources Management", 2nd edition Aspen Publication Inc. Rockville, Maryland, USA, 1990.
3. Peter Berman "Health Sector Reform in Developing Countries" - Harvard University Press, 1995.
4. William A. Reinke "Health Planning For Effective Management" - Oxford University Press.1988
5. Blane, David, Brunner, "Health and SOCIAL Organization: Towards a Health Policy for the 21st Century", Eric Calrendon Press 2002.
6. Arnold D. Kalcizony & Stephen M. Shortell, "Health Care Management", 6th Edition Cengage Learning, 2011.

OME754 **INDUSTRIAL SAFETY** **L T P C**
3 0 0 3

OBJECTIVES :
To impart knowledge on safety engineering fundamentals and safety management practices.

UNIT I **INTRODUCTION** **9**
Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.

UNIT II **CHEMICAL HAZARDS** **9**
Chemical exposure – Toxic materials – Ionizing Radiation and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.

UNIT III **ENVIRONMENTAL CONTROL** **9**
Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

UNIT IV **HAZARD ANALYSIS** **9**
System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment

UNIT V **SAFETY REGULATIONS** **9**
Explosions – Disaster management – catastrophe control, hazard control ,Safety education and training - Factories Act, Safety regulations Product safety – case studies.

TOTAL : 45 PERIODS

OUTCOMES:
* Students must be able to identify and prevent chemical, environmental mechanical, fire hazard through analysis and apply proper safety techniques on safety engineering and management.

TEXT BOOK:
1. John V.Grimaldi, "Safety Management", AITB S Publishers, 2003.

REFERENCES:
1. Safety Manual, "EDEL Engineering Consultancy", 2000.
2. David L.Goetsch, "Occupational Safety and Health for Technologists", 5th Edition, Engineers and Managers, Pearson Education Ltd., 2005.

OCS752 **INTRODUCTION TO C PROGRAMMING** **L T P C**
3 0 0 3

OBJECTIVES
* To develop C Programs using basic programming constructs
* To develop C programs using arrays and strings
* To develop applications in C using functions and structures

UNIT I **INTRODUCTION** **9**
Structure of C program – Basics: Data Types – Constants –Variables - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements – Decision-making statements - Switch statement - Looping statements – Pre-processor directives - Compilation process – Exercise Programs: Check whether the required amount can be withdrawn based on the available amount – Menu-driven program to find the area of different shapes – Find the sum of even numbers
Text Book: Reema Thareja (Chapters 2,3)

UNIT II   ARRAYS   9

Introduction to Arrays – One dimensional arrays: Declaration – Initialization - Accessing elements – Operations: Traversal, Insertion, Deletion, Searching - Two dimensional arrays: Declaration – Initialization - Accessing elements – Operations: Read – Print – Sum – Transpose – Exercise Programs: Print the number of positive and negative values present in the array – Sort the numbers using bubble sort - Find whether the given is matrix is diagonal or not.
Text Book: Reema Thareja (Chapters 5)

UNIT III   STRINGS   9

Introduction to Strings - Reading and writing a string - String operations (without using built-in string functions): Length – Compare – Concatenate – Copy – Reverse – Substring – Insertion – Indexing – Deletion – Replacement – Array of strings – Introduction to Pointers – Pointer operators – Pointer arithmetic - Exercise programs: To find the frequency of a character in a string - To find the number of vowels, consonants and white spaces in a given text - Sorting the names.
Text Book: Reema Thareja (Chapters 6 & 7)

UNIT IV   FUNCTIONS   9

Introduction to Functions – Types: User-defined and built-in functions - Function prototype - Function definition - Function call - Parameter passing: Pass by value - Pass by reference - Built-in functions (string functions) – Recursive functions – Exercise programs: Calculate the total amount of power consumed by 'n' devices (passing an array to a function) – Menu-driven program to count the numbers which are divisible by 3, 5 and by both (passing an array to a function) – Replace the punctuations from a given sentence by the space character (passing an array to a function)
Text Book: Reema Thareja (Chapters 4)

UNIT V   STRUCTURES   9

Introduction to structures – Declaration – Initialization – Accessing the members – Nested Structures – Array of Structures – Structures and functions – Passing an entire structure – Exercise programs: Compute the age of a person using structure and functions (passing a structure to a function) – Compute the number of days an employee came late to the office by considering his arrival time for 30 days (Use array of structures and functions)
Text Book: Reema Thareja (Chapters 8)

TOTAL: 45 PERIODS

OUTCOMES
Upon completion of this course, the students will be able to
- Develop simple applications using basic constructs
- Develop applications using arrays and strings
- Develop applications using functions and structures

TEXT BOOK
1. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016

REFERENCES:
1. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
2. Paul Deitel and Harvey Deitel, "C How to Program", Seventh edition, Pearson Publication
3. Juneja, B. L and Anita Seth, "Programming in C", CENGAGE Learning India pvt. Ltd., 2011
4. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009

OBT753 **INTRODUCTION OF CELL BIOLOGY** **L T P C**
                                                3 0 0 3

AIM
- To provide knowledge on cell structure and its function.

UNIT I   CELL STRUCTURE   9
Cell organization, structure of organelles, extra cellular matrix and cell junctions.

UNIT II   CELL ORGANELLE AND FUNCTION   9
Nuclues, Mitochondria, Lysosomes, Endoplasmic reticulum, Golgi apparatus, vesicles, centrosomes, cell membranes, ribosomes, cytosol, chloroplasts, flagella, cell wall.

UNIT III   DIVISION   9
Cell cycle – mitosis, meiosis, cell cycle regulation and apoptosis.

UNIT IV   MACROMOLECULES   9
DNA, RNA and Proteins – basic units, architectural hierarchy and organisation, functions.

UNIT V   ENZYMES   9
Enzymes – Structure, Mechanism of action, Factors that affect enzyme activity, Common enzymes used in industrial setup of plant and animal origin.

                                                TOTAL : 45 PERIODS

TEXT BOOKS
1. Lodish, Harvey etal., "Molecular Cell Biology", 5 th Edition, W.H.Freeman, 2005.
2. Cooper, G.M. and R.E. Hansman "The Cell : A Molecular Approach", 4 th Edition, ASM Press, 2007.
3. Alberts, Bruce etal., "Molecular Biology of the Cell", 4 th Edition, Garland Science (Taylors Francis), 2002.

REFERENCES
1. McDonald, F etal., " Molecular Biology of Cancer" 2nd Edition, Taylor & Francis, 2004.
2. King, Roger J.B. "Cancer Biology" Addison Wesley Longman, 1996.

OMF751 **LEAN SIX SIGMA** **L T P C**
                                3 0 0 3

OBJECTIVE:
- To gain insights about the importance of lean manufacturing and six sigma practices.

UNIT I   LEAN & SIX SIGMA BACKGROUND AND FUNDAMENTALS   9
Historical Overview – Definition of quality – What is six sigma -TQM and Six sigma - lean manufacturing and six sigma- six sigma and process tolerance – Six sigma and cultural changes – six sigma capability – six sigma need assessments - implications of quality levels, Cost of Poor Quality (COPQ), Cost of Doing Nothing – assessment questions

UNIT II THE SCOPE OF TOOLS AND TECHNIQUES 9

Tools for definition – IPO diagram, SIPOC diagram, Flow diagram, CTQ Tree, Project Charter – Tools for measurement – Check sheets, Histograms, Run Charts, Scatter Diagrams, Cause and effect diagram, Pareto charts, Control charts, Flow process charts, Process Capability Measurement, Tools for analysis – Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, Five Whys, interrelationship diagram, overall equipment effectiveness, TRIZ innovative problem solving – Tools for improvement – Affinity diagram, Normal group technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis – Tools for control – Gantt chart, Activity network diagram, Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.

UNIT III SIX SIGMA METHODOLOGIES 9

Design For Six Sigma (DFSS),Design For Six Sigma Method - Failure Mode Effect Analysis (FMEA), FMEA process - Risk Priority Number (RPN)- Six Sigma and Leadership, committed leadership – Change Acceleration Process (CAP)- Developing communication plan – Stakeholder

UNIT IV SIX SIGMA IMPLEMENTATION AND CHALLENGES 9

Tools for implementation – Supplier Input Process Output Customer (SIPOC) – Quality Function Deployment or House of Quality (QFD) – alternative approach –implementation – leadership training, close communication system, project selection – project management and team – champion training – customer quality index – challenges – program failure, CPQ vs six sigma, structure the deployment of six sigma – cultural challenge – customer/internal metrics

UNIT V EVALUATION AND CONTINUOUS IMPROVEMENT METHODS 9

Evaluation strategy – the economics of six sigma quality, Return on six Sigma (ROSS), ROI, poor project estimates – continuous improvement – lean manufacturing – value, customer focus, Perfection, focus on waste, overproduction – waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people – Kaizen – 5S

TOTAL: 45 PERIODS

OUTCOME:

- The student would be able to relate the tools and techniques of lean sigma to increase productivity

REFERENCES:

1. Michael L.George, David Rownalds, Bill Kastle, What is Lean Six Sigma, McGraw – Hill 2003
2. Thomas Pyzdek, The Six Sigma Handbook, McGraw-Hill,2000
3. Fred Soleimannejed , Six Sigma, Basic Steps and Implementation, AuthorHouse, 2004
4. Forrest W. Breyfogle, III, James M. Cupello, Becki Meadows, Managing Six Sigma:A Practical Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line Success, John Wiley & Sons, 2000
5. James P. Womack, Daniel T.Jones, Lean Thinking, Free Press Business, 2003

OAN751	LOW COST AUTOMATION	L T P C
		3 0 0 3

OBJECTIVES

- To give basic knowledge about automation
- To understand the basic hydraulics and pneumatics systems for automation
- To understand the assembly automation

UNIT I AUTOMATION OF ASSEMBLY LINES 9

Concept of automation - mechanization and automation - Concept of automation in industry - mechanization and automation - classification, balancing of assembly line using available algorithms - Transfer line-monitoring system (TLMS) using Line Status - Line efficiency - Buffer stock Simulation in assembly line

UNIT II   AUTOMATION USING HYDRAULIC SYSTEMS   9
Design aspects of various elements of hydraulic systems such as pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc. - Selection of hydraulic fluid, practical case studied on hydraulic circuit design and performance analysis - Servo valves, electro hydraulic valves, proportional valves and their applications.

UNIT III   AUTOMATION USING PNEUMATIC SYSTEMS   9
Pneumatic fundamentals - control elements, position and pressure sensing -logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods – step counter method - compound circuit design - combination circuit design. Pneumatic equipments - selection of components - design calculations -application - fault finding – hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

UNIT IV   AUTOMATION USING ELECTRONIC SYSTEMS   9
Introduction - various sensors – transducers - signal processing - servo systems - programming of microprocessors using 8085 instruction - programmable logic controllers

UNIT V   ASSEMBLY AUTOMATION   9
Types and configurations - Parts delivery at workstations - Various vibratory and non vibratory devices for feeding - hopper feeders, rotary disc feeder, centrifugal and orientation - Product design for automated assembly.

                                                                TOTAL : 45 PERIODS
OUTCOMES:
  • Upon completion of this course, the students can able to do low cost automation systems
  • Students can do some assembly automation

TEXT BOOKS:
1.   Anthony Esposito, "Fluid Power with applications", Prentice Hall international, 2009.
2.   Mikell P Groover, "Automation, Production System and Computer Integrated
3.   Manufacturing", Prentice Hall Publications, 2007.

REFERENCES
1. Kuo .B.C, "Automatic control systems", Prentice Hall India, New Delhi, 2007.
2. Peter Rohner, "Industrial hydraulic control", Wiley Edition, 1995.
3. Mujumdar.S.R, "Pneumatic System", Tata McGraw Hill 2006

OBT752   MICROBIOLOGY   L T P C
                                                                       3 0 0 3
OBJECTIVE
  • To introduce students to the principles of Microbiology ,to emphasize the structure and biochemical aspects of various microbes.

UNIT I   INTRODUCTION TO MICROBIOLOGY   9
classification and nomenclature of microorganisms, microscopic examination of microorganisms: light, fluorescent, dark field, phase contrast, and electron microscopy.

UNIT II   MICROBES- STRUCTURE AND REPRODUCTION   9
Structural organization and multiplication of bacteria, viruses (TMV, Hepatitis B), algae (cyanophyta, rhodophyta) and fungi (Neurospora), life history of actinomycetes (Streptomyces), yeast (Sacharomyces), mycoplasma (M. pneumoniae) and bacteriophages (T4 phage, ʎ phage)

UNIT III   MICROBIAL NUTRITION, GROWTH AND METABOLISM   9
Nutritional classification of microorganisms based on carbon, energy and electron sourcesDefinition of growth, balanced and unbalanced growth, growth curve and different methods to quantify bacterial growth:(counting chamber, viable count method, counting without equipment,different media used for bacterial culture (defined, complex, selective, differential, enriched) themathematics of growth-generation time, specific growth rate.

UNIT IV   CONTROL OF MICROORGANISMS   9
Physical and chemical control of microorganisms Definition of sterilization, dry and moist heat, pasteurization, tyndalization; radiation, ultrasonication, filtration. Disinfection sanitization, antiseptics sterilants and fumigation. mode of action and resistance to antibiotics; clinically important microorganisms

UNIT V   INDUSTRIAL MICROBIOLOGY   9
Microbes involved in preservation (Lactobacillus,bacteriocins), spoilage of food and food borne pathogens *(E.coli, S.aureus, Bacillus, Clostridium)*. Industrial use of microbes (production of penicillin, alcohol, vitamin B-12); biogas; bioremediation(oil spillage leaching of ores by microorganisms ,pollution control); biofertilizers, biopesticides. Biosensors.

TOTAL: 45 PERIODS

OUTCOMES:
- To provide to the students the fundamentals of Microbiology , the scope of microbiology and solve the problems in microbial infection and their control,

TEXT BOOKS:
1. Pelczar, M.J. "Microbiology", 5th Edition, Tata McGraw-Hill, 1993.
2. Prescot. Harley, Klein. " Microbiology ": McGraw-Hill Higher Education, 2008
3. Ananthanarayanan, R. and C.K. Jayaram Paniker, "Textbook of Microbiology",4th Edition, Orient Longman, 1990.

OMV751   MARINE VEHICLES   L   T   P   C
                                                                         3   0   0   3

OBJECTIVES:
- To provide the students a basic knowledge about various types of marine vehicles
- To provide the students basic theory behind the design and development of marine vehicles

UNIT I   MARINE VEHICLES   6
Types – general – by function – commercial marine vehicles- passenger ship, cargo ships, oil and chemical tankers , cattle carriers, harbor crafts, off shore platform, container ships

UNIT II   REEFERS AND GAS CARRIERS   9
Introduction – Types , design considerations, safety – operation and controls, precaution during bunkering

UNIT III   REMOTELY OPERABLE VEHICLE (ROV), UMS SHIPS   9

Remotely Operable Vehicles (ROV) – The ROV business – Design theory and standards – control and simulation – design and stability – components of ROV – applications, UMS operation, and controls

UNIT IV   SUBMERSIBLES AND AUTONOMOUS UNDERWATER VEHICLE (AUV)   9

submersibles types – applications, AUV – Design and construction considerations – components – sensors – Navigation -control strategies – applications

UNIT V   MANNED AND UN MANNED SUBMERSIBLE   12

Introduction – Design and operational consideration – pressure hull exo-structure – ballasting and trim – maneuvering and control – Life support and habitability – emergency devices and equipment's – certification and classification, towed vehicles – gliders – crawler – Design and construction

TOTAL :45 PERIODS

OUTCOMES:
- Students will be able understand the types of marine vehicles
- Students should get a preliminary knowledge in marine vehicle design, construction and its components

TEXT BOOKS:
1. Jonathan M. Ross, human factors for naval marine vehicle design and operation
2. Sabiha A. Wadoo, Pushkin Kachroo, Autonomous underwater vehicles, modelling, control design and Simulation, CRC press, 2011
3. R. Frank Busby, Manned Submersibles, Office of the oceanographer of the Navy, 1976

REFERENCES
1. Ferial L hawry, The ocean engineering handbook, CRC press,2000
2. Richard A Geyer, "Submersibles and their use in oceanography and ocean engineering", Elsevier, 1997
3. Robert D. Christ,Robert L. Wernli, Sr. "The ROV Manual A User Guide for Remotely Operated Vehicles", Elsevier, second edition, 2014

OAE752   PRINCIPLES OF FLIGHT MECHANICS   L T P C
**   3 0 0 3**

OBJECTIVE:
- To make the student understand the performance of airplanes under various flight conditions like take off, cruise, landing, climbing, gliding, turning and other maneuvers.

UNIT I   GENERAL CONCEPTS   9

International Standard atmosphere, IAS, EAS, TAS, Propeller theory- Froude momentum and blade element theories, Propeller co-efficients, Use of propeller charts, Performance of fixed and variable pitch propellers, High lift devices, Thrust augmentation

UNIT II   DRAG OF BODIES   8

Streamlined and bluff body, Types of drag, Effect of Reynold's number on skin friction and pressure drag, Drag reduction of airplanes, Drag polar, Effect of Mach number on drag polar. Concept of sweep- effect of sweep on drag.

UNIT III   STEADY LEVEL FLIGHT   10
General equation of motion of an airplane. Steady level flight, Thrust required and Power required, Thrust available and Power available for propeller driven and jet powered aircraft, Effect of altitude, maximum level flight speed, conditions for minimum drag and minimum power required, Effect of drag divergence on maximum velocity, Range and Endurance of Propeller and Jet aircrafts. Effect of wind on range and endurance.

UNIT IV   GLIDING AND CLIMBING FLIGHT   9
Shallow and steep angles of climb, Rate of climb, Climb hodograph, Maximum Climb angle and Maximum Rate of climb- Effect of design parameters for propeller jet and glider aircrafts, Absolute and service ceiling, Cruise climb, Gliding flight, Glide hodograph

UNIT V   ACCELERATED FLIGHT   9
Estimation of take-off and landing distances, Methods of reducing landing distance, level turn, minimum turn radius, maximum turn rate, bank angle and load factor, Constraints on load factor, SST and MSTR. Pull up and pull down maneuvers, V-n diagram.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to
   • Understand concepts of take-off, climb, cruise, turn, descent and landing performance.
   • understand the performance characteristics of the different types of power plants
   • Understand and predict the behavior of fixed wing aircraft undertaking a typical flight profile
   • Understand the factors that influence aircraft design and limit aircraft performance.

TEXT BOOKS:
   1. Anderson, Jr., J.D. Aircraft Performance and Design, McGraw-Hill International Edition, 1999
   2. Houghton,E.L. and Carruthers, N.B. Aerodynamics for engineering students, Edward Arnold Publishers, 1988.

REFERENCES:
   1. Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th edition , 2015
   2. Clancy, L J., Aerodynamics, Shroff publishers (2006)
   3. John J Bertin., Aerodynamics for Engineers, Prentice Hall; 6th edition, 2013.
   4. Kuethe, A.M. and Chow, C.Y., Foundations of Aerodynamics, John Wiley & Sons; 5th Edition, 1997.

OIE751	ROBOTICS	L	T	P	C
		3	0	0	3

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   6
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   12

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   13

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   5

RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

OUTCOME:
- Upon completion of this course, the students can able to apply the basic engineering knowledge for the design of robotics

TEXT BOOKS:
1. Klafter R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall, 2003.
2. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2001.

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., 1994.
3. Koren Y., "Robotics for Engineers", Mc Graw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.
5. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill, 1995.
6. Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company, 2008.
7. Surender Kumar, "Industrial Robots and Computer Integrated Manufacturing", Oxford and IBH Publishing Co. Pvt. Ltd., 1991.

OME752   **SUPPLY CHAIN MANAGEMENT**   L   T   P   C
                                                                    3   0   0   3

OBJECTIVE:
- To provide an insight on the fundamentals of supply chain networks, tools and techniques.

UNIT I   INTRODUCTION   9
Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain - Decision Phases in Supply Chain - Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles.

UNIT II   SUPPLY CHAIN NETWORK DESIGN   9
Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions.

UNIT III   LOGISTICS IN SUPPLY CHAIN   9
Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation.

UNIT IV   SOURCING AND COORDINATION IN SUPPLY CHAIN   9
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.

UNIT V   SUPPLY CHAIN AND INFORMATION TECHNOLOGY   9
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

OUTCOME:
- The student would understand the framework and scope of supply chain networks and functions.

TEXTBOOK:
1. Sunil Chopra, Peter Meindl and Kalra, "Supply Chain Management, Strategy, Planning, and Operation", Pearson Education, 2010.

REFERENCES:
1. Jeremy F.Shapiro, "Modeling the Supply Chain", Thomson Duxbury, 2002.
2. Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management, PHI, 2010
3. David J.Bloomberg , Stephen Lemay and Joe B.Hanna, "Logistics", PHI 2002.
4. James B.Ayers, "Handbook of Supply Chain Management", St.Lucle press, 2000.

OME753   **SYSTEMS ENGINEERING**   L T P C
                                                                    3 0 0 3

OBJECTIVE:
- To introduce system engineering concepts to design the manufacturing system for optimum utilization of source for effective functioning.

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

Definitions of Systems Engineering, Systems Engineering Knowledge, Life cycles, Life-cycle phases, logical steps of systems engineering, Frame works for systems engineering.

UNIT II **SYSTEMS ENGINEERING PROCESSES** **9**

Formulation of issues with a case study, Value system design, Functional analysis, Business Process Reengineering, Quality function deployment, System synthesis, Approaches for generation of alternatives.

UNIT III **ANALYSIS OF ALTERNATIVES- I** **9**

Cross-impact analysis, Structural modeling tools, System Dynamics models with case studies, Economic models: present value analysis – NPV, Benefits and costs over time, ROI, IRR; Work and Cost breakdown structure,

UNIT IV **ANALYSIS OF ALTERNATIVES–II** **9**

Reliability, Availability, Maintainability, and Supportability models; Stochastic networks and Markov models, Queuing network optimization, Time series and Regression models, Evaluation of large scale models

UNIT V **DECISION ASSESSMENT** **9**

Decision assessment types, Five types of decision assessment efforts, Utility theory, Group decision making and Voting approaches, Social welfare function; Systems Engineering methods for Systems Engineering Management,

TOTAL : 45 PERIODS

OUTCOMES:
- The Student must be able to apply systems engineering principles ot make decision for optimization.
- Hence an understanding of the systems engineering discipline and be able to use the core principles and processes for designing effective system.

TEXT BOOK:
1. Andrew P. Sage, James E. Armstrong Jr. "Introduction to Systems Engineering", John Wiley and Sons, Inc,2000.

OTL751 **TELECOMMUNICATION SYSTEM MODELING AND SIMULATION** **L T P C**
3 0 0 3

OBJECTIVES:
- To gain knowledge in modeling of different communication systems.
- To know the techniques involved in performance estimation of telecommunication systems.
- To learn the use of random process concepts in telecommunication system simulation.
- To study the modeling methodologies of a telecommunication system.
- To study about the QAM digital radio link environment.

UNIT I **SIMULATION OF RANDOM VARIABLES RANDOM PROCESS** **9**

Generation of random numbers and sequence – Gaussian and uniform random numbers Correlated random sequences – Testing of random numbers generators – Stationary and uncorrelated noise – Goodness of fit test.

UNIT II   MODELING OF COMMUNICATION SYSTEMS   9
Radio frequency and optical sources – Analog and Digital signals – Communication channel and model – Free space channels – Multipath channel and discrete channel noise and interference.

UNIT III   ESTIMATION OF PERFORMANCE MEASURE FOR SIMULATION   9
Quality of estimator – Estimation of SNR – Probability density function and bit error rate – Monte Carlo method – Importance sampling method – Extreme value theory.

UNIT IV   SIMULATION AND MODELING METHODOLOGY   9
Simulation environment – Modeling considerations – Performance evaluation techniques – Error source simulation – Validation.

UNIT V   CASE STUDIES   9
Simulations of QAM digital radio link environment – Light wave communication link – Satellite system.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course , students would be able to
- Apply the constituents of a telecommunication systems.
- Analyze various modeling methodologies and simulation techniques.
- Estimate the performance measures of telecommunication systems.
- Apply system modeling in telecommunication.
- Demonstrate light wave communication and satellite communication systems.

TEXTBOOKS:
1.Jeruchim MC   Balaban P Sam K Shanmugam, " Simulation of communication Systems:
   Modeling, Methodology and Techniques", Plenum press , New York,2002
2.Jerry banks & John S Carson, " Discrete Event System Simulation",Prentice Hall of
   India,1996

REFERENCES:
1. Averill M Law, "Simulation Modeling and Analysis",McGraw-Hill Inc,2007
   Geoffrey Gorden, "System Simulation",Prentice Hall of India,1992
2.Turin W, "Performance Analysis of Digital Communication Systems", Computer Science
   Press, New York,1990

OML751   TESTING OF MATERIALS   L T P C
                                                                            3 0 0 3
OBJECTIVE:
To understand the various destructive and non destructive testing methods of materials and its industrial applications.

UNIT I   INTRODUCTION TO MATERIALS TESTING   9
Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.

UNIT II   MECHANICAL TESTING   9
Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT III   NON DESTRUCTIVE TESTING   9
Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT IV   MATERIAL CHARACTERIZATION TESTING   9
Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT V   OTHER TESTING   9
Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo-mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.

TOTAL: 45 PERIODS

OUTCOMES:
- Identify suitable testing technique to inspect industrial component
- Ability to use the different technique and know its applications and limitations

TEXT BOOKS:
1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Cullity, B. D., "Elements of X-ray diffraction", 3rd Edition, Addison-Wesley Company Inc., New York, 2000.
3. P. Field Foster, "The Mechanical Testing of Metals and Alloys" 7th Edition, Cousens Press, 2007.

REFERENCES:
1. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.
2. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA.
3. Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.

| OIC751 | TRANSDUCER ENGINEERING | L T P C |
| | | 3 0 0 3 |

OBJECTIVES:
- To understand how physical quantities are measured and how they are converted to electrical or other forms.
- To have an adequate knowledge in resistance, transducers.
- To develop the knowledge of inductance and capacitance transducers.
- To study the characteristics of Transducers.
- To impart knowledge on various types of transducers

UNIT I   SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS   9

Units and standards – Calibration methods – Static calibration – Classification of errors :-   Limiting error and probable error – Error analysis :– Statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers.

UNIT II   CHARACTERISTICS OF TRANSDUCERS   9

Static characteristics: – Accuracy, precision, resolution, sensitivity, linearity, span and range -Dynamic characteristics: – Mathematical model of transducer – Zero, I and II order transducers - Response to impulse, step, ramp and sinusoidal inputs.

UNIT III   VARIABLE RESISTANCE TRANSDUCERS   9

Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezoresistive sensor and humidity sensor.

UNIT IV   VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS   9

Induction potentiometer – Variable reluctance transducers – EI pick up – Principle of operation, construction details, characteristics and applications of LVDT –Capacitive transducer and types – Capacitor microphone – Frequency response.

UNIT V   OTHER TRANSDUCERS   9

Piezoelectric transducer - Hall Effect transducer – Magneto elastic sensor- Digital transducers – Smart sensors - Fibre optic sensors- Film sensors-Introduction to MEMS and Nano sensors.

TOTAL : 45 PERIODS

OUTCOMES:
- Ability to model and analyze transducers.

TEXT BOOKS:
1. Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design, Oxford University Press, Cambridge, 2003.
2. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.
3. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2010. E.A.

REFERENCES:
1. John P. Bentley, Principles of Measurement Systems, III Edition, Pearson Education, 2000.
2. Murthy, D.V.S., Transducers and Instrumentation, 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
3. W.Bolton, Engineering Science, Elsevier Newnes, Fifth edition, 2006.
4. Ramón Pallás-Areny, John G. Webster, Sensors and Signal Conditioning, Wiley-Interscience 2nd Edition, 1991.
5. Bela G.Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th Edition, Vol. 1, ISA/CRC Press, 2003.
6. Ian Sinclair, Sensors and Transducers, 3rd Edition, Elsevier, 2012.

OCY751   **WASTE WATER TREATMENT**   **L T P C**
                                                                           3 0 0 3

OBJECTIVES
- To make the student conversant with the water treatment methods including adsorption and oxidation process.
- To provide basic under standings about the requirements of water, its preliminary treatment.

UNIT I   WATER QUALITY AND PRELIMINARY TREATMENT   9
Water Quality-physical- chemical and biological parameters of water- water quality requirement - potable water standards -wastewater effluent standards -water quality indices. Water purification systems in natural systems- physical processes-chemical processes and biological processes-primary, secondary and tertiary treatment-Unit operations-unit processes. Mixing, clarification - sedimentation; Types; aeration and gas transfer – coagulation and flocculation, coagulation processes - stability of colloids - destabilization of colloids- transport of colloidal particles, clariflocculation.

UNIT II   INDUSTRIAL WATER TREATMENT   9
Filtration – size and shape characteristics of filtering media – sand filters hydraulics of filtration – design considerations – radial, upflow, highrate and multimedia filters, pressure filter. Water softening – lime soda, zeolite and demineralization processes – industrial water treatment for boilers.

UNIT III   CONVENTIONAL TREATMENT METHODS   9
Taste and odour control – adsorption – activated carbon treatment – removal of color – iron and manganese removal – aeration, oxidation, ion exchange and other methods – effects of fluorides – fluoridation and defluoridation –desalination - corrosion prevention and control – factors influencing corrosion – Langelier index – corrosion control measures.

UNIT IV   WASTEWATER TREATMENT   9
Wastewater treatment – pre and primary treatment – equalization neutralization – screening and grid removal – sedimentation – oil separation gas stripping of volatile organics – biological oxidation – lagoons and stabilization basins – aerated lagoons – activated sludge process – trickling filtration – anaerobic decomposition.

UNIT V   ADSORPTION AND OXIDATION PROCESSES   9
Chemical process – adsorption – theory of adsorption – ion exchange process – chemical oxidation – advanced oxidation process – sludge handling and disposal – miscellaneous treatment processes.

                                                                  TOTAL: 45 PERIODS
OUTCOMES
- Will have knowledge about adsorption and oxidation process.
- Will gain idea about various methods available for water treatment.
- Will appreciate the necessity of water and acquire knowledge of preliminary treatment.

TEXTBOOKS:
1. Metcalf and Eddy, "Wastewater Engineering", 4th ed., McGraw Hill Higher Edu., 2002.
2. W. Wesley Eckenfelder, Jr., "Industrial Water Pollution Control", 2nd Edn., McGraw Hill Inc., 1989.

REFERENCES
1. S.P. Mahajan, "Pollution control in process industries", 27th Ed. Tata McGraw Hill Publishing Company Ltd., 2012.
2. M. Lancaster, "Green Chemistry: An Introductory Text", 2nd edition, RSC publishing, 2010.
3. C.S. Rao, "Environmental Pollution Control Engineering", New Age International, 2007.

ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
B.E. MECHANICAL ENGINEERING
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM
OPEN ELECTIVES (Offered by Other Branches)

V SEMESTER
OPEN ELECTIVE - I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OCE551	Air Pollution and Control Engineering	OE	3	3	0	0	3
2.	OAT551	Automotive Systems	OE	3	3	0	0	3
3.	OIC551	Biomedical Instrumentation	OE	3	3	0	0	3
4.	OIT552	Cloud Computing	OE	3	3	0	0	3
5.	OIT551	Database Management Systems	OE	3	3	0	0	3
6.	OAI551	Environment and Agriculture	OE	3	3	0	0	3
7.	OPT551	Fibre Reinforced Plastics	OE	3	3	0	0	3
8.	OCE552	Geographic Information System	OE	3	3	0	0	3
9.	OAT552	Internal Combustion Engines	OE	3	3	0	0	3
10.	OML551	Introduction To Nanotechnology	OE	3	3	0	0	3
11.	OIM552	Lean Manufacturing	OE	3	3	0	0	3
12.	OBM552	Medical Physics	OE	3	3	0	0	3
13.	OML552	Microscopy	OE	3	3	0	0	3
14.	OAI552	Participatory Water Resources Management	OE	3	3	0	0	3
15.	OCH552	Principles of Chemical Engineering	OE	3	3	0	0	3
16.	OBT554	Principles of Food Preservation	OE	3	3	0	0	3
17.	OMF551	Product Design and Development	OE	3	3	0	0	3
18.	OAI553	Production Technology of Agricultural machinery	OE	3	3	0	0	3
19.	ORO551	Renewable Energy Sources	OE	3	3	0	0	3
20.	OAN551	Sensors and Transducers	OE	3	3	0	0	3
21.	OIC552	State Variable Analysis and Design	OE	3	3	0	0	3
22.	OTL553	Telecommunication Network Management	OE	3	3	0	0	3
23.	OIM551	World Class Manufacturing	OE	3	3	0	0	3

VII SEMESTER

OPEN ELECTIVE - II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OAI751	Agricultural Finance, Banking and Co-operation	OE	3	3	0	0	3
2.	OEE751	Basic Circuit Theory	OE	3	3	0	0	3
3.	OGI751	Climate Change and its Impact	OE	3	3	0	0	3
4.	OCS751	Data Structures and Algorithms	OE	3	3	0	0	3
5.	OML752	Electronic Materials	OE	3	3	0	0	3
6.	OCE751	Environmental and Social Impact Assessment	OE	3	3	0	0	3
7.	OAE751	Fundamentals of Combustion	OE	3	3	0	0	3
8.	OGI752	Fundamentals of Planetary Remote Sensing	OE	3	3	0	0	3
9.	OEN751	Green Building Design	OE	3	3	0	0	3
10.	OAI752	Integrated Water Resources Management	OE	3	3	0	0	3
11.	OEI 751	Introduction to Embedded Systems	OE	3	3	0	0	3
12.	OMF751	Lean Six Sigma	OE	3	3	0	0	3
13.	OAN751	Low Cost Automation	OE	3	3	0	0	3
14.	OMT751	MEMS and NEMS	OE	3	3	0	0	3
15.	ORO751	Nano Computing	OE	3	3	0	0	3
16.	OAE752	Principles of Flight Mechanics	OE	3	3	0	0	3
17.	OCH751	Process Modeling and Simulation	OE	3	3	0	0	3
18.	OAT751	Production of Automotive Components	OE	3	3	0	0	3
19.	OIE751	Robotics	OE	3	3	0	0	3
20.	OML753	Selection of Materials	OE	3	3	0	0	3
21.	OML751	Testing of Materials	OE	3	3	0	0	3
22.	OAT752	Vehicle Styling and Design	OE	3	3	0	0	3
23.	OTT751	Weaving Mechanisms	OE	3	3	0	0	3
24.	OMV751	Marine Vehicles	OE	3	3	0	0	3

OCE551   **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.

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 - Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators.

UNIT IV   CONTROL OF GASEOUS CONTAMINANTS   11
Factors affecting Selection of Control Equipment – Working principle - absorption, Adsorption, condensation, Incineration, Bio filters – Process control and Monitoring.

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.

OAT551   **AUTOMOTIVE SYSTEMS**   **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   **AUTOMOTIVE ENGINE AUXILIARY SYSTEMS**   **9**
Automotive engines- External combustion engines –Internal combustion engines -classification of engines- SI Engines- CI Engines- two stroke engines -four stroke engines- construction and working principles - IC engine components- functions and materials -valve timing –port timing diagram- Injection system -Unit injector system- Rotary distributor type - Electronically controlled injection system for SI engines-CI engines-Ignition system - Electronic ignition system -Transistorized ignition system, capacitive discharge ignition system.

UNIT II   **VEHICLE FRAMES AND STEERING SYSTEM**   **9**
Vehicle construction and different Chassis layouts –classifications of chassis- types of frames- frameless chassis construction –articulated vehicles- vehicle body - Vehicle aerodynamics-various resistances and its effects - steering system –conventional – sophisticated vehicle- and types of steering gear box-Power Steering- Steering geometry-condition for true rolling motion-Ackermann's- Devi's steering system - types of stub axle – Types of rear axles.

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 –- Hotchkiss Drive and Torque Tube Drive- rear axle- Differential-wheels and tyres.

UNIT IV   **SUSPENSION AND BRAKES SYSTEMS**   **9**
Suspension Systems- conventional Suspension Systems -independent Suspension Systems –leaf spring – coil spring –taper-lite - eligo,s spring Types of brakes -Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control. Derive the equation of Forces acting while applying a brakes on plain surface - inclined road-gradient .

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. Turbo chargers -Engine emission control by three way catalytic converter system.
Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

                                                  TOTAL: 45 PERIODS

OUTCOMES:
- Upon completion of this course, the students will be able to identify the different components in automobile engineering.
- Have clear understanding on different auxiliary and transmission systems usual.

TEXT BOOKS:
1. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2007.
2. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.
3. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 1997.

REFERENCES:
1. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
2. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.
3. Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart –Will Cox Company Inc, USA ,1978.
4. Newton ,Steeds and Garet, "Motor Vehicles", Butterworth Publishers,1989.

OIC551	BIOMEDICAL INSTRUMENTATION	L T P C
		3 0 0 3

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   HUMAN BODY SUBSYSTEM AND TRANSDUCERS   9
Brief description of muscular, cardiovascular and respiratory systems; their electrical, mechanical and chemical activities. Principles and classification of transducers for Bio-medical applications. Electrode theory, different types of electrodes; Selection criteria for transducers and electrodes.

UNIT II   NON ELECTRICAL PARAMETERS MEASUREMENT   9
Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Blood Gas analysers, pH of blood – Measurement of blood pCO_2, pO_2.

UNIT III   ELECTRICAL PARAMETERS MEASUREMENT AND ELECTRICAL SAFETY   9
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 equipments.

UNIT IV   IMAGING MODALITIES AND BIO-TELEMETRY   9
Diagnostic X-rays - Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography – Different types of biotelemetry systems.

UNIT V   LIFE ASSISTING AND THERAPEUTIC DEVICES   9
Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators - Heart Lung machine – Dialysers - Diathermy – Lithotripsy.

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to understand communication mechanics in a biomedical system.
- Ability to understand and analyze measurement of certain electrical and non-electrical parameters.
- Ability to understand basic principles of imaging techniques, life assisting and therapeutic devices.

TEXT BOOKS:
1. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice hall of India, New Delhi, 2007.
2. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.
3. Khandpur R.S, Handbook of Biomedical Instrumentation, , Tata McGraw-Hill, New Delhi, 2nd Edition, 2003.

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.

OIT552   **CLOUD COMPUTING**   **L T P C**
                                                                 3 0 0 3

OBJECTIVES:
- To learn about the concept of cloud and utility computing.
- 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 TO CLOUD COMPUTING**   **9**
Introduction to Cloud Computing – Roots of Cloud Computing – Desired Features of Cloud Computing – Challenges and Risks – Benefits and Disadvantages of Cloud Computing.

UNIT II   **VIRTUALIZATION**   **9**
Introduction to Virtualization Technology – Load Balancing and Virtualization – Understanding Hypervisor – Seven Layers of Virtualization – Types of Virtualization – Server, Desktop, Application Virtualization.

UNIT III   **CLOUD ARCHITECTURE, SERVICES AND STORAGE**   **9**
NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage.

UNIT IV   **RESOURCE MANAGEMENT AND SECURITY IN CLOUD**   **9**
Inter Cloud Resource Management – Resource Provisioning Methods – Security Overview – Cloud Security Challenges – Data Security –Application Security – Virtual Machine Security.

UNIT V   **CASE STUDIES**   **9**
Google App Engine(GAE) – GAE Architecture – Functional Modules of GAE – Amazon Web Services(AWS) – GAE Applications – Cloud Software Environments – Eucalyptus – Open Nebula – Open Stack.

                                                       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.
- Choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

TEXT BOOKS:
1. Buyya R., Broberg J., Goscinski A., "Cloud Computing: Principles and Paradigm", First Edition, John Wiley & Sons, 2011.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, Management, And Security", CRC Press, 2017.

OIT551   **DATABASE MANAGEMENT SYSTEMS**   **L T P C**
                                                                          3 0 0 3

OBJECTIVES
- To learn the fundamentals of data models
- To learn conceptual modeling using ER diagrams.
- To study SQL queries and database programming
- To learn proper designing of relational database.
- To understand database security concepts
- To understand Information retrieval techniques

UNIT I   DBMS AND CONCEPTUAL DATA MODELING   9
Purpose of Database System – Data independence - Data Models – Database System Architecture – Conceptual Data modeling: ER models - Enhanced-ER Model. Introduction to relational databases – Relational Model – Keys – ER-to-Relational Mapping. Modeling of a library management system.

UNIT II   DATABASE QUERYING   11
Relational Algebra – SQL: fundamentals – DDL – Specifying integrity constraints - DML – Basic retrieval queries in SQL - Complex SQL retrieval queries – nested queries – correlated queries – joins - aggregate functions. Creating a table, populating data, adding integrity constraints, querying tables with simple and complex queries.

UNIT III   DATABASE PROGRAMMING   7
Database programming with function calls, stored procedures - views – triggers. Embedded SQL. ODBC connectivity with front end tools. Implementation using ODBC/JDBC and SQL/PSM, implementing functions, views, and triggers in MySQL / Oracle.

UNIT IV   DATABASE DESIGN   9
Functional Dependencies – Design guidelines – Normal Forms: first, second, third – Boyce/Codd Normal Form – Normalization algorithms. Design of a banking database system / university database system.

UNIT V   ADVANCED TOPICS   9
Database security issues – Discretionary access control – role based access – Encryption and public key infrastructures – challenges. 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:
- understand relational data model, evolve conceptual model of a given problem, its mapping to relational model and Normalization
- query the relational database and write programs with database connectivity
- understand the concepts of database security and information retrieval systems

TEXT BOOKS:
1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Sixth Edition , Pearson, 2011.
2. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill, 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 Systems , Fourth Edition, McGraw-Hill College Publications, 2015.

OAI551	ENVIRONMENT AND AGRICULTURE	L T P C
		3 0 0 3

OBJECTIVE:
- To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it.

UNIT I   ENVIRONMENTAL CONCERNS   8
Environmental basis for agriculture and food – Land use and landscape changes – Water quality issues – Changing social structure and economic focus – Globalization and its impacts – Agro ecosystems.

UNIT II   ENVIRONMENTAL IMPACTS   9
Irrigation development and watersheds – mechanized agriculture and soil cover impacts – Erosion and problems of deposition in irrigation systems – Agricultural drainage and downstream impacts – Agriculture versus urban impacts.

UNIT III   CLIMATE CHANGE   8
Global warming and changing environment – Ecosystem changes – Changing blue-green-grey water cycles – Water scarcity and water shortages – Desertification.

UNIT IV   ECOLOGICAL DIVERSITY AND AGRICULTURE   10
Ecological diversity, wild life and agriculture – GM crops and their impacts on the environment – Insets and agriculture – Pollination crisis – Ecological farming principles – Forest fragmentation and agriculture – Agricultural biotechnology concerns.

UNIT V   EMERGING ISSUES   10
Global environmental governance – alternate culture systems – Mega farms and vertical farms – Virtual water trade and its impacts on local environment – Agricultural environment policies and its impacts – Sustainable agriculture.

TOTAL: 45 PERIODS

OUTCOMES:
- Students will appreciate the role of environment in the current practice of agriculture and concerns of sustainability, especially in the context of climate change and emerging global issues.
- Ecological context of agriculture and its concerns will be understood

TEXTBOOKS:
1. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
2. Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.

REFERENCES:
1. T.C. Byerly, Environment and Agriculture, United States. Dept. of Agriculture. Economic Research Service, 2006.
2. Robert D. Havener, Steven A. Breth, Environment and agriculture: rethinking development issues for the 21st century : proceedings of a symposium, Winrock International Institute for Agricultural Development, 1994
3. Environment and agriculture: environmental problems affecting agriculture in the Asia and Pacific region; World Food Day Symposium, Bangkok, Thailand. 1989

OPT551	FIBRE REINFORCED PLASTICS	L T P C
		3 0 0 3

OBJECTIVES:
To enable the students
- To introduce the various materials for composite structure.
- To equip with the knowledge of sandwich structure technology.
- To provide knowledge in fracture mechanics of composites.
- To impart knowledge in fatigue and damping capacity of composite materials.
- To provide understanding of various manufacturing/fabricating techniques for composite structures

UNIT 1 9
Introduction: Definition, Reason for composites, Classifications of composites, Thermosets - Epoxy; Unsaturated polyester resin; vinyl ester,polyimides etc.,- preparation, properties, and uses.

UNIT II 9
Reinforcements; Types, Properties, chemistry and applications of fillers such as silica, titanium oxide, talc, mica etc., Manufacturing process, Properties, structure and uses of Glass fiber-. Carbon, Aramid, Boron, jute, sisal, cotton

UNIT III 9
Fabrications of Thermoset composites – Hand lay up method, compression and transfer moulding, pressure and vacuum bag process, filament winding, protrusion, reinforced RIM, RRIM, Injection moulding, of thermosets, SMC and DMC, Advantages and disadvantages of each method.

UNIT IV 9
Testing of composites- destructive and non-destructive tests; Destructive- tensile, compression, flexural, impact strength, Hardness – Fatigue- toughness HDT ,basic concepts of fracture mechanisms

UNIT V 9
Applications of composites – aerospace, land transport, marine, structural, chemical plants and corrosion resistant products, mechanical engineering and energy applications sports, electrical, electronic and communication applications, biomedical applications, repairs and maintenance etc.,

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, , the students will be able to
- Select various materials for designing composite structures.
- Apply knowledge of fracture mechanics of composites during designing of composite structures.
- Analyze critically the damping capacity of composite materials.
- Correlate various manufacturing/fabricating techniques for composite structures based on design

REFERENCES:
1. Hand book of composite by G. Lubin, Van Nostrand Co., New York 1969.
2. Polymers and Polymer Composites in Construction by L.C. Holleway, 1990
3. Engineering Plastics and Composites by John C. Bittence, 1990
4. Handbook of Plastics, Elastomers and Composites by Chrles A Harper, 1975
5. Designing with Reinforced composites- Technology-Performance, Economics-Rosato, 2st Ed. 1997.
6. Delwane Composite design Encyclopedia – (Vol 3 Processing and Fabrication / Technology _ Ed. Leif Carlssen. And Joahn W. Hillispie, Technomic Publishing Ah. Lancaster U.S.A.
7. Fiber glass Reinforce Plastics – Nicholas P. Cheremisinoff and Composites Paul N. Cheremmisinoff.,
8. Noyes Publications, N.J. U.S.A. 1995.
9. Composite applications – the future is now, Thomas J. Drozdr, (Eds), Published by Society of Manufacturing Engineers, Michigan, 1989.
10. Polymer layered silicate and silica nano composites, Y.C. Ke, P. Stroeve and F.S. Wang, Elsevier, 2005

OCE552   **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 – ER diagram - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector Models- TIN and GRID data models - OGC standards - Data Quality.

UNIT III   DATA INPUT AND TOPOLOGY   9
Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input –Digitiser – Topology - Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping.

UNIT IV   DATA ANALYSIS   9
Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Education models - 3D data collection and utilisation.

UNIT V   APPLICATIONS   9
GIS Applicant - Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies.

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

OAT552	INTERNAL COMBUSTION ENGINES	L T P C
		3 0 0 3

OBJECTIVE:

- To impart the basic fundamental knowledge on IC engines and its working along with some of the recent trends in IC engine

UNIT I INTRODUCTION IC ENGINE 9

Introduction, Types of IC engines, Constructional details IC engine, working, principles – 2 & 4 stroke engines, Cycles – Air standard cycles, Fuel air cycles and actual cycles, Actual Indicator diagram for four stroke and two stroke engines, General fuel properties, ignition properties – octane and cetane rating, Materials for engine components

UNIT II PETROL ENGINES 9

Working and constructional details of petrol engines, Carburetor – constructional and working, types of carburetors, additional features in modern carburetor, A/F ratio calculation, Petrol Injection - introduction, Ignition – introduction and requirements, Battery and magneto coil ignition system, Electronic ignition system, Stages of combustion in petrol engines, Combustion chambers for petrol engine, formation of knock in petrol engine

UNIT III DIESEL ENGINES 9

Working and constructional details of diesel engines, fuel injection – requirements, types of injection systems – inline, distributor pumps, unit injector, Mechanical and pneumatic governors. Fuel injector, Types of injection nozzles, Spray characteristics. Injection timing, Split and multiple injection, Stages of combustion in Diesel engines, direct and indirect combustion chambers for diesel engine, knocking in diesel engine, Introduction on supercharging and turbocharging

UNIT IV COOLING AND LUBRICATION 9

Requirements, Types- Air cooling and liquid cooling systems, forced circulation cooling system, pressure and Evaporative cooling systems, properties of coolants for IC engine. Need of lubrication, Lubricants for IC engines - Properties of lubricants, Types of lubrication – Mist, Wet and dry sump lubrication systems.

UNIT V MODERN TECHNOLOGIES IN IC ENGINES 9

HCCI Engines – construction and working, CRDi injection system, GDI Technology, E - Turbocharger, Variable compression ratio engines, variable valve timing technology, Fuel cell, Hybrid Electric Technology

TOTAL:45 PERIODS

TEXT BOOKS:
1. Ganesan.V., Internal Combustion Engines, Tata McGraw Hill Publishing Co., New York,1994.
2. Ramalingam. K. K., Internal Combustion Engines, Scitech publications, Chennai, 2003

REFERENCES:
1. Ellinger, H.E., Automotive Engines, Prentice Hall Publishers, 1992.
2. Heldt.P.M. High Speed Combustion Engines, Oxford IBH Publishing Co., Calcutta,1975.
3. Obert E.F., Internal Combustion Engines Analysis and Practice, International Text Books:Co., Scranton, Pennsylvania, 1988.
4. William. H. Crouse, Automotive Engines, McGraw Hill Publishers, 1985.

OML551	INTRODUCTION TO NANOTECHNOLOGY	L T P C
		3 0 0 3

OBJECTIVE:
Make the students to understand about the nanomaterials, synthesis and its characterization.

UNIT I   BASICS AND SCALE OF NANOTECHNOLOGY   9
Introduction –Scientific revolutions –Time and length scale in structures –Definition of a nanosystem –Dimensionality and size dependent phenomena –Surface to volume ratio -Fraction of surface atoms –Surface energy and surface stress- surface defects-Properties at nanoscale (optical, mechanical, electronic and magnetic).

UNIT II   DIFFERENT CLASSES OF NANOMATERIALS   9
Classification based on dimensionality-Quantum Dots,Wells and Wires- Carbon- based nano materials (buckyballs, nanotubes, graphene)–Metalbased nano materials (nanogold, nanosilver and metal oxides) -Nanocomposites- Nanopolymers –Nanoglasses –Nano ceramics -Biological nanomaterials.

UNIT III   SYNTHESIS OF NANOMATERIALS   9
Classification of synthesis: Top down and bottom up nanofabrication. Chemical Methods: Metal Nanocrystals by Reduction - Solvothermal Synthesis- Photochemical Synthesis - Sonochemical Routes- Chemical Vapor Deposition (CVD) –Metal Oxide - Chemical Vapor Deposition (MOCVD).Physical Methods:Ball Milling –Electrodeposition - Spray Pyrolysis - Flame Pyrolysis - DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE)

UNIT IV   FABRICATION AND CHARACTERIZATION OF NANOSTRUCTURES   9
Nanofabrication: Photolithography and its limitation-Electron-beam lithography (EBL)- Nanoimprint –Softlithography patterning. Characterization:Field Emission Scanning Electron Microscopy (FESEM) –Environmental Scanning Electron Microscopy (ESEM) High Resolution Transmission Electron Microscope (HRTEM) –Scanning Tunneling Microscope (STM)-Surface enhanced Raman spectroscopy (SERS)- X-ray Photoelectron Spectroscopy (XPS) - Auger electron spectroscopy (AES) –Rutherford backscattering spectroscopy (RBS).

UNIT V   APPLICATIONS   9
Solar energy conversion and catalysis - Molecular electronics and printed electronics - Nanoelectronics -Polymers with aspecial architecture - Liquid crystalline systems - Linear and nonlinear optical and electro-optical properties, Applicationsin displays and other devices - Nanomaterials for data storage - Photonics, Plasmonics- Chemical and biosensors -Nanomedicine and Nanobiotechnology –Nanotoxicology challenges.

TOTAL: 45 PERIODS

TEXT BOOKS
1. Bhusan, Bharat (Ed), "Springer Handbook of Nanotechnology", 2nd Edition, 2007.
2. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, 2002.
3. Pradeep T., "A Textbook of Nanoscience and Nanotechnology", Tata McGraw Hill Education Pvt. Ltd., 2012.

REFERENCES
1. Charles P. Poole Jr., Frank J. Ownes, 'Introduction to Nanotechnology", Wiley Interscience, 2003.
2. Dupas C., Houdy P., Lahmani M., "Nanoscience: Nanotechnologies and Nanophysics", Springer-Verlag Berlin Heidelberg, 2007.
3. Mark Ratner and Daniel Ratner, "Nano Technology", Pearson Education, New Delhi, 2003.
4. Nabok A., "Organic and Inorganic Nanostructures", Artech House, 2005.

OIM552 **LEAN MANUFACTURING** **L T P C**
3 0 0 3

OBJECTIVES:
- To study the various tools for lean manufacturing (LM).
- To apply the above tools to implement LM system in an organization.

UNIT I   INTRODUCTION TO LEAN MANUFACTURING   9
Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.

UNIT II   CELLULAR MANUFACTURING, JIT, TPM   9
Cellular Manufacturing – Types of Layout, Principles of Cell layout, Implementation. JIT – Principles of JIT and Implementation of Kanban. TPM – Pillars of TPM, Principles and implementation of TPM.

UNIT III   SET UP TIME REDUCTION, TQM, 5S, VSM   9
Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles.

UNIT IV   SIX SIGMA   9
Six Sigma – Definition, statistical considerations, variability reduction, design of experiments – Six Sigma implementation

UNIT V   CASE STUDIES   9
Various case studies of implementation of lean manufacturing at industries.
TOTAL: 45 PERIODS

OUTCOMES:
- The students will be able to identify waste in any process, reduce the waste using proper kaizens and other methods thereby improving the productivity of the organisation using LM tools.

REFERENCES:
1. Design and Analysis of Lean Production Systems, Ronald G. Askin & Jeffrey B. Goldberg, John Wiley & Sons, 2003
2. Mikell P. Groover (2002) Automation, Production Systems and CIM.
3. Rother M. and Shook J, 1999 Learning to See: Value Stream Mapping to Add Value and Eliminate   Muda' , Lean Enterprise Institute, Brookline, MA.

OBM552   **MEDICAL PHYSICS**   **L T P C**
                                                                     3 0 0 3
OBJECTIVES:
- To study the complete non-ionizing radiations including light and its effect in human body.
- To understand the principles of ultrasound radiation and its applications in medicine.
- To learn about radioactive nuclides and also the interactions of radiation with matters and how isotopes are produced.
- To study the harmful effects of radiation and radiation protection regulations.

UNIT I   NON-IONIZING RADIATION AND ITS MEDICAL APPLICATIONS   9
Introduction to EM waves - Tissue as a leaky dielectric - Relaxation processes: Debye model, Cole–Cole model- Overview of non-ionizing radiation effects-Low Frequency Effects- Higher frequency effects. Physics of light-Measurement of light and its unit- limits of vision and color vision an overview - Applications of ultraviolet in medicine, Thermography.

UNIT II   ULTRASOUND IN MEDICINE   9
Ultrasound fundamentals – Generation of ultrasound (Ultrasound Transducer) - Interaction of Ultrasound with matter: Cavitation, Reflection, Transmission- Scanning systems – Artefacts-Ultrasound- Doppler-Double Doppler shift-Clinical Applications- Ultrasonography.

UNIT III   PRINCIPLES OF RADIOACTIVE NUCLIDES AND DECAY   9
Introduction to Radioisotopes - Radioactive decay : Spontaneous Fission, Isomeric Transition, Alpha Decay, Beta Decay, Positron Decay, Electron Capture- Radioactive decay equations – Half life- Mean Life- Effective half-life - Natural and Artificial radioactivity, - Production of radionuclide – Cyclotron produced Radionuclide - Reactor produced Radionuclide: fission and electron Capture reaction, Target and Its Processing Equation for Production of Radionuclide - Radionuclide Generator-Technetium generator.

UNIT IV   INTERACTION OF RADIATION WITH MATTER   9
Interaction of charged particles with matter –Specific ionization, Linear energy transfer, range, Bremsstrahlung, Annihilation - Interaction of X and Gamma radiation with matter: Photoelectric effect, Compton Scattering, Pair production- Attenuation of Gamma Radiation - Interaction of neutron with matter and their clinical significance- Radionuclide used in Medicine and Technology.

UNIT V   RADIATION EFFECTS AND REGULATIONS   9
Classification of Radiation Damage, Stochastic and Deterministic Effects, Acute Effects of Total Body Irradiation, Long-Term Effects of Radiation, Risk Versus Benefit in Diagnostic Radiology and Nuclear Medicine, Risk of Pregnant Women, Nuclear Regulatory Commission, ALARA Program, Medical Uses of Radioactive Materials, Survey for Contamination and Exposure Rate, Dose Calibrators and Survey Meters, Bioassay, Radioactive Waste Disposal.
                                                                     TOTAL: 45 PERIODS
OUTCOMES:
At the end of the course, the student should be able to:
- Analyze the low frequency and high frequency effects of non-ionizing radiation and physics of light.
- Define various clinical applications based on ultrasound wave.
- Explain the process of radioactive nuclide production using different techniques
- Analyze radiation mechanics involved with various physiological systems
- Outline the detrimental effects of radiation and regulations for radiation safety.

TEXT BOOKS:
1. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, Medical Physics and Biomedical Engineering, 2nd Edition, IOP Publishers.2001. (Unit I & II)
2. Gopal B. Saha, Physics and Radiobiology of Nuclear Medicine, 4th Edition, Springer, 2013. (Unit III & IV)
3. R.Hendee and Russell Ritenour "Medical Imaging Physics", Fourth Edition William, Wiley-Liss, 2002. (Unit V)

REFERENCES:
1. S.Webb " The Physics of Medical Imaging", Taylor and Francis, 1988
2. HyltonB.Meire and Pat Farrant "Basic Ultrasound" John Wiley & Sons, 1995
3. John R Cameran , James G Skofronick "Medical Physics" John-Wiley & Sons. 1978
4. W.J.Meredith and J.B. Massey " Fundamental Physics of Radiology" Third edition, Varghese Publishing house. 1992

OML552	MICROSCOPY	L T P C
		3 0 0 3

OBJECTIVE:
This course will cover the basic principles and techniques of optical and electron microscopy. This course also deals with the sample preparation techniques for the microstructural analysis.

UNIT I   INTRODUCTION   9
History of Microscopy, Overview of current microscopy techniques. Light as particles and waves, Fundamental of optics: Diffraction and interference in image formation, real and virtual images, Resolution, Depth of field and focus, Magnification, Numerical aperture, Aberration of lenses. Components of Light Microscopy, Compound light microscopy and its variations.

UNIT II   MICROSCOPY   9
Phase contrast microscopy: optical design, theory, image interpretation, Dark-field microscopy: optical design, theory , image interpretation, Polarization Microscopy: Polarized light, optical design, theory , image interpretation, Differential Interference Contrast (DIC): equipment and optics, image interpretation, Modulation contrast microscopy: contrast methods using oblique illumination.

UNIT III   ELECTRON MICROSCOPY   9
Interaction of electrons with matter, elastic and inelastic scattering, secondary effects, Components of electron microscopy: Electron sources, pumps and holders, lenses, apertures, and resolution. Scanning Electron and Transmission Electron Microscopy: Principle, construction, applications and limitations.

UNIT IV   SAMPLE PREPARATION FOR MICROSTRUCTURAL ANALYSIS   9
Optical Microscopy sample preparation: Grinding, polishing and etching, SEM sample preparation: size constrains, TEM sample preparation: Disk preparation, electro polishing, ion milling, lithography, storing specimens.

UNIT V   CHEMICAL ANALYSIS   9
Surface chemical composition (Principle and applications) - Mass spectroscopy and X-ray emission spectroscopy - Energy Dispersive Spectroscopy- Wave Dispersive Spectroscopy. Electron spectroscopy for chemical analysis (ESCA), Ultraviolet Photo Electron Spectroscopy (UPS), X ray Photoelectron Spectroscopy (XPS), Auger Electron Spectroscopy (AES)- Applications.

TOTAL: 45 PERIODS

OUTCOMES:
- Able to understand the physics behind the microscopy.
- Ability to describe the principle, construction and working of light microscopy.
- Ability to appreciate about electron microscopy.
- Ability to understand about the important of sample preparation technique.
- Ability to identify the appropriate spectroscopy technique for chemical analysis.

TEXT BOOKS
1. Douglas B. Murphy, Fundamentals of light microscopy and electronic imaging, 2001, Wiley-Liss, Inc. USA
2. David B. Williams and C. Barry Carter, Transmission Electron Microscopy-A Textbook for Materials Science, Springer US, 2nd edition, 2009.

REFERENCES:
1. Brandon D. G, "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA,1986.
2. Whan R E (Ed), ASM Handbook, Volume 10, Materials Characterisation", Nineth Edition, ASM international, USA, 1986.
3. Thomas G., "Transmission electron microscopy of metals", John Wiley, 1996.

OAI552	PARTICIPATORY WATER RESOURCES MANAGEMENT	L T 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 – Comparison 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 Intersectoral 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 famers 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.

TEXT BOOKS:
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

OCH552   **PRINCIPLES OF CHEMICAL ENGINEERING**   **L T P C**
                                                              3 0 0 3

OBJECTIVES:
- To understand the overall view of the chemical engineering subjects

UNIT I   **5**
Chemistry, Chemical Engineering and Chemical Technology; Chemical process industries: History and their role in Society; Role of Chemical Engineer; History and Personalities of Chemical Engineering; Greatest achievements of Chemical Engineering.

UNIT II   **12**
Components of Chemical Engineering: Role of Mathematics, Physics, Chemistry and Biology; Thermodynamics, Transport Phenomena, Chemical Kinetics and Process dynamics, design and control.

UNIT III   **12**
Concept of Unit Processes and Unit Operations; Description of different Unit Processes and Unit Operations; Designing of equipments; Flowsheet representation of process plants, Evolution of an Industry – Sulphuric acid and Soda ash manufacture. Demonstration of simple chemical engineering experiments; Plant visit to a chemical industry

UNIT IV   **12**
Role of Computer in Chemical Engineering; Chemical Engineering Software; Visit to Process Simulation Lab; Relation between Chemical Engineering and other engineering disciplines; Traditional vs. modern Chemical Engineering; Versatility of Chemical Engineering: Role of Chemical Engineers in the area of Food, Medical, Energy, Environmental, Biochemical, Electronics etc. Plant visit to an allied industry.

UNIT V   **4**
Paradigm shifts in Chemical Engineering; Range of scales in Chemical Engineering; Opportunities for Chemical Engineers; Future of Chemical Engineering.

TOTAL : 45 PERIODS

OUTCOMES
- On completion of the course, students will attain knowledge in fluid behavior and solid properties.
- Understand the concept of chemical engineering principles

TEXT BOOKS:
1. Badger W.L. and Banchero J.T., "Introduction to Chemical Engineering", 6th Edition, Tata McGraw Hill, 1997.
2. Dryden, C.E., "Outlines of Chemicals Technology", Edited and Revised by Gopala Rao, M. and M.Sittig, 2nd Edition, Affiliated East-West press, 1993.
3. Randolph Norris Shreve, George T. Austin, "Shreve'e Chemical Process Industries", 5th edition, McGraw Hill, 1984

REFERENCES:
1. McCabe, W.L., Smith, J. C. and Harriot, P. "Unit operations in Chemical Engineering", McGraw Hill, 7th Edition, 2001
2. Finlayson, B. A., Introduction to Chemical Engineering Computing, John Wiley & Sons, New Jersey, 2006.

OBT554	PRINCIPLES OF FOOD PRESERVATION	L T P C
		3 0 0 3

OBJECTIVE:
- The course aims to introduce the students to the area of Food Preservation. This is necessary for effective understanding of a detailed study of food processing and technology subjects.

UNIT I   FOOD PRESERVATION AND ITS IMPORTANCE   9
Introduction to food preservation. Wastage of processed foods; Shelf life of food products; Types of food based on its perishability. Traditional methods of preservation

UNIT II   METHODS OF FOOD HANDLING AND STORAGE   9
Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.retort pouch packing, Aseptic packaging.

UNIT III   THERMAL METHODS   9
Newer methods of thermal processing; batch and continuous; In container sterilization- canning; application of infra-red microwaves; ohmic heating; control of water activity; preservation by concentration and dehydration; osmotic methods

UNIT IV   DRYING PROCESS FOR TYPICAL FOODS   9
Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures. Psychrometric chart, freezing and cold storage.freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages.

UNIT V   NON-THERMAL METHODS   9
Super Critical Technology for Preservation - Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology,
                                                                TOTAL: 45 PERIODS
OUTCOMES:
On completion of the course the students are expected to
- Be aware of the different methods applied to preserving foods.

TEXT BOOKS:
1. Karnal, Marcus and D.B. Lund "Physical Principles of Food Preservation". Rutledge, 2003.
2. VanGarde, S.J. and Woodburn. M "Food Preservation and Safety Principles and Practice".Surbhi Publications, 2001.
3. Sivasankar, B. "Food Processing & Preservation", Prentice Hall of India, 2002.
4. Khetarpaul, Neelam, "Food Processing and Preservation", Daya Publications, 2005.

REFERENCES:
1. Rahman, M. Shafiur. "Handbook of Food Preservation". Marcel & Dekker, 2006.

2. Zeuthen, Peter and Bogh-Sarensen, Leif. "Food Preservation Techniques". CRC / Wood Head Publishing, 2003.
3. Ranganna, S. "Handbook of Canning and Aseptic Packaging". Tata McGraw-Hill, 2000.
4. Ranganna, S. "Handbook of Canning and Aseptic Packaging". Tata McGraw-Hill, 2000.

OMF551	PRODUCT DESIGN AND DEVELOPMENT	L T P C
		3 0 0 3

OBJECTIVE:
The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

UNIT I   INTRODUCTION   9
Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.

UNIT II   CONCEPT GENERATION AND SELECTION   9
Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT III   PRODUCT ARCHITECTURE   9
Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

UNIT IV   INDUSTRIAL DESIGN   9
Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT V   DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT   9
Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

TOTAL: 45 PERIODS

OUTCOME:
- The student will be able to design some products for the given set of applications; also the knowledge gained through prototyping technology will help the student to make a prototype of a problem and hence product design and development can be achieved.

TEXT BOOK:
1. Kari T.Ulrich and Steven D.Eppinger, "Product Design and Development", McGraw-Hill International Edns. 1999.

REFERENCES:
1. Kemnneth Crow, "Concurrent Engg./Integrated Product Development", DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Staurt Pugh, "Tool Design –Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New york, NY.

OAI553   PRODUCTION TECHNOLOGY OF AGRICULTURAL MACHINERY   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) machine tool and CNC programming.

UNIT I   ENGINEERING MATERIALS   9
Engineering materials - their classification - Mechanical properties of materials, strength, elasticity, plasticity, stiffness, malleability, ductility, brittleness, toughness, hardness, resilience, machinability, formability, weldability. Steels and cast irons: Carbon steels, their classification based on percentage of carbon as low, mild, medium & high carbon steel, their properties & applications. Wrought iron, cast iron. Alloy steels: Stainless steel, tool steel.

UNIT II   MACHINING   9
Basic principles of lathe - machine and operations performed on it. Basic description of machines and operations of Shaper-Planner, Drilling, Milling & Grinding.

UNIT III   WELDING   9
Introduction, classification of welding processes. Gas welding, types of flames and their applications. Electric Arc welding. Resistance welding, Soldering & Brazing processes and their uses.

UNIT IV   ADVANCED MANUFACTURING PROCESS   9
Abrasive flow machining - abrasive jet machining - water jet machining - Electro Discharge Machining (EDM) - Wire cut EDM - Electro Chemical Machining (ECM) - Ultrasonic Machining / Drilling (USM / USD) - Electron Beam Machining (EBM) - Laser Beam Machining (LBM).

UNIT V   CNC MACHINE   9
Numerical control (NC) machine tools - CNC: types, constitutional details, special features - design considerations of CNC machines for improving machining accuracy - structural members - slide ways - linear bearings - ball screws - spindle drives and feed drives. Part programming fundamentals - manual programming.

TOTAL: 45 PERIODS

OUTCOME:
*   Upon completion of this course, the students can able to apply the different manufacturing process and use this in industry for component production.

TEXTBOOKS:
1. "Manufacturing Engineering and Technology", Kalpakjian and Schmid, Pearson, 2010.
2. Hajra Choudry, "Elements of workshop technology - Vol II", Media promoters, 2002.

REFERENCES:
1. Gupta. K.N., and Kaushik, J.P., 1998, Workshop Technology Vol I and II, New Heights, Daryaganj, New Delhi.
2. Arthur. D., et. al. 1998, General Engineering Workshop Practice, Asia Publishing House, Bombay.
3. Chapman W.A.J., Workshop Technology, 1992, Part I, II, III, E.L.B.S. and Edward Amold Publishers Ltd, London.

ORO551	RENEWABLE ENERGY SOURCES	L T P C
		3 0 0 3

OBJECTIVES:
- To get exposure on solar radiation and its environmental impact to power.
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar energy.
- To learn about the wind energy and biomass and its economic aspects.
- To know about geothermal energy with other energy sources.

UNIT I   PRINCIPLES OF SOLAR RADIATION   10

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT II   SOLAR ENERGY COLLECTION   8

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT III   SOLAR ENERGY STORAGE AND APPLICATIONS   7

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications-solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT IV   WIND ENERGY   10

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

UNIT V   GEOTHERMAL ENERGY: 9

Resources, types of wells, methods of harnessing the energy, potential in India. OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics. DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, principles of DEC.

TOTAL : 45 PERIODS

OUTCOMES:
- Understanding the physics of solar radiation.
- Ability to classify the solar energy collectors and methodologies of storing solar energy.
- Knowledge in applying solar energy in a useful way.
- Knowledge in wind energy and biomass with its economic aspects.
- Knowledge in capturing and applying other forms of energy sources like wind, biogas and geothermal energies.

TEXT BOOKS:
1. Rai G.D. , "Non-Conventional Energy Sources", Khanna Publishers, 2011
2. Twidell & Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2011

REFERENCES:
1. Tiwari and Ghosal, "Renewable energy resources", Narosa Publishing House, 2007
2. Ramesh R & Kumar K.U , "Renewable Energy Technologies",Narosa Publishing House, 2004
3. Mittal K M , "Non-Conventional Energy Systems", Wheeler Publishing Co. Ltd, New Delhi, 2003
4. Kothari D.P, Singhal ., K.C., "Renewable energy sources and emerging technologies", P.H.I, New Delhi, 2010

OAN551	SENSORS AND TRANSDUCERS	L T P C
		3 0 0 3

OBJECTIVES:
- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

UNIT I   INTRODUCTION   9
Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT II   MOTION, PROXIMITY AND RANGING SENSORS   9
Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III   FORCE, MAGNETIC AND HEADING SENSORS   9
Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT IV   OPTICAL, PRESSURE AND TEMPERATURE SENSORS   9
Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V   SIGNAL CONDITIONING and DAQ SYSTEMS   9
Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

                                                                            TOTAL :   45 PERIODS

OUTCOMES:
The students will be able to
CO1. Expertise in various calibration techniques and signal types for sensors.
CO2. Apply the various sensors in the Automotive and Mechatronics applications
CO3. Study the basic principles of various smart sensors.
CO4. Implement the DAQ systems with different sensors for real time applications

TEXT BOOKS:

1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009.
2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCES

1. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
3. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.

OIC552	STATE VARIABLE ANALYSIS AND DESIGN	L T P C
		3 0 0 3

OBJECTIVES:

- To provide knowledge on design in state variable form
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter

UNIT I   STATE FORMULATION   9

Formulation of state variable model, non-uniqueness, controllability, observability, stability.

UNIT II   STATE VARIABLE DESIGN   9

Modes, controllability of modes -effect of state and output Feedback- pole placement Design

UNIT III   STATE ESTIMATION   9

Need for state estimation- design of state Observers- full and reduced order – disturbance estimation-separation principle

UNIT IV   OPTIMAL CONTROL   9

Introduction - Time varying optimal control – LQR steady state optimal control – Solution of Ricatti's equation – Application examples.

UNIT V   OPTIMAL ESTIMATION   9

 Optimal estimation – Kalman Bucy Filter-Solution by duality principle-Discrete systems-Kalman Filter- Application examples..

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to apply advanced control theory to practical engineering problems.

TEXT BOOKS :

1. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006.
2. G. J. Thaler, " Automatic Control Systems", Jaico Publishing House 1993.
3. M.Gopal, Modern Control System Theory, New Age International Publishers, 2002.

REFERENCES:

 1. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011.
 2. Ashish Tewari, 'Modern Control Design with Matlab and Simulink', John Wiley, New Delhi, 2002.

3. K. Ogata, 'Modern Control Engineering', 4th Edition, PHI, 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.

OTL553	TELECOMMUNICATION NETWORK MANAGEMENT	L T P C
		3 0 0 3

OBJECTIVES:
*   To understand the concept of network management standards.
*   To design the common management information service element model.
*   To understand the various concept of information modelling.
*   To analyze the concept of SNMPv1 and SNMPv2 protocol.
*   To analyze the concept of examples of network management.

UNIT I   FOUNDATIONS   9
Network management standards–network management model– organization model– information model abstract syntax notation 1 (ASN.1) – encoding structure– macros–functional model. Network management application functional requirements: Configuration management– fault management–performance management–Error correlation technology– security management–accounting management– common management–report management– polity based management–service level management–management service–community definitions– capturing the requirements– simple and formal approaches–semi formal and formal notations.

UNIT II   COMMON MANAGEMENT INFORMATION SERVICE ELEMENT   9
CMISE model–service definitions–errors–scoping and filtering features– synchronization–functional units– association services– common management information protocol specification.

UNIT III   INFORMATION MODELING FOR TMN   9
Rationale for information modeling–management information model–object oriented modeling paradigm– structure of management information–managed object class definition–management information base.

UNIT IV   SIMPLE NETWORK MANAGEMENT PROTOCOL   9
SNMPv1: managed networks–SNMP models– organization model–information model–SNMPv2 communication model–functional model–major changes in SNMPv2–structure of management information, MIB–SNMPv2 protocol– compatibility with SNMPv1– SNMPv3– architecture–applications–MIB security, remote monitoring–SMI and MIB– RMQN1 and RMON2.

UNIT V   NETWORK MANAGEMENT EXAMPLES   9
ATM integrated local management interface–ATM MIB–M1– M2–M3– M4– interfaces–ATM digital exchange interface management–digita1 subscriber loop and asymmetric DSL technologies–ADSL configuration management–performance management Network management tools: Network statistics management–network management system–management platform case studies: OPENVIEW–ALMAP.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course , students would be able to
*   Design and analyze of fault management.
*   Analyze the common management information protocol specifications.
*   Design and analyze of management information model.
*   Design the simple network management protocol.
*   Design the various types of network management tools.

TEXT BOOKS:
1. Mani Subramanian, "Network Management: Principles and Practice" Pearson Education, Second edition, 2010
2. Lakshmi G Raman, "Fundamentals of Telecommunications Network Management" ,Wiley, 1999

REFERENCES:
1. Henry Haojin Wang, "Telecommunication Network Management", Mc- Graw Hill ,1999
2. Salah Aidarous & Thomas Plevyak, "Telecommunication Network Management: Technologies and Implementations" , Wiley,1997

OIM551   **WORLD CLASS MANUFACTURING**   **L T P C**
                                                                         3 0 0 3
OBJECTIVES
- Understanding of the concept and importance of strategy planning for manufacturing industries
- To apply principles and techniques in the identifiable formulation and implementation of manufacturing strategy for competitive in global context.

UNIT I   INDUSTRIAL DECLINE AND ASCENDANCY   9
Manufacturing excellence - US Manufacturers - French Manufacturers - Japan decade – American decade - Global decade

UNIT II   BUILDING STRENGTH THROUGH CUSTOMER – FOCUSED PRINCIPLES   9
Customer - Focused principles - General principles - Design - Operations - Human resources - Quality and Process improvement - Promotion and Marketing

UNIT III   VALUE AND VALUATION   9
Product Costing - Motivation to improve - Value of the enterprises QUALITY - The Organization : Bulwark of stability and effectiveness - Employee stability – Quality Individuals Vs. Teams - Team stability and cohesiveness - Project cohesiveness and stability

UNIT IV   STRATEGIC LINKAGES   9
Product decisions and customer service - Multi-company planning - Internal manufacturing planning - Soothing the demand turbulence

UNIT V   IMPEDIMENTS   9
Bad plant design - Mismanagement of capacity - Production Lines - Assembly Lines – Whole Plant Associates - Facilitators - Teamsmanship - Motivation and reward in the age of continuous Improvement

TOTAL : 45 PERIODS
OUTCOMES:
- Able to understand the concept and the importance of manufacturing strategy for industrial enterprise competitiveness.
- Apply appropriate techniques in the analysis an devaluation of company's opportunities for enhancing competitiveness in the local regional and global context.
- Identify formulation and implement strategies for manufacturing and therefore enterprise competitiveness.

TEXT BOOKS:
1. By Richard B. Chase, Nicholas J. Aquilano, F. Robert Jacobs – "Operations Management for Competitive Advantage", McGraw-Hill Irwin, ISBN 0072323159
2. Moore Ran, "Making Common Sense Common Practice: Models for Manufacturing Excellence", Elsevior Multiworth

3. Narayanan V. K., "Managing Technology & Innovation for Competitive Advantage", Pearson Education Inc.
4. Korgaonkar M. G., "Just In Time Manufacturing", MacMillan Publishers India Ltd.,
5. Sahay B. S., Saxena K. B. C., Ashish Kumar, "World Class Manufacturing", MacMillan Publishers

OAI751   AGRICULTURAL FINANCE, BANKING AND CO-OPERATION   L T P C
                                                              3 0 0 3

OBJECTIVES:
*   To make the students aware about the agricultural Finance, Banking and Cooperation.
*   To acquaint the students with the basic concepts, principles and functions of management.
*   To understand the process of finance banking and cooperation.

UNIT I   AGRICULTURAL FINANCE - NATURE AND SCOPE   9
Agricultural Finance: Definition, Importance, Nature and Scope - Agricultural Credit: Meaning, Definition, Need and Classification - Sources of credit - Role of institutional and non - Institutional agencies: Advantages and Disadvantages - Rural indebtedness: consequences of rural indebtedness - History and Development of rural credit in India.

UNIT II   FARM FINANCIAL ANALYSIS   9
Principles of Credit - 5C's, 5R's and & 7P's of Credit - Project Cycle and Management - Preparation of bankable projects / Farm credit proposals - Feasibility - Time value of money: Compounding and Discounting - Appraisal of farm credit proposals - Undiscounted and discounted measures - Repayment plans - Farm Financial Statements: Balance Sheet, Income Statement and Cash Flow statement - Financial Ratio Analysis.

UNIT III   FINANCIAL INSTITUTIONS   9
Institutional Lending Agencies - Commercial banks: Nationalization, Agricultural Development Branches - Area Approach - Priority Sector Lending - Regional Rural Banks, Lead bank, Scale of finance - Higher financial institutions: RBI, NABARD, AFC, ADB, World Bank and Deposit Insurance and Credit Guarantee Corporation of India - Microfinance and its role in poverty alleviation - Self-Help Groups - Non -Governmental Organizations - Rural credit policies followed by State and Central Government - Subsidized farm credit, Differential Interest Rate (DIR), Kisan Credit Card (KCC) Scheme - Relief Measures and Loan Waiver Scheme and Know Your Customer (KYC).

UNIT IV   CO-OPERATION   9
Co-operation: Philosophy and Principles - History of Indian Cooperative Credit Movement: Pre and Post-Independence periods and Cooperation in different plan periods - Cooperative credit institutions: Two tier and three tier structure, Functions: provision of short term and long term credit, Strength and weakness of cooperative credit system, Policies for revitalizing cooperative credit: Salient features of Vaithiyananthan Committee Report on revival of rural cooperative credit institutions, Reorganisation of Cooperative credit structure in Andhra Pradesh and single window system and successful cooperative credit systems in Gujarat, Maharashtra, Punjab etc, - Special cooperatives: LAMPS and FSS: Objectives, role and functions - National Cooperative Development Corporation (NCDC) and National Federation of State Cooperative Banks Ltd., (NAFSCOB) - Objectives and Functions.

UNIT V   BANKING AND INSURANCE   9
Negotiable Instruments: Meaning, Importance and Types - Central Bank: RBI - functions - credit control - objectives and methods: CRR, SLR and Repo rate - Credit rationing - Dear money and cheap money - Financial inclusion and Exclusion: Credit widening and credit deepening monetary policies. Credit gap: Factors influencing credit gap - Non - Banking Financial Institutions (NBFI) -

Assessment of crop losses, Determination of compensation - Crop insurance: Schemes, Coverage, Advantages and Limitations in implementation - Estimation of crop yields - Livestock, insurance schemes - Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

TOTAL: 45 PERIODS

OUTCOME:
After completion of this course, the students will
- Be familiar with agricultural finance, Banking, cooperation and basic concepts, principles and functions of management.

REFERENCES:
1. Muniraj, R., 1987, Farm Finance for Development, Oxford & IBH, New Delhi
2. Subba Reddy. S and P.Raghu Ram 2011, Agricultural Finance and Management, Oxford & IBH, New Delhi.
3. Lee W.F., M.D. Boehlje A.G., Nelson and W.G. Murray, 1998, Agricultural Finance, Kalyani Publishers, New Delhi.
4. Mammoria, C.B., and R.D. Saxena 1973, Cooperation in India, Kitab Mahal, Allahabad.

OEE751   **BASIC CIRCUIT THEORY**   **L T P C**
                                                                              3 0 0 3
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 introduce Phasor diagrams and analysis of three phase circuits

UNIT I   BASIC CIRCUITS ANALYSIS   9
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 CIRCUITS   9
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.

UNITIII   AC CIRCUITS   9
 Introduction to AC circuits , inductance reactance, capacitive reactance, Phasor diagrams, real power, reactive power, apparent power, power factor, R-L R-C , RLC networks, Network reduction: voltage and current division, source transformation –mesh and node analysis, Thevenins and Norton Theorems – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem – Millman's theorem.

UNIT IV   THREE PHASE CIRCUITS   9
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   9
Series and parallel resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to introduce electric circuits and its analysis
- Ability to impart knowledge on solving circuit equations using network theorems
- Ability to introduce the phenomenon of resonance in coupled circuits.
- Ability to introduce Phasor diagrams and analysis of three phase circuits

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.

OGI751	CLIMATE CHANGE AND ITS IMPACT	L T P C
		3 0 0 3

OBJECTIVES:
- To understand the basics of weather and climate
- To have an insight on Atmospheric dynamics and transport of heat
- To develop simple climate models and evaluate climate changes using models

UNIT I   BASICS OF WEATHER AND CLIMATE: 9
Shallow film of Air– stratified & disturbed atmosphere – law – atmosphere Engine. Observation of parameters: Temperature – Humidity – Wind - Pressure – precipitation-surface – networks. Constitution of atmosphere: well stirred atmosphere – process around turbopause – in dry air – ozone – carbon Dioxide – Sulphur Dioxide– Aerosol - water. Evolution of Atmosphere. State of atmosphere: Air temperature – pressure – hydrostatic – Chemistry – Distribution – circulation

UNIT II   ATMOSPHERIC DYNAMICS: 9
Atmosphere dynamics: law – isobaric heating and cooling – adiabatic lapse rates – equation of motion - solving and forecasting. Forces – Relative and absolute acceleration – Earth's rotation coriolis on sphere – full equation of motion – Geostrophy;- Thermal winds –departures – small-scale motion. Radiation, convection and advections: sun & solar radiation – energy balance – terrestrial radiation and the atmosphere – Green house effect- Global warming - Global budget – radiative fluxes - heat transport. Atmosphere and ocean systems convecting & advecting heat. Surface and boundary layer – smaller scale weather system – larger scale weather system.

UNIT III   GLOBAL CLIMATE   9

Components and phenomena in the climate system: Time and space scales – interaction and parameterization problem. Gradients of Radiative forcing and energy transports by atmosphere and ocean – atmospheric circulation – latitude structure of the circulation - latitude – longitude dependence of climate features. Ocean circulation: latitude – longitude dependence of climate features – ocean vertical structure – ocean thermohaline circulation – land surface processes – carbon cycle.

UNIT IV   CLIMATE SYSTEM PROCESSES   9

Conservation of motion: Force – coriolis - pressure gradient- velocity equations – Application – geotropic wind – pressure co-ordinates. Equation of State – atmosphere – ocean. Application: thermal circulation – sea level rise. Temperature equation: Ocean – air – Application – decay of sea surface temperature. Continuity equation: ocean – atmosphere. Application: coastal upwelling – equatorial upwelling – conservation of warm water mass.   Moisture and salinity equation: conservation of mass – moisture. Source & sinks – latent heat. Moist processes – saturation – convection – Wave processes in atmosphere and ocean.

UNIT V   CLIMATE CHANGE MODELS   9

Constructing a climate model – climate system modeling – climate simulation and drift – Evaluation of climate model simulation – regional (RCM) – global (GCM) – Global average response to warming – climate change observed to date. .

OUTCOMES:
At the end of the course the student will be able to understand
- The concepts of weather and climate
- The principles of Atmospheric dynamics and transport of heat and air mass
- The develop simple climate models and to predict climate change

TEXT BOOKS:
1. Fundamentals of weather and climate (2nd Edition) Robin Moilveen (2010), Oxford University Press
2. Climate change and climate modeling, J. David Neelin (2011) Cambridge University press.

OCS751   **DATA STRUCTURES AND ALGORITHMS**   **L T P C**
                                                                                                    3 0 0 3

OBJECTIVES:
- To understand the various algorithm design and analysis techniques
- To learn linear data structures – lists, stacks, and queues
- To learn different sorting and searching algorithms
- To understand Tree and Graph data structures

UNIT I   ALGORITHM ANALYSIS, LIST ADT   11

Algorithms: Notation - analysis – running time calculations. Abstract Data Types (ADTs): List ADT – array-based implementation – linked list implementation – singly linked lists- applications of lists: Polynomial Manipulation. Implementation of List ADT using an array and using a linked list in C.

UNIT II   STACKS AND QUEUES   7

Stack ADT - Applications - Evaluating arithmetic expressions- Conversion of Infix to Postfix- Recursion. Queue ADT – Priority Queue - applications of queues. Implementation of Stack ADT and palindrome checking using C.   Implementation of Queue operations using arrays in C.

UNIT III SEARCHING AND SORTING ALGORITHMS 10

Divide and conquer methodology - Searching: Linear Search - Binary Search. Sorting: Insertion sort – Merge sort – Quick sort – Heap sort. Analysis of searching and sorting techniques. Implementation of linear search, binary search, insertion sort, merge sort and quick sort algorithms in C.

UNIT IV TREES 9

Tree ADT – tree traversals - Binary Tree ADT – expression trees – binary search tree ADT – applications of trees. Heap – applications of heap. Implementation of Binary search tree and its operations, tree traversal methods, finding height of the tree using C. Implementation of heap and heap sorting using arrays in C.

UNIT V GRAPHS 8

Definition – Representation of Graph – Breadth-first traversal - Depth-first traversal – Dynamic programming Technique – Warshall's and Floyd's algorithm – Greedy method - Dijkstra's algorithm – applications of graphs. Implementation of graph, graph traversal methods, finding shortest path using Dijkstra's algorithm in C

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course, the students should be able to:
- Implement linear data structures and solve problems using them.
- Implement and apply trees and graphs to solve problems.
- Implement the various searching and sorting algorithms.

TEXT BOOKS:
1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education,1997.
2. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", 2nd Edition, Pearson Education, 1988.

REFERENCES:
1. Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education,1983.
2. S.Sridhar, "Design and Analysis of Algorithms", First Edition, Oxford University Press. 2014
3. Byron Gottfried, Jitender Chhabra, "Programming with C" (Schaum's Outlines Series), Mcgraw Hill Higher Ed., III Edition, 2010
4. Yashvant Kanetkar, "Data Structures Through C", BPB publications, II edition, 2003

OML752	ELECTRONIC MATERIALS	L T P C
		3 0 0 3

OBJECTIVE:
- Understanding the various materials and its properties contribution towards electrical and electronics field. This course covers the properties of materials behind the electronic applications.

UNIT I INTRODUCTION 7

Structure: atomic structures and bonding, types of bonding, band formation. Defects and imperfections in solids: Point, Line and Planer defects; Interfacial defects and volume defects. Classification of materials based on bonding: conductors, semiconductors and insulators.

UNIT II CONDUCTING MATERIALS 9

Introduction, factors affecting the conductivity of materials, classification based on conductivity of materials, temperature dependence of resistivity, Low resistivity materials (graphite, Al, Cu and steel) and its applications, high resistivity materials (manganin, constantin, nichrome, tungsten) and their applications. Superconductors: Meissner effect, classification and applications.

UNIT III SEMICONDUCTING AND MAGNETIC MATERIALS 10

Semiconductors: Introduction, types of semiconductors, temperature dependence of semiconductors, compound semiconductors, basic ideas of amorphous and organic semiconductors. Magnetic Materials: classification of magnetic materials, ferromagnetism-B-H curve (Qualitative), hard and soft magnetic materials, magneto materials applications.

UNIT IV DIELECTRIC AND INSULATING MATERIALS 9

Dielectric Materials: Introduction, classification, temperature dependence on polarization, properties,dielectric loss, factors influencing dielectric strength and capacitor materials, applications. Insulators: Introduction, thermal and mechanical properties required for insulators, Inorganic materials, organic materials, liquid insulators, gaseous insulators and ageing of insulators, applications.

UNIT V OPTOELECTRONIC ANDNANO ELECTRONIC MATERIALS 10

Optoelectronic materials. Introduction, properties, factor affecting optical properties, role of optoelectronic materials in LEDs, LASERs, photodetectors, solar cells. Nano electronic Materials: Introduction, advantage of nanoelectronic devices, materials, fabrication, challenges in Nano electronic materials.

TOTAL : 45 PERIODS

OUTCOME:

- With the basis, students will be able to have clear concepts on electronic behaviors of materials

TEXT BOOKS:

1. S.O. Kasap "Principles of Electronic Materials and Devices", 3rd edition, McGraw-Hill Education (India) Pvt. Ltd., 2007.
2. W D Callister, "Materials Science & Engineering – An Introduction", Jr., John Willey & Sons, Inc, New York, 7th edition, 2007.

REFERENCES:

1. B.G. Streetman and S. Banerjee, Solid State Electronic Devices, 6th edition, PHI Learning, 2009.
2. Eugene A. Irene, Electronic Materials Science, Wiley, 2005
3. Wei Gao, Zhengwei Li, Nigel Sammes, An Introduction to Electronic Materials for Engineers, 2nd Edition, World Scientific Publishing Co. Pvt. Ltd., 2011

OCE751 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.

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, flora and fauna - Matrices – Networks – Checklist Methods - Mathematical models for Impact prediction.

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 – Public Hearing-Environmental Clearance

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 – Roads and Bridges – Mass Rapid Transport Systems - Airports - Dams and Irrigation projects - Power plants.

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

TEXT BOOKS:
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.

OAE751   FUNDAMENTALS OF COMBUSTION   L T P C
**   3 0 0 3**
OBJECTIVE:
To make the student understand the fundamentals of combustion and to teach them combustion in different regions like basic flame to gas turbine engines to rocket engines and finally how it is done in supersonic speeds.

UNIT I   INTRODUCTION TO COMBUSTION   9
Thermo-chemical equations –Heat of formation –Activation energy -Multi-step reactions - Heat of reaction -first order, second order and third order reactions – Calculation of adiabatic flame temperature

UNIT II   BASICS OF CHEMICAL KINETICS AND FLAMES   9

Premixed flames –Diffusion flames –measurement of burning velocity – various methods –Effect of various parameters on burning velocity – flame stability –Deflagration – Detonation – Rankine-Hugoniot curve –Radiation by flames.

UNIT III   COMBUSTION IN GAS TURBINE ENGINES   9

Combustion in gas turbine combustion chambers -Recirculation – combustion efficiency, Factors affecting combustion efficiency-Fuels used for gas turbine combustion chambers – combustion stability –Flame holder types.

UNIT IV   COMBUSTION IN ROCKETS   9

Solid propellant grain types – types of solid propellant burning in rocket combustion chambers – basic mechanism of composite propellant combustion – solid propellant burn rate laws – criterion for stable combustion - combustion in liquid rocket engines – single fuel droplet combustion model – combustion in hybrid rockets.

UNIT V   SUPERSONIC COMBUSTION   (Qualitative Treatment only)   9

Introduction – supersonic combustion controlled by diffusion, mixing and heat convection – Analysis of reactions and mixing processes - supersonic burning with detonation shocks .

TOTAL: 45 PERIODS

OUTCOMES:
- The student will be in a position to understand the detailed mechanism of Aerospace Vehicles and Aircraft Engines.
- The student will be able to analyse and impart the combustion processes that occur in Aircraft Engines and Rocket Vehicles.

TEXT BOOK:
1. Sharma, S.P., and Chandra Mohan, "Fuels and Combustion", Tata Mc. Graw Hill Publishing Co., Ltd., New Delhi, 1987.

REFERENCES:
1. Beer, J.M., and Chiierar, N.A. "Combustion Aerodynamics", Applied Science Publishers Ltd., London, 1981.
2. Chowdhury, R., Applied Engineering Thermodynamics, Khanna Publishers, New Delhi, 1986.
3. Loh, W.H.T., "Jet, Rocket, Nuclear, Ion and Electric Propulsion: Theory and Design, Springer Verlag, New York, 1982.
4. Mathur, M.L. and Sharma, R.P., "Gas Turbine, Jet and Rocket Propulsion", Standard Publishers & Distributors, Delhi, 2nd edition 2014.
5. Sutton,G.P., Rocket Propulsion Elements, John Wiley, 1993.

OGI752   FUNDAMENTALS OF PLANETARY REMOTE SENSING   L T P C
                                                                3 0 0 3

OBJECTIVES:
- To provide an insight to the basics of planetary Remote Sensing
- To demonstrate how the Remote Sensing technique is applied to explore the surface characteristics of the planets and its environ.

UNIT I   PLANETARY SCIENCE   9

History and inventory of solar system – planet-definition –properties – Formation of solar system. Planetary Atmospheres: composition - thermal structure – clouds – meteorology – photo chemistry – Eddy Diffusion. Surfaces and Interiors: Mineralogy and Petrology – Planetary interiors – surface morphology. Terrestrial planets and the Moon: The moon & Mercury – surface – Atmosphere – Interior – Magnetic Field.

UNIT II   SATELLITE ORBIT   9

Equation of 2 body motion: Energy, orbits and energy – Circular Orbits-EOS Terra-Geosynchronous satellite orbit- orbital elements. Launching Satellites and space probes – Retrograde orbits-Inter planetary Transfer – Hohmann Transfer – Gravity Assist-Cassini-Messenger. Breaking into orbit or landing- Retro Rockets-Aerobraking- Parachutes- Impact.

UNIT III   PROPERTIES OF EMR   9

Definition of Remote Sensing – Electro Magnetic Radiation: Electromagnetic Spectrum-Development of EM theory – White Light – Excited hydrogen gas – Quantum physics – Definition. EM Radiation: Properties – Radiant energy – Sun's luminosity calculation. Other Energy: Black body radiation – Plank curve of black body. Properties of EMR: Kinetic energy – Polarization, laws of Max Plank, Wien's and Stephen Boltzmann

UNIT IV   RADIOMETRY AND SCATTEROMETRY   9

Radiometry – Radar Altimetry – Effect of surface roughness – Altimetry derived data – Reflectivity – Radiometry and Derived emissivity – Incorporation of data set into image analysis – Introduction to SAR – convolution – bidirectional reflectance distribution – Microwave scatterometry - side looking RADAR , SAR – Interferometry.

UNITV   PLANETARY APPLICATION   9

Planetary Imaging Spectroscopy- USGS Tetracoder and Expert system - Mars Global Surveyor Mission (MGS) – Digital Elevation Model(DEM) of Mars – Mars Orbiter Camera (MOC) – Stereo and photoclinometric techniques for DEM.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the students have

- Exposure to fundamentals of planetary science or orbital mechanics
- The principles of observing the planets
- Knowledge of Remote Sensing methods for determining surface elevation and mapping of planets.

REFERENCES:

1. Fundamental Planetary Science : Physics, Chemistry and Habitability, Jack J. Lissauer, Imke de Pater (2013) Cambridge University Press
2. Physical principles of Remote Sensing, Rees, W.G.(2013) 3rd Edn, Cambridge University Press
3. Radar Remote Sensing of Planetary Surfaces, Bruce A Campbell (2011) Cambridge University Press
4. Remote Sensing Application for Planetary Surfaces, Kumar Deepak (2014) Lambert Publication.

OEN751   **GREEN BUILDING DESIGN**   L T P C
                                           3 0 0 3

UNIT I   ENVIRONMENTAL IMPLICATIONS OF BUILDINGS   9

Energy use, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transportation Energy for Building Materials; Maintenance Energy for Buildings.

UNIT II   IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY OF
                BUILDINGS   9

Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

UNIT III   COMFORTS IN BUILDING   9
Thermal Comfort in Buildings- Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings-Implications of Geographical Locations.

UNIT IV   UTILITY OF SOLAR ENERGY IN BUILDINGS   9
Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.

UNIT V   GREEN COMPOSITES FOR BUILDINGS   9
Concepts of Green Composites. Water Utilisation in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

TOTAL: 45 PERIODS

TEXT BOOKS:
1. K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao. Alternative Building Materials and Technologies. New Age International, 2007.
2. Low Energy Cooling For Sustainable Buildings. John Wiley and Sons Ltd, 2009.
3. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

REFERENCES:
1. Osman Attmann Green Architecture Advanced Technologies and Materials. McGraw Hill, 2010.
2. Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.
3. Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke

OAI752   INTEGRATED WATER RESOURCES MANAGEMENT   L T P C
**   3 0 0 3**

OBJECTIVE:
- 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

UNIT II   CONTEXTUALIZING IWRM   9
UN formulations - SDG goals - IWRM in Global, Regional and Local water partnership – Institutional transformation - Bureaucratic reforms - Inclusive development

UNIT III   EMERGING ISSUES IN WATER MANAGEMENT   9
Emerging Issues -– Drinking water management in the context of climate change - IWRM and irrigation - Flood – Drought – Pollution – Linkages between water, health and poverty

UNIT IV   IWRM AND WATER RESOURCES DEVELOPMENT IN INDIA   9
Rural Development - Ecological sustainability- -Watershed development and conservation - Ecosystem regeneration – Wastewater reuse - Sustainable livelihood - Food security

UNIT V   ASPECTS OF INTEGRATED DEVELOPMENT   9
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.

OEI751   **INTRODUCTION TO EMBEDDED SYSTEMS**   **L T P C**
                                                                 3 0 0 3
OBJECTIVES:
- To introduce the Building Blocks of Embedded System
- To Educate in Various Embedded Development Strategies
- To Introduce Bus Communication in processors, Input/output interfacing.
- To impart knowledge in Various processor scheduling algorithms.
- To introduce 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 – The build process for 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 – RS485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I^{2}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, comparison of Real time Operating systems: Vx Works, C/OS-II, RT Linux.

UNIT V   EMBEDDED SYSTEM APPLICATION DEVELOPMENT   9
Case Study of Washing Machine- Automotive Application- Smart card System Application,.

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to understand and analyse, linear and digital electronic circuits.

TEXT BOOKS:
1. Rajkamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013.
2. Peckol, "Embedded system Design", John Wiley & Sons,2010
3. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson, 2013

REFERENCES:
1. Shibu. K.V, "Introduction to Embedded Systems", Tata Mcgraw Hill,2009.
2. Elicia White," Making Embedded Systems", O' Reilly Series,SPD,2011.
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.

OMF751   LEAN SIX SIGMA   L T P C
                                                                3 0 0 3
OBJECTIVE:
- To gain insights about the importance of lean manufacturing and six sigma practices.

UNIT I   LEAN & SIX SIGMA BACKGROUND AND FUNDAMENTALS   9
Historical Overview – Definition of quality – What is six sigma -TQM and Six sigma - lean manufacturing and six sigma- six sigma and process tolerance – Six sigma and cultural changes – six sigma capability – six sigma need assessments - implications of quality levels, Cost of Poor Quality (COPQ), Cost of Doing Nothing – assessment questions

UNIT II   THE SCOPE OF TOOLS AND TECHNIQUES   9
Tools for definition – IPO diagram, SIPOC diagram, Flow diagram, CTQ Tree, Project Charter – Tools for measurement – Check sheets, Histograms, Run Charts, Scatter Diagrams, Cause and effect diagram, Pareto charts, Control charts, Flow process charts, Process Capability Measurement, Tools for analysis – Process Mapping, Regression analysis, RU/CS analysis, SWOT, PESTLE, Five Whys, interrelationship diagram, overall equipment effectiveness, TRIZ innovative problem solving – Tools for improvement – Affinity diagram, Normal group technique, SMED, 5S, mistake proofing, Value stream Mapping, forced field analysis – Tools for control – Gantt chart, Activity network diagram, Radar chart, PDCA cycle, Milestone tracker diagram, Earned value management.

UNIT III   SIX SIGMA METHODOLOGIES   9
Design For Six Sigma (DFSS),Design For Six Sigma Method - Failure Mode Effect Analysis (FMEA), FMEA process - Risk Priority Number (RPN)- Six Sigma and Leadership, committed leadership – Change Acceleration Process (CAP)- Developing communication plan – Stakeholder

UNIT IV   SIX SIGMA IMPLEMENTATION AND CHALLENGES   9
Tools for implementation – Supplier Input Process Output Customer (SIPOC) – Quality Function Deployment or House of Quality (QFD) – alternative approach –implementation – leadership training, close communication system, project selection – project management and team – champion training – customer quality index – challenges – program failure, CPQ vs six sigma, structure the deployment of six sigma – cultural challenge – customer/internal metrics

UNIT V   EVALUATION AND CONTINUOUS IMPROVEMENT METHODS   9

Evaluation strategy – the economics of six sigma quality, Return on six Sigma (ROSS), ROI, poor project estimates – continuous improvement – lean manufacturing – value, customer focus, Perfection, focus on waste, overproduction – waiting, inventory in process (IIP), processing waste, transportation, motion, making defective products, underutilizing people – Kaizen – 5S

TOTAL: 45 PERIODS

OUTCOME:
- The student would be able to relate the tools and techniques of lean sigma to increase productivity

REFERENCES:
1. Michael L.George, David Rownalds, Bill Kastle, What is Lean Six Sigma, McGraw – Hill 2003
2. Thomas Pyzdek, The Six Sigma Handbook, McGraw-Hill,2000
3. Fred Soleimannejed , Six Sigma, Basic Steps and Implementation, AuthorHouse, 2004
4. Forrest W. Breyfogle, III, James M. Cupello, Becki Meadows, Managing Six Sigma:A Practical Guide to Understanding, Assessing, and Implementing the Strategy That Yields Bottom-Line Success, John Wiley & Sons, 2000
5. James P. Womack, Daniel T.Jones, Lean Thinking, Free Press Business, 2003

OAN751	LOW COST AUTOMATION	L T P C
		3 0 0 3

OBJECTIVES
- To give basic knowledge about automation
- To understand the basic hydraulics and pneumatics systems for automation
- To understand the assembly automation

UNIT I   AUTOMATION OF ASSEMBLY LINES   9

Concept of automation - mechanization and automation - Concept of automation in industry - mechanization and automation - classification, balancing of assembly line using available algorithms - Transfer line-monitoring system (TLMS) using Line Status - Line efficiency - Buffer stock Simulation in assembly line

UNIT II   AUTOMATION USING HYDRAULIC SYSTEMS   9

Design aspects of various elements of hydraulic systems such as pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc. - Selection of hydraulic fluid, practical case studied on hydraulic circuit design and performance analysis - Servo valves, electro hydraulic valves, proportional valves and their applications.

UNIT III   AUTOMATION USING PNEUMATIC SYSTEMS   9

Pneumatic fundamentals - control elements, position and pressure sensing -logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods – step counter method - compound circuit design - combination circuit design. Pneumatic equipments - selection of components - design calculations -application - fault finding – hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

UNIT IV   AUTOMATION USING ELECTRONIC SYSTEMS   9

Introduction - various sensors – transducers - signal processing - servo systems - programming of microprocessors using 8085 instruction - programmable logic controllers

UNIT V   ASSEMBLY AUTOMATION   9

Types and configurations - Parts delivery at workstations - Various vibratory and non vibratory devices for feeding - hopper feeders, rotary disc feeder, centrifugal and orientation - Product design for automated assembly.

OUTCOMES:
- Upon completion of this course, the students can able to do low cost automation systems
- Students can do some assembly automation

TEXT BOOKS:
- Anthony Esposito, "Fluid Power with applications", Prentice Hall international, 2009.
- Mikell P Groover, "Automation, Production System and Computer Integrated
- Manufacturing", Prentice Hall Publications, 2007.

REFERENCES
1. Kuo .B.C, "Automatic control systems", Prentice Hall India, New Delhi, 2007.
2. Peter Rohner, "Industrial hydraulic control", Wiley Edition, 1995.
3. Mujumdar.S.R, "Pneumatic System", Tata McGraw Hill 2006.

OMT751	MEMS AND NEMS	L	T	P	C
		3	0	0	3

OBJECTIVE:
To develop the basic knowledge about the MEMS system and to know about the concepts and principles of MEMS & NEMS with various applications.

UNIT I   INTRODUCTION   9

Fundamentals – Micro systems and microelectronics - working principle of microsystems – Micro sensors, acoustic sensor, Bio sensor, chemical sensor, pressure sensor, Temperature sensor - micro actuation techniques – Actuation using thermal forces, actuation using SMA, Actuation using piezo electric effect, Actuation using electro static forces – micro gripper – micro motors – micro valves – micro pumps, types – micro heat pipes.

UNIT II   MICRO FABRICATION AND MANUFACTURING TECHNIQUES   9

Materials for micro systems – Substrates and wafer- Silicon, Quartz, Piezoelectric crystals, polymers - Photo Lithography – Diffusion- Oxidation – CVD- PVD, Etching, types - Bulk micro manufacturing – Surface micro machining - Micro system packaging-materials, die level, device level, system level - Packaging techniques – die preparation - Surface bonding-wire bonding - sealing.

UNIT III   MECHANICS FOR MICRO SYSTEM DESIGN AND APPLICATIONS   9

Basic concepts – Bending of thin plates – Mechanical vibration – Thermo mechanics - Fracture mechanics – Fluid mechanics at micro systems- Design considerations - Process design-mask layout design – Mechanical design-Applications of micro system in automotive industry, bio medical, aerospace and telecommunications.

UNIT IV   NANO ELECTRONICS   9

Basics of nano electronics – Nano electronics with tunneling devices – Nano electronics with super conducting devices - Molecular nano technology – Applications of MNT - Direct self-assembly-device assembly - Electrostatic self-assembly-nano tubes – Nano wire and carbon-60 - Dielectrophoretic nano assembly.

UNIT V   ARCHITECTURE AND APPLICATIONS   9
Architecture of MEMS – Requirements of nano systems - Development of nano electronics and structuring – Application of NEMS – Deposition of coatings – Three dimensional materials – Dewatering.

TOTAL :45PERIODS

OUTCOMES:
CO1: Understand the Fundamentals and working principles of microsystems and microelectronics
CO2: Knowledge on both micro fabrication and manufacturing techniques
CO3: Acquiring knowledge about micro system design and its various applications
CO4: Study about the basic concepts of Nano electronics with various devices and also discusses with its applications
CO5: Realizing the various application of NEMS and Architecture of MEMS

TEXT BOOKS:
1. Goser.K , Dienstuhl .J , " Nano Electronics & Nanosystems '' , Springer International Edition, 2008.
2. Michael Pycraft Inrushes , "Nano Electro Mechanics in Engineering & biology '' ,CRC press New York, 2002.
3. Tai – Ran Hsu,"MEMS & Microsystems: Design and Manufacture ", second edition Tata Mc Graw Hill, 2008.

REFERENCES
1. Charles P.Poojlejr Fran K J.Owners , " Introduction to Nano Technology '', Willey student Edition 2008.
2. Gregory Timp, " Nano Technology '',Spinger International Edition , 1999.
3. Julian W.Gardner,Vijay   K.Varadan,Osama O.Awadel   Karim, Microsensors MEMS and Smart Devices, John Wiby & sons Ltd.,2001.
4. Mohamed Gad – el- Hak,The MEMS HAND book,CRC press 2005

ORO751   NANO COMPUTING   L T P C
                                                                       3 0 0 3
OBJECTIVES:
The student should be made to:
- Learn nano computing challenges
- Be familiar with the imperfections
- Be exposed to reliability evaluation strategies
- Learn nano scale quantum computing
- Understand Molecular Computing and Optimal Computing

UNIT I   NANOCOMPUTING-PROSPECTS AND CHALLENGES   9
Introduction - History of Computing - Nanocomputing - Quantum Computers – Nanocomputing Technologies - Nano Information Processing - Prospects and Challenges - Physics of Nanocomputing: Digital Signals and Gates - Silicon Nanoelectronics - Carbon Nanotube Electronics - Carbon Nanotube Field-effect Transistors – Nanolithography.

UNIT II   NANOCOMPUTING WITH IMPERFECTIONS   9
Introduction - Nanocomputing in the Presence of Defects and Faults - Defect Tolerance - Towards Quadrillion Transistor Logic Systems.

UNIT III   RELIABILITY OF NANOCOMPUTING   9
Markov Random Fields - Reliability Evaluation Strategies - NANOLAB - NANOPRISM - Reliable Manufacturing and Behavior from Law of Large Numbers.

UNIT IV NANOSCALE QUANTUM COMPUTING 9
Quantum Computers - Hardware Challenges to Large Quantum Computers - Fabrication, Test, and Architectural Challenges - Quantum-dot Cellular Automata (QCA) - Computing with QCA - QCA Clocking - QCA Design Rules.

UNIT V QCADESIGNER SOFTWARE AND QCA IMPLEMENTATION 9
Basic QCA Circuits using QCA Designer - QCA Implementation - Molecular and Optical Computing: Molecular Computing - Optimal Computing - Ultrafast Pulse Shaping and Tb/sec Data Speeds.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the student should be able to:
- Discuss nano computing challenges.
- Handle the imperfections.
- Apply reliability evaluation strategies.
- Use nano scale quantum computing.
- Utilize Molecular Computing and Optimal Computing.

TEXT BOOK:
1. Sahni V. and Goswami D., Nano Computing, McGraw Hill Education Asia Ltd. (2008), ISBN (13): 978007024892.

REFERENCES:
1. Sandeep K. Shukla and R. Iris Bahar., Nano, Quantum and Molecular Computing, Kluwer Academic Publishers 2004, ISBN: 1402080670.
2. Sahni V, Quantum Computing, McGraw Hill Education Asia Ltd. 2007.
3. Jean-Baptiste Waldner, Nanocomputers and Swarm Intelligence, John Wiley & Sons, Inc. 2008, ISBN (13): 978-1848210097.

OAE752	PRINCIPLES OF FLIGHT MECHANICS	L T P C
		3 0 0 3

OBJECTIVE:
- To make the student understand the performance of airplanes under various flight conditions like take off, cruise, landing, climbing, gliding, turning and other maneuvers.

UNIT I GENERAL CONCEPTS 9
International Standard atmosphere, IAS, EAS, TAS, Propeller theory- Froude momentum and blade element theories, Propeller co-efficients, Use of propeller charts, Performance of fixed and variable pitch propellers, High lift devices, Thrust augmentation

UNIT II DRAG OF BODIES 8
Streamlined and bluff body, Types of drag, Effect of Reynold's number on skin friction and pressure drag, Drag reduction of airplanes, Drag polar, Effect of Mach number on drag polar. Concept of sweep- effect of sweep on drag.

UNIT III STEADY LEVEL FLIGHT 10
General equation of motion of an airplane. Steady level flight, Thrust required and Power required, Thrust available and Power available for propeller driven and jet powered aircraft, Effect of altitude, maximum level flight speed, conditions for minimum drag and minimum power required, Effect of drag divergence on maximum velocity, Range and Endurance of Propeller and Jet aircrafts. Effect of wind on range and endurance.

UNIT IV GLIDING AND CLIMBING FLIGHT 9
Shallow and steep angles of climb, Rate of climb, Climb hodograph, Maximum Climb angle and Maximum Rate of climb- Effect of design parameters for propeller jet and glider aircrafts, Absolute and service ceiling, Cruise climb, Gliding flight, Glide hodograph

UNIT V ACCELERATED FLIGHT 9
Estimation of take-off and landing distances, Methods of reducing landing distance, level turn, minimum turn radius, maximum turn rate, bank angle and load factor, Constraints on load factor, SST and MSTR. Pull up and pull down maneuvers, V-n diagram.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to
- Understand concepts of take-off, climb, cruise, turn, descent and landing performance.
- understand the performance characteristics of the different types of power plants
- Understand and predict the behavior of fixed wing aircraft undertaking a typical flight profile
- Understand the factors that influence aircraft design and limit aircraft performance.

TEXT BOOKS:
1. Anderson, Jr., J.D. Aircraft Performance and Design, McGraw-Hill International Edition, 1999
2. Houghton,E.L. and Carruthers, N.B. Aerodynamics for engineering students, Edward Arnold Publishers, 1988.

REFERENCES:
1. Anderson, J.D., Introduction to Flight, McGraw-Hill; 8th edition , 2015
2. Clancy, L J., Aerodynamics, Shroff publishers (2006)
3. John J Bertin., Aerodynamics for Engineers, Prentice Hall; 6th edition, 2013.
4. Kuethe, A.M. and Chow, C.Y., Foundations of Aerodynamics, John Wiley & Sons; 5th Edition, 1997.

OCH751 **PROCESS MODELING AND SIMULATION** **L T P C**
3 0 0 3

OBJECTIVE:
- To give an overview of various methods of process modeling, different computational techniques for simulation.

UNIT I INTRODUCTION 7
Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.

UNIT II STEADY STATE LUMPED SYSTEMS 9
Degree of freedom analysis, single and network of process units, systems yielding linear and non-linear algebraic equations, flow sheeting – sequential modular and equation oriented approach, tearing, partitioning and precedence ordering, solution of linear and non-linear algebraic equations.

UNIT III UNSTEADY STATE LUMPED SYSTEMS 9
Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash and distillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems.

UNIT IV STEADY STATE DISTRIBUTED SYSTEM 7
Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.

UNIT V UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER MODELLING APPROACHES 13

Analysis laminar flow in pipe, sedimentation, boundary layer flow, conduction, heat exchanger, heat transfer in packed bed, diffusion, packed bed adsorption, plug flow reactor. Empirical modeling, parameter estimation, population balance and stochastic modeling.

TOTAL : 45 PERIODS

OUTCOME:
- Upon completing the course, the student should have understood the development of process models based on conservation principles and process data and computational techniques to solve the process models.

TEXT BOOKS:
1. Ramirez, W.; " Computational Methods in Process Simulation ", 2nd Edn., Butterworths Publishers, New York, 2000.
2. Luyben, W.L., " Process Modelling Simulation and Control ",2nd Edn, McGraw-Hill Book Co., 1990

REFERENCES:
1. Felder, R. M. and Rousseau, R. W., " Elementary Principles of Chemical Processes ", John Wiley, 2000.
2. Franks, R. G. E., " Mathematical Modelling in Chemical Engineering ", John Wiley, 1967.
3. Amiya K. Jana,"Process Simulation and Control Using ASPEN", 2nd Edn,PHI Learning Ltd (2012).
4. Amiya K. Jana, "Chemical Process Modelling and Computer Simulation" 2nd Edn, PHI Learning Ltd,(2012).

OAT751 PRODUCTION OF AUTOMOTIVE COMPONENTS L T P C
3 0 0 3

OBJECTIVES:
- To study in detail about the modern casting, forging, molding and machining processes followed in automotive components.
- To enhance the knowledge of the students in the field of non–ferrous materials, emerging metallic and non-metallic materials like polymers, fiber reinforced plastics (FRP), engineering ceramics, metal matrix composites (MMCs) and its manufacturing methods, selection criteria, properties and applications for automotive components.

UNIT I ENGINE COMPONENTS 9
Overview -Material selection and Manufacturing methods for the Engine Components. Engine block– Casting– Conventional and expendable pattern. Cylinder head– Casting, machining and thermal barrier coating. Crank shaft, connecting rod, camshaft–Forging, machining and heat treatment. Piston Gravity, squeeze, die casting, machining and finishing. Gudgeon Pin -Machining and Finishing, Valve forging, friction welding, machining, thermal barrier coating, heat treatment and surface improvement. Cylinder Liners, Piston ring -Centrifugal, HPDC, LPDC, machining and finishing. Castings Processes for Oil pan and Carburettors. Push Rods, Rocker Arm , Tappets, Spark Plug- Forging, Machining, Finishing and Heat treatment.

UNIT II TRANSMISSION COMPONENTS 9
Overview - Material selection and Manufacturing methods for transmission system. Flywheel - *Casting* and Machining. Clutch - Friction plate, clutch housing, pressure plate conventional and fine blanking, composite friction lining. Methods of Gear manufacture – Gear hobbing and gear Shaping machines - gear generation - gear finishing and shaving – Grinding and lapping of hobs and shaping cutters –gear honing –gear broaching. Gearbox -Casting, precision forging, powder metallurgy, heat treatment and finishing. Propeller shaft -Continuous casting, extrusion, dies heat treatment and surface hardening. Axle-Differential –Axle Shaft –Bearing –fasteners-Forging,

casting and machining. Leaf and coil spring -Forging and machining, composite leaf spring and wrap forming of coil spring.

UNIT III   BODY COMPONENTS   9
Surface treatment –Plastics – Plastics in Automobile vehicles –Processing of plastics - Body Panel -Thermoforming and hydro forming, press forming, stretch forming. Emission control system –catalytic converter –Hydro forming of exhaust manifold and lamp housing. Welding – Resistance welding and other welding processes with the use of Robots in Body weldment. Instrument Panel -Principle of injection molding, injection molding of instrument panel. Bumpers - Molding of bumpers, reinforced reaction injection molding, Manufacture of polymer panels.

UNIT IV   CHASSIS COMPONENTS   9
Material selection and manufacturing methods for Vehicle Frame Manufacturing, Wheel drum, Brake drum, Brake shoes, wheel rim and wheel housing manufacturing. Steering systems, shock absorbers, dead axle – casting, forging, machining and finishing operation- Heat treatment procedures for chassis components.

UNIT V   TYRES AND ADVANCED MATERIALS MANUFACTURING   9
Tire and tube manufacturing, spray painting, powder coating, Prototype Manufacturing -RPT,3-D Printing, chemical vapour deposition, physical vapour deposition, cryogenic grinding of powders, sealants, sound proof materials, structural adhesives, MMC liners – Selection of materials for Auto components.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the student should
- Will be able to select an appropriate manufacturing process for particular Automotive Components.
- Have in-depth knowledge of various engineering materials used in automobile engineering and the corresponding manufacturing processes for the same.

TEXT BOOKS:
1. Heldt P M, "High Speed Combustion Engines", Oxford IBH publishing Co., Calcutta, 1996.
2. Kalpakjian, "Manufacturing Engineering and Technology", Pearson Education, 2005.

REFERENCES:
1. B.P. Bhardwaj, "The Complete Book on Production of Automobile Components & Allied Products", NIIR Project Consultancy Services, 2014.
2. Degarmo E P, "Materials and process in Manufacturing", Macmillan Publishing Co, 1997.
3. John A S, "Introduction to Manufacturing Processes", Tata McGraw -Hill, 2012.
4. Kalpakjian, "Manufacturing Processes For Engineering Materials", Pearson Education, 2009.
5. Philip F O and JairoMunuz, "Manufacturing Processes and Systems", John Wiley & Sons, New York, 1998.

OIE751	ROBOTICS	L	T	P	C
		3	0	0	3

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   6
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   12
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   13
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   5
RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

OUTCOME:
- Upon completion of this course, the students can able to apply the basic engineering knowledge for the design of robotics

TEXT BOOKS:
1. Klafter R.D., Chmielewski T.A and Negin M., "Robotic Engineering - An Integrated Approach", Prentice Hall, 2003.
2. Groover M.P., "Industrial Robotics -Technology Programming and Applications", McGraw Hill, 2001.

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., 1994.
3. Koren Y., "Robotics for Engineers", Mc Graw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.
5. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill, 1995.
6. Rajput R.K., "Robotics and Industrial Automation", S.Chand and Company, 2008.
7. Surender Kumar, "Industrial Robots and Computer Integrated Manufacturing", Oxford and IBH Publishing Co. Pvt. Ltd., 1991.

OML753　　　　　　　　**SELECTION OF MATERIALS**　　　　　　　**L T P C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　3 0 0 3

OBJECTIVES:
The subject exposes students to the basics parameter for selection of materials and different classes of materials, manufacturing processes and their properties , applications of materials.

UNIT I　　ENGINEERING MATERIALS　　　　　　　　　　　　　　　　9
Introduction – classification of engineering materials – selection of materials for engineering purposes –selection of materials and shape –classification metal and alloys, polymers, ceramics and glasses, composites, natural materials,-non metallic materials- smart materials - physical, metrical properties of metals

UNIT II　　MATERIAL PROPERTIES　　　　　　　　　　　　　　　　9
Mechanical properties – fatigue strength – fracture Toughness - Thermal Properties - Magnetic Properties - Fabrication Properties –electrical , optical properties - Environmental Properties , Corrosion properties –shape and size - Material Cost and Availability– failure analysis

UNIT III　　MANUFACTURING PROCESSING AND ECONOMIC ANALYSIS　　9
Interaction of Materials Selection, Design, and Manufacturing Processes - Production Processes and Equipment for Metals - Metal Forming, Shaping, and Casting - Plastic Parts Processing - Composites Fabrication Processes - Advanced Ceramics Processing – surface treatment - Resource -The Price and Availability of Materials

UNIT IV　　MATERIALS SELECTION CHARTS AND TESTING　　　　　9
Ashby material selection charts-Testing of Metallic Materials - Plastics Testing - Characterization and Identification of Plastics - Professional and Testing Organizations - Ceramics Testing - Nondestructive Inspection.

UNIT V　　APPLICATIONS AND USES　　　　　　　　　　　　　　9
Selection of Materials for Biomedical Applications - Medical Products - Materials in Electronic Packaging - Advanced Materials in Sports Equipment - Materials Selection for Wear Resistance - Advanced Materials in Telecommunications - Using Composites - Manufacture and Assembly with Plastics, fiber and Diamond Films.

　　　　　　　　　　　　　　　　　　　　　　　　TOTAL : 45 PERIODS

OUTCOMES:
 • Understand different types of availability materials
 • Easy and effective way to select required materials
 • Ability to identify the material properties

TEXT BOOKS:
1. Ashby, M. F. Materials selection in mechanical design, 3rd edition. Elsevier, 2005.
2. Ashby, M. F. and Johnson, K. Materials and design – the art and science of material selection in product design. Elsevier, 2002.

REFERENCES:
1. Charles, J. A., Crane, F. A. A. and Furness, J. A. G. Selection and use of engineering materials, 3rd edition. Butterworth-Heinemann, 1997
2. Handbook of Materials Selection. Edited by Myer Kutz2002 John Wiley & Sons, Inc., NewYork.

OML751   **TESTING OF MATERIALS**   **L T P C**
                                                                            3 0 0 3

OBJECTIVE:
To understand the various destructive and non destructive testing methods of materials and its industrial applications.

UNIT I   INTRODUCTION TO MATERIALS TESTING   9
Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.

UNIT II   MECHANICAL TESTING   9
Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT III   NON DESTRUCTIVE TESTING   9
Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT IV   MATERIAL CHARACTERIZATION TESTING   9
Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT V   OTHER TESTING   9
Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo-mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.

TOTAL: 45 PERIODS

OUTCOMES:
* Identify suitable testing technique to inspect industrial component
* Ability to use the different technique and know its applications and limitations

TEXT BOOKS:
1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Cullity, B. D., "Elements of X-ray diffraction", 3rd Edition, Addison-Wesley Company Inc., New York, 2000.
3. P. Field Foster, "The Mechanical Testing of Metals and Alloys" 7th Edition, Cousens Press, 2007.

REFERENCES:
1. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.
2. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA.
3. Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.

OAT752   **VEHICLE STYLING AND DESIGN**   **L T P C**
                                                               3 0 0 3

UNIT I   INTRODUCTION TO VEHICLE DESIGN: 9
Timeline developments in design - Mass production – Streamlining for style and low drag - Commercial vehicles - Engine developments - Transmission system development – Steering – Suspension – Brakes - Interior refinement - Safety design.

UNIT II   VEHICLE BODY DESIGN: 9
The styling process - Working environment and structure - Product planning - Concept sketching and package related sketching - Full sized tape drawing - Clay modelling.
Aerodynamics - Aerodynamic forces – Drag & Drag reduction - Stability during cross-winds – Wind Noise - Under-hood ventilation - Cabin ventilation - Introduction to Computational fluid dynamics - Wind tunnel testing of scale models.

UNIT III   NOISE AND VIBRATION: 9
Vibration – fundamentals & control – Acoustics – fundamentals - Human response to sound - Sound measurement - Automotive noise criteria - Drive-by noise tests, Noise from stationary vehicles, Interior noise in vehicles, Automotive noise sources and control techniques - Engine noise, Transmission noise, Intake & exhaust noise, Aerodynamic noise, Tyre noise, Brake noise

UNIT IV   CRASHWORTHINESS AND ERGONOMIC APPROACH: 9
Accident and injury analysis - Vehicle impacts: general dynamics & crush characteristics - Structural collapse and its influence upon safety - Occupant accommodation – Ergonomics in the automotive industry - Ergonomics methods and tools - Case studies of Fiat Punto - Strategies for improving occupant accommodation and comfort.

UNIT V   VEHICLE CONTROL SYSTEMS   9
Automotive application of sensors - Chassis control systems - Anti-lock braking systems, Traction control systems, Electronically controlled power-assisted steering - Vehicle safety and security systems - Air-bag and seat belt pre-tensioner systems, Remote keyless entry and vehicle immobilization, Introduction to On-board navigation systems.

                                                            TOTAL: 45 PERIODS
TEXT BOOK:
1. An Introduction to Modern Vehicle Design, Julian Happian-Smith, Butterworth-Heinemann Ltd (2002)

REFERENCES:
1. Aerodynamics of Road Vehicles: From Fluid Mechanics to Vehicle Engineering, Wolf-Heinrich Hucho (Eds.), Butterworth-Heinemann Ltd (1987)
2. Sensors and Transducers, Ian R Sinclair, Butterworth - Heinemann Ltd (2001)
3. The Motor Vehicle - T.K. Garrett, K. Newton & W. Steeds, Butterworth- Heinemann Ltd (2001)

OTT751   **WEAVING MECHANISMS**   **L T P C**
                                                       3 0 0 3
OBJECTIVE:
- To enable the students to understand the preparation for weaving and various functions of weaving machine.

UNIT I   INTRODUCTION   9
Types of winding drums - Design of winder drums; various motions for automatic weaving– primary, secondary and auxiliary motions; Driving plain power loom; timing of motions.

UNIT II   SHEDDING   9

Principles of tappet, dobby and jacquard shedding mechanisms, positive and negative shedding mechanisms, electronic dobby and jacquard mechanism, tappet design.

UNIT III   PICKING-I   9

Mechanism of picking in shuttle looms, components of picking system, design of shuttle, multi shuttle mechanism.

UNIT IV   PICKING-II   9

Principles of weft insertions in shuttle less looms; weft feeder, mechanism of weft insertion by projectile, gripper cycle; rapier loom-classification,rapier drive mechanisms, devices timings; Water jet weft insertion; Air jet weft insertion.

UNIT V   OTHER MECHANISMS   9

Shuttle and shuttleless terry mechanisms; Let-off and take-up mechanism; selvedge mechanism in shuttless loom, warp weft, stop motions, warp protector mechanism

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course, the students shall,
- Understand the concepts of preparation of weaving process
- Understand different motions of loom in fabric formation.

TEXT BOOKS:

1. Talukdar. M.K., Sriramulu. P.K., and Ajgaonkar. D.B., "Weaving: Machines, Mechanisms,Management", Mahajan Publishers, Ahmedabad, 1998, ISBN: 81-85401-16-0.
2. Booth. J.E., "Textile Mathematics Volume 3", The Textile Institute, Manchester, 1977, ISBN:090073924X.
3. Marks R., and Robinson. T.C., "Principles of Weaving", The Textile Institute, Manchester,1989, ISBN: 0 900739 258.

REFERENCES:

1. SabitAdanur., "Handbook of Weaving", Technomic Publishing Co. Inc., 2001, ISBN: 1587160137 | ISBN-13: 9781587160134
2. Vangheluwe L., "Air- Jet Weft Insertion", Textile progress, Vol. 29, No. 4, Textile InstitutePublication, 1999, ISBN; 1870372255.
3. Valeriy V. Choogin., PalithaBandara., and Elena V. Chepelyuk., "Mechanisms of Flat WeavingTechnology", Wood Head Publishing, 2013, ISBN: 0857097806 | ISBN-13: 9780857097804
4. Prabir Kumar Banerjee., "Principles of Fabric Formation" CRC Press, 2014, ISBN: 1466554444 | ISBN-13: 9781466554443
5. Majumdar A., Das A., Alagirusamy R.,and Kothari V.K., " Process Control in Textile Manufacturing", wood Head publishing, 2012, ISBN: 0857090275 | ISBN-13: 9780857090270
6. "Weaving: The knowledge in Technology", Papers Presented at the Textile Institute WeavingConference 1998, Textile Institute, ISBN: 1870372182 ISBN-13: 9781870372183.

OMV751	MARINE VEHICLES	L	T	P	C
		3	0	0	3

OBJECTIVES:
- To provide the students a basic knowledge about various types of marine vehicles
- To provide the students basic theory behind the design and development of marine vehicles

UNIT I   **MARINE VEHICLES**   **6**
Types – general – by function – commercial marine vehicles- passenger ship, cargo ships, oil and chemical tankers , cattle carriers, harbor crafts, off shore platform, container ships

UNIT II   **REEFERS AND GAS CARRIERS**   **9**
Introduction – Types , design considerations, safety – operation and controls, precaution during bunkering

UNIT III   **REMOTELY OPERABLE VEHICLE (ROV), UMS SHIPS**   **9**
Remotely Operable Vehicles (ROV) – The ROV business – Design theory and standards – control and simulation – design and stability – components of ROV – applications, UMS operation, and controls

UNIT IV   **SUBMERSIBLES AND AUTONOMOUS UNDERWATER VEHICLE**   **9**
                         (AUV)
submersibles types – applications, AUV – Design and construction considerations – components – sensors – Navigation -control strategies – applications

UNIT V   **MANNED AND UN MANNED SUBMERSIBLE**   **12**
Introduction – Design and operational consideration – pressure hull exo-structure – ballasting and trim – maneuvering and control – Life support and habitability – emergency devices and equipment's – certification and classification, towed vehicles – gliders – crawler – Design and construction

                                             TOTAL :   45   PERIODS

OUTCOMES:
- Students will be able understand the types of marine vehicles
- Students should get a preliminary knowledge in marine vehicle design, construction and its components

TEXT BOOKS:
 1 Jonathan M. Ross, human factors for naval marine vehicle design and operation
 2 Sabiha A. Wadoo, Pushkin Kachroo, Autonomous underwater vehicles, modelling, control design and Simulation, CRC press, 2011
 3 R. Frank Busby, Manned Submersibles, Office of the oceanographer of the Navy, 1976

REFERENCES
 1   Ferial L hawry, The ocean engineering handbook, CRC press,2000
 2   Richard A Geyer, "Submersibles and their use in oceanography and ocean engineering", Elsevier, 1997
 3   Robert D. Christ,Robert L. Wernli, Sr. "The ROV Manual A User Guide for Remotely Operated Vehicles", Elsevier, second edition, 2014

ANNA UNIVERSITY, CHENNAI
FACULTY OF INFORMATION AND COMMUNICATION ENGINEERING
LIST OF ONLINE COURSES

SL.NO.	COURSES TITLE	SOURCE
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING		
SL.NO.	**COURSES TITLE**	**SOURCE**
1.	Artificial Intelligence Search Methods for Problem Solving	IIT-NPTEL
2.	Block Chain Architecture Design and Use Cases	IIT-NPTEL
3.	Computer Networks and Internet Protocol	IIT-NPTEL
4.	Introduction to Internet of Things	IIT-NPTEL
5.	Model Checking	IIT-NPTEL
6.	Social Networks	IIT-NPTEL
7.	The Joy of Computing Using Python	IIT-NPTEL
8.	AI:Knowledge Representation and Reasoning	IIT-NPTEL
9.	Foundations to Computer Systems Design	IIT-NPTEL
10.	Machine Learning for Engineering and Science Applications	IIT-NPTEL
11.	Computer Organization and Architecture - A Pedagogical Aspect	IIT-NPTEL
12.	Deep Learning	IIT-NPTEL
DEPARTMENT OF INFORMATION TECHNOLOGY		
SL.NO.	**COURSES TITLE**	**SOURCE**
13.	Joy of Computing Using Python	NPTEL
14.	Randomized Algorithms	NPTEL
15.	Parallel Algorithms	NPTEL
16.	Block Chain Architecture and Use Cases	NPTEL
17.	Social Networks	NPTEL
18.	Introduction to Internet of Things	NPTEL
19.	Introduction to Industry 4.0 and Industrial Internet of Things	NPTEL
DEPARTMENT OF INFORMATION SCIENCE ANDTECHNOLOGY		
SL.NO.	**COURSES TITLE**	**SOURCE**
20.	The Joy of Computer Using Python	NPTEL
21.	Deep Learning	NPTEL
22.	Artificial Intelligence Search Methods for Problem Solving	NPTEL
23.	Blockchain Architecture Design and Use Cases	NPTEL
24.	Switching Circuits and Logic Design	NPTEL
25.	Embedded Systems- Design Verification and Test	NPTEL
26.	Social Networks	NPTEL
27.	Applied Optimization for Wireless, Machine Learning, Big Data	NPTEL
28.	Regression Analysis	NPTEL
29.	E-Business	NPTEL
30.	Deep Learning for Visual Computing	NPTEL
31.	Intellectual Property	NPTEL

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING		
SL.NO.	**COURSES TITLE**	**SOURCE**
32.	LDPC and Polar Codes	NPTEL
33.	Basics of Software – Defined Radios and Practical Applications	NPTEL
34.	Digital Speech Processing	NPTEL
35.	Millimeter – Wave Technology	NPTEL
36.	Satellite Communication Systems	NPTEL
37.	Fundamentals of MIMO Wireless Communications	NPTEL
38.	Estimation for Wireless Communications- MIMO/OFDM Cellular and Sensor Networks	NPTEL
39.	Machine Learning	NPTEL
40.	Deep Learning	NPTEL
41.	Applied Natural Language Processing	NPTEL