CURRICULUM AND ACADEMIC REGULATIONS FOR B. TECH. PROGRAM

Applicable for students admitted in 2014-15 Academic Year

K L University
u/s 3 of UGC Act, 1956
Koneru Lakshmaiah Education Foundation

Vaddeswaram – 522 502 (A.P) INDIA

CONTENTS

Note: While every effort has been made to ensure that this book is accurate and up to date, it may include typographical or other errors. Changes are periodically made to this publication and will be incorporated in new edition.

ACADEMIC REGULATIONS FOR B.TECH. PROGRAM

(Applicable for students admitted from 2014-2015)

This document supplements the University's rules and regulations to provide assistance to all B.Tech students. It is required that every individual has to abide by these regulations.

TERMINOLOGY

Academic Council: The Academic Council is the highest academic body of the University and is responsible for the maintenance of standards of instruction, education and examination within the University. Academic Council is an authority as per UGC regulations and it has the right to take decisions on all academic matters including academic research.

Academic Year: It is the period necessary to complete an actual course of study within a year. It comprises of two consecutive semesters i.e., Even and Odd semester.

Audited Course: It is a course of study which neither has evaluation component nor a grade.

Backlog Course: A course is considered to be a backlog course if the student has obtained a failure grade (F).

Basic Sciences : The courses of foundational nature in the areas of Mathematics, Physics, Chemistry, Biology etc., are offered in this category.

Betterment : Betterment is a way that contributes towards improving the students' grade in any course(s). It can be done by either (a) re-appearing or (b) re-registering for the course.

Board of Studies : Board of Studies (BOS) is an authority as defined in UGC regulations, constituted by Vice Chancellor for each of the department separately. They are responsible for curriculum design and update in respect of all the programs offered by a department.

Branch of Study: It is a branch of knowledge, an area of study or a specific program (like Civil Engineering, Mechanical Engineering, Electrical and Electronics Engineering etc.)

Certificate course : It is a course that makes a student gain hands-on expertise and skills required for holistic development. It is a mandatory, non-credited course for the award of degree.

Change of Branch : Change of branch means transfer from one's branch of study to other.

Compulsory course : Course required to be undertaken for the award of the degree as per the program.

Course : A course is a subject offered by the University for learning in a particular semester.

Course Handout : Course Handout is a document, which gives complete plan of the course. It contains the details of the course viz. Course title, Course code, Pre-requisite, Credit structure, team of instructors, Course objectives, Course rationale, Course Outcomes and the relevant syllabus, textbook(s) and reference books, Course delivery plan and session plan, evaluation method, chamber consultation hour, course notices and other course related aspects. In essence, course handout is an agreement between students (learners) and the instructor.

Course Outcomes : The essential skills that need to be acquired by every student through a course.

Credit : A credit is a unit that gives weight to the value, level or time requirements of an academic course. The number of 'Contact Hours' in a week of a particular course determines its credit value. One credit is equivalent to one lecture hour per week or two hours per week of tutorials/ self-learning/ practical/ field work during a semester.

Credit point : It is the product of grade point and number of credits for a course.

Credit Transfer : The procedure of granting credit(s) to a student for course(s) undertaken at another institution.

Cumulative Grade Point Average (CGPA) : It is a measure of cumulative performance of a student over all the completed semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

Curriculum : Curriculum incorporates the planned interaction of students with instructional content, materials, resources, and processes for evaluating the attainment of Program Educational Objectives.

Degree : A student who fulfills all the Program requirements is eligible to receive a degree.

Degree with Specialization : A student who fulfills all the Program requirements of her/his discipline and successfully completes a specified set of Professional elective courses in a specialized area is eligible to receive a degree with specialization.

Department : An academic entity that conducts relevant curricular and co-curricular activities, involving both teaching and non-teaching staff and other resources.

Detention in a course : Student who does not obtain minimum prescribed marks in continuous in-semester evaluation and /or minimum prescribed attendance in a course shall be detained in that particular course.

Dropping from the Semester : A student who doesn't want to register for the semester should do so in writing in a prescribed format before commencement of the semester.

Elective Course : A course that can be chosen from a set of courses. An elective can be Professional Elective, Open Elective, Management Elective and Humanities Elective.

Engineering Sciences : The courses belonging to basic evolutionary aspects of engineering from Mechanical Sciences, Electrical Sciences and Computing like Engineering Mechanics, Data structures, Network Theory, Signal Analysis etc...

Evaluation : Evaluation is the process of judging the academic work done by the student in her/his courses. It is done through a combination of continuous in-semester assessment and semester end examinations.

Grade : It is an index of the performance of the students in a said course. Grades are denoted by alphabets.

Grade Point : It is a numerical weight allotted to each letter grade on a 10 - point scale.

Honors Degree : A student who fulfills the entire Program requirements of her/his discipline and successfully completes a specified set of additional courses within the same program is eligible to receive an Honors degree.

Humanities Elective : A course offered in the area of Liberal Arts.

Industrial Training : Training program undergone by the student as per the academic requirement in any company/firm. It is a credited course.

Industrial Visit : Visit to a company/firm as per the academic requirement.

In-Semester Evaluation : Summative assessments used to evaluate student learning, acquired skills, and academic attainment during a course.

Make-up Test : An additional test scheduled on a date other than the originally scheduled date.

Management elective: A course that develops managerial skills and inculcates entrepreneurial skills.

Mini project : Mini Project is a credit-based course that a student has to undergo during his/her academic term, which involves the student to explore in a discipline belonging to their research interest within their program area.

Minor Degree : A student who fulfills all the Program requirements of her/his discipline and successfully completes a specified set of courses from another discipline is eligible to receive a minor degree in that discipline.

Multi- Section Course : Course taught for more than one section.

Open Elective : This is a course of interdisciplinary nature. It is offered across the University for all programs.

Over loading : Registering for more number of credits than normally prescribed by the Program in a semester.

Practice School : It is a part of the total program and takes one full semester in a professional location, where the students and the faculty get involved in finding solutions to real-world problems. A student can choose Project/Practice School during his/her 7th or 8th semester of his/her Academic Year to meet the final requirements for a degree.

Pre-requisite : A course, the knowledge of which is required for registration into higher level course.

Professional Core : The courses that are essential constituents of each engineering discipline are categorized as Professional Core courses for that discipline.

Professional Elective : A course that is discipline centric. An appropriate choice of minimum number of such electives as specified in the program will lead to a degree with specialization.

Program : A set of courses offered by the Department. A student can opt and complete the stipulated minimum credits to qualify for the award of a degree in that Program.

Program Educational Objectives : The broad career, professional, personal goals that every student will achieve through a strategic and sequential action plan.

Project : Course that a student has to undergo during his/her final year which involves the student to undertake a research or design, which is carefully planned to achieve a particular aim. It is a credit based course.

Project based laboratory : Project Based Laboratory is a student-centric learning methodology that involve students in design, problem-solving, decision making, and investigative activities; gives students the opportunity to work in teams, over extended periods of time; and culminate in realistic products or presentations

Re-Appearing : A student can reappear only in the semester end examination for the Theory component of a course, subject to the regulations contained herein.

Registration : Process of enrolling into a set of courses in a semester/ term of the Program.

Re-Registering : A student desiring to repeat a course is permitted to do so, subject to the regulations contained herein.

Semester : It is a period of study consisting of 15 to 18 weeks of academic work equivalent to normally 90 working days including examination and preparation holidays. The odd Semester starts normally in July and even semester in December.

Semester End Examinations : It is an examination conducted at the end of a course of study.

Single Section Course : Course taught for a single section.

Social Service : An activity designed to promote *social* awareness and generate well-being; to improve the life and living conditions of the society.

Student Outcomes : The essential skill sets that need to be acquired by every student during her/his program of study. These skill sets are in the areas of employability, entrepreneurial, social and behavioral.

Substitution of Elective course : Replacing an elective course with another elective course as opted by the student.

Summer term : The term during which courses are offered from May to July. Summer term is not a student right and will be offered at the discretion of the University.

Term Paper : A 'term paper' is a research report written by students that evolves their course based knowledge, accounting for a grade. Term paper is a written original research work discussing a topic in detail. It is a credit based course.

Under-loading : Registering for lesser number of credits than normally prescribed by the Program in a semester.

Withdraw from a Course : Withdrawing from a Course means that a student can drop from a course within the first two weeks of the odd or even Semester (deadlines are different for summer sessions). However s/he can choose a substitute course in place of it by exercising the option within 5 working days from the date of withdrawal.

Degrees:

A student enrolling into the B.Tech Programs offered by various departments are eligible for the following degrees:

a) **B.Tech degree** in the respective departments : A general degree, obtained by taking courses offered by the department, and Five Professional Electives ; within from various Groups offered by the department, and taking up a Practice School / Project in his/ her chosen area within the domain of the department.

b) **B.Tech degree with Specialization** in domains: A degree, obtained by taking courses offered by the department, and taking the Five Professional Electives chosen from within the Specialized Streams offered by the department, and along with it taking up Practice School / Project preferably falling in the domain of the chosen Specialization only.

c) **B.Tech Honors Degree:** This is a flexibility offered only for the elite students of the Program, who opts for it and take up additional courses that foster their domain knowledge which are over and above the courses minimum required for any student to get a regular B.Tech degree. This degree will also be offered only within a duration of 4 years, and in between such students should not have any discontinuities in terms of Re-registrations, back logs, failures, detentions etc in any one the courses registered by them.

d) **Dual Degree:** A B.Tech student can opt for a dual degree either in M.Tech or M.B.A at the end of 4^{th} Semester. The required courses to be done and the program structure to obtain Dual degree in a minimum period of 5 years will be supplemented by the respective departments. At the end of four years the student will get his normal degree and after successful completion of 5 years the M.Tech./MBA degree will be awarded.

e) **B.Tech degree with a Minor in different discipline:** A student who completes all the B. Tech requirements of one discipline for which he/she is admitted (or took transfer of branch), is awarded with Major degree in that discipline. The University offers flexibility for a student to complete a smaller set of courses from another discipline and awards him/her a minor degree in a different discipline.

RULES AND REGULATIONS

This document supplements the University's rules and regulations to provide assistance to all undergraduate students. It is the responsibility of the student to comply with it, as it is the rule and the requirements of the University for the Conferment of degrees.

1.0 INTRODUCTION

K.L University will confer B. Tech degree to candidates who are admitted to the Bachelor of Technology (B. Tech) Programs and fulfill all the requirements for the award of the degree. The University offers four year full time programmes in specialized engineering disciplines that address the immediate national requirements by providing adequately trained manpower.

2.0 DETAILS OF B.TECH PROGRAMS ON OFFER

2.1 Department wise list of programs offered

The disciplines in which the courses of study are available and degrees will be offered at undergraduate (B. Tech) level are:

1. Biotechnology (BT)
2. Civil Engineering (CE)
3. Computer Science & Engineering (CSE)
4. Electronics and Communication Engineering (ECE)
5. Electrical and Electronics Engineering (EEE)
6. Electronics and Computer Engineering (ECM)
7. Mechanical Engineering (ME)

2.2 UG Engineering programs with Specialization

University offers courses for engineering program with specialization that are to be chosen by the students as part of their UG Engineering specialization program of:

a) The University permits a student to register for a minimum 5 specialization elective courses. A student will be awarded Degree with Specialization if she / he complete 5 courses of his choice from a particular stream within the discipline. However he has to do his project preferably in the particular domain of his/her chosen.

b) In situations where a student completes courses of two different specialization streams, he/she will be awarded the degree with specialization (optional) in any one stream of his/her choice, for which they need to make a representation to the concerned HOD at the end of 7^{th} semester.

2.3 UG Engineering programs with a Minor in different discipline

a) A student who completes all the B. Tech requirements of one discipline for which he/she is admitted (or took transfer of branch), is awarded with Major degree in that discipline. The University offers flexibility for a student to complete a smaller set of courses from another discipline and awards him/her a minor degree in a different discipline.

b) For obtaining minor degree the student must complete 5 additional courses from the regular curriculum of his/her desired domain and as stipulated by the relevant BOS.

c) In situations where a student completes courses of two different minor degree programs by overloading himself or by attending summer term programs, he will be awarded with a minor degree in any single stream of his choice. However the courses successfully completed by him will be listed in the transcript.

d) Such students will be awarded only one degree by specifying the minor area they have done (Optional).

2.4 UG Engineering Program with Honors

The Honors programme is for those who wish to do more in their major branch of engineering. It is also recognition of excellence in that field of engineering. Thus, in order to earn the Honors in the major field of engineering, a student has to do 5 extra courses by overloading themselves and earn additional credits through course work in topics related to the major discipline and also maintain a Cumulative Grade Point Average (CGPA) of 8.5 or higher at the levels of Entry & Exit.

A student having a CGPA of 8.5 or higher at the end of 4^{th} semester can start taking additional course towards the Honors' programme. However if the aspirants are more than 10% in each programme opportunity will be provided on merit basis to the top 10%. Extra 5 courses done in specified focused areas will thus lead to earning an Honor in one's own discipline.

Starting from the fifth semester, students who have opted for Honors are permitted to take one or two courses in every semester, in addition to the prescribed courses for their degree and as mentioned earlier, it is subjected to offering of the course by the University. A student has to pre-register for the course, which she/he intends to take towards the end of the semester and seats will be allotted based on the academic performance of the student towards the basic requirement of his/her, degree. A student has to enter this extra course too in the course registration form, when permitted. One should note that there is no separate registration for Honors.

In any semester, a student cannot register for only those courses which form part of her/his additional learning component. There should at least be one course component that is specified as the minimum requirement of the degree. Moreover, a student cannot overstay in the programme once the minimum requirements prescribed for the degree are completed.

3.0 ELIGIBILITY CRITERIA FOR REGISTERING INTO UG ENGINEERING PROGRAMS

Admission to the University is open to qualified young men and women. Candidates seeking admission to the first semester of the eight semesters B. Tech. Degree Programme should have passed the Intermediate Examination (10 +2) (Higher Secondary) of program of study with 60% of marks in Mathematics, Physics, and Chemistry in the case of Engineering programmes and Mathematics/Biology, Physics, and Chemistry in the case of Bio-Technology programmes approved by the Government of Andhra Pradesh

(AND / OR)

Should have passed the engineering entrance examination i.e., EAMCET, or AIEEE, or JEE (MAIN), or KLUEEE

(AND / OR)

To enter into the 3^{rd} semester of B-Tech engineering programme directly, the students should possess the Diploma in Engineering / Technology awarded by the State Board of Technical Education, Andhra Pradesh (SBTET)

For foreign students who wish to study at the University, please refer to the "Foreign Student Admission Procedures" stated separately and comply with the study requirements of the Ministry of Education.

Transferees are accepted only if there are allotted slots in any departments. Should there be allotted slots, a transferee examination will be conducted for the enrollment of transfer students. Take note that a transferee must at least finish one full school year at his/her previous University and cannot transfer to the University if in his/her final year of study.

4.0 UG PROGRAM CURRICULUM DESIGN

For an academic programme the curriculum is the basic framework that will stipulate the credits, category, course code, course title, course delivery (Lectures / Tutorials / Lab / Project), in the credit based system

4.1 Program Structure

a) Each Academic Year is divided into two semesters, each of, approximately, 18 weeks duration:

- Odd Semester (July – December)
- Even Semester (January – May).
  (Summer Term (May – July))

b) All courses are categorized into three streams even, odd and dual semester courses.

c) Even semester courses are offered only during even semester i.e., January-May, Odd semester courses are offered only during odd semester i.e., July-December and dual semester courses are offered during both even & odd semesters.

d) Summer Term starts around the middle of May and ends around first week of July.

e) A Program is a set of courses offered by the University that a student can opt and complete certain credits to qualify for the award of a degree. First year courses are divided into two semesters. Students have independency to choose courses of their own choice prescribed by the University, subject to the maximum permissible limit in each course as specified by the University from time to time.

f) From second year onwards a student can register for a maximum of 24 credits or 7 credit courses(whichever is less) per semester (except while doing project work/practice school/Minor degree/Honors degree/Integrated program) of his/her choice from his entire curriculum, subject to the fulfillment of pre-requisites as defined for each course.

g) A student can choose project/practice school only during 7th or 8th semester.

4.2 Course Structure

a) All courses have a Lecture/Tutorial/Experiment/Design component (L-T-P) to indicate the contact hours. 'T' and 'P' components of a course may be void. Separate pure Laboratory course (0-0-P) may also be provided. All courses have a credit count. Teaching of courses would be reckoned in terms of credits. Every course has a list of courses (may be void) in certain cases as its pre-requisite.

b) For calculating credit, in general each lecture and tutorial hour per week will be considered as one credit and two practical hours as one credit. Project work will be treated as equivalent to twelve credits and Practice school will be treated as equivalent to twelve credits.

c) However, in situations where calculated value of credit is a fraction, it is rounded to the next number.

d) The curriculum for all the programmes in the first year shall be common for all disciplines (except Bio-Technology). However, slight deviations are permitted with prior approval from Board of Studies and Academic Council.

e) For all the Professional Core Courses, offered by various departments, the students have to necessarily undertake a Lab Course along with a Group based Project task, which must be allotted by the Course Coordinator and the Team of Instructors, ensuring the topic for each Group of students to be covering all major portions of the course. This is for making the students gain more Practical exposure / hands on, on the Core Courses and thus making them well versed and potentially strong in fundamentals of their respective departments.

4.3 Course Precedence

a) A student who has qualified in all the courses in the pre-requisite would be allowed to register in the course.

b) In any course if a student appears for final exam or is successfully promoted (through internals etc.) deemed to have met the prerequisite for next higher level course.

c) The Dean Academics after consulting with Department concerned has the prerogative to waive the prerequisite (if it is satisfied through a test) if the student has gained sufficient proficiency to take up the course.

4.4 Specialization through Elective Courses

a) If a student chooses any course outside the compulsory courses prescribed by the department is known as elective course.

b) The student is permitted to choose the elective courses of his/her choice within his/her own discipline.

c) The University offers five types of electives:
   (i) Specialization elective: An elective course offered by the Department for the fulfillment of degree with specialization is known as specialization elective.

   (ii) University/open elective: A course which is of interdisciplinary nature having no prerequisites is known as University elective. B. Tech degree student can register for these courses during 5th semester or later.

   (iii) Management elective: An elective course offered to encourage managerial skills and to inculcate entrepreneurship skills for an undergraduate student is known as management elective. Management elective courses are offered at institutional level and are different from electives of management group.

   (iv) Professional Core Elective: Professional Core Elective course is deemed essential for an academic degree consists of all core courses that considered being essential and consisting of the required core courses to meet a graduation requirement for a student. A student can register for these courses from 3rd year onwards.

   (v) Humanities and Science Elective: The Humanities and Sciences elective offer a variety of academic choices for all students working toward an undergraduate

Engineering degree. It is designed to provide the students with social, cultural, political and economic background crucial to fulfilling the College of Engineering's purpose of "preparing our graduates to begin a lifetime of technical and professional creativity and leadership in their chosen field". Students are responsible for determining their qualification for taking an H&S course, not limited to pre-requisites.

d) Specialization electives, discipline electives and compulsory discipline courses can be chosen by the students of the respective disciplines only. However, the students of a particular discipline can register for specialization/ discipline / interdisciplinary minor / compulsory discipline courses of other disciplines provided they have met the pre requisite or when pre requisite is waived by Dean Academics.

e) A student is not permitted to choose an open elective, if he has already done that course as a part of regular programme (or) a student is not permitted to choose an open elective course, if it covers more than 30% of content already done by him under regular programme.

f) An elective course is offered, only if there are a minimum 20 number of students registered for it.

g) A student shall take up minimum two certificate courses related to advanced topics/ areas as offered by their Department.

4.5 Summer Term and Evening Courses

The University may offer summer term and evening courses, as per the necessity from time to time. The course to be run during summer shall be decided on the basis of essential deficiencies made by group of students. Following conditions apply for students registering for summer term and evening courses.

(a) Students falling in any one of the following categories can register for summer term and evening courses, provided they have completed prerequisites for the courses offered:

(i) Who have been allowed semester withdrawal on medical grounds
(ii) Who have failed in the subjects in a regular semester (OR)
(iii) Who have taken lesser load on advice/by choice (OR)
(iv) Whose earned credits have fallen below the credits earned by a regular student of the same programme for some reason and who has taken courses as per advice of his/her faculty.

(b) A student can register only for a maximum of three courses in each summer term. Students registering for more than 1 summer course have to ensure that there is no clash in the time table. In case of clash immediately they have to approach Director, Registrations/Dean-Academics for time table adjustment. If the time table does not permit the fee paid by them will be refunded.

(c) For students who would like to register for evening courses can do so only if the timings do not clash with regular course work and the registration of such students is subjected to the approval of Dean-Academics.

(d) Any student who is registering for summer term or evening courses has to pay Requisite fee prescribed by the University.

(e) Summer course/evening course is not a student right and will be offered based on availability of faculty and other institute resources. If the course is not offered the fees paid will be refunded in to-to.

5.0 EVALUATION OF UG PROGRAMS

A student's academic progress is examined according to any one or combination of the following methods as decided by the Course Coordinator.

- Home Assignments and Assignment tests given by the faculty during the course of study
- Periodic internal Tests
- Quizzes
- Mid- Semester examinations in the middle of each semester
- Semester Project Report assigned by faculty upon requirement
- Final end examinations given at the end of the semester

a) The Mid-Semester and the End-semester examinations in respect of theory courses will be conducted centrally by the examination section as per the schedule.
b) Appearing in the end-semester examination in the theory and laboratory subjects is mandatory for a student.
c) Students will be permitted to appear in the examinations in only those subjects for which they have registered either for study or for Examination at the beginning of the semester.
d) Attending the Co-curricular activities like Seminars, Group discussion, Colloquia etc., are mandatory.
e) Supplementary examinations for the benefit of fail/detained/summer term students will be held only once in a year immediately after summer term classes.
f) Students may have to take more than one examination in a day either during regular/supplementary examination.

5.1 Internal evaluation

a) The process of evaluation should be continuous throughout the semester and involves components as decided by the course coordinator such as session tests, quizzes, surprise quiz, case analysis, assignments, attendance, Home assignments, open book tests, Seminars, project, term papers and practical examination constituting a total weightage of 40% of total marks. However for Miniproject, Industrial training, Term paper, final year project and Practice school, total weightage of 50% of total marks may be allotted for Internal evaluation.

b) The distribution of weightage will be decided and announced by the course coordinator, towards the beginning of the course, so that students are aware of the evaluation mechanism to be followed in the course. In general, the distribution of weightage among various components of a course for Combined Theory & Lab courses follow the proportion rule of credits as L+T : P

c) The Course Coordinator will display solution - key on the notice board and in e-learning site immediately after the evaluation component with evaluation scheme.

d) In order to maintain transparency in evaluation, the test and quiz answer sheets **including end exam will be shown to the students** within one week of conducting the exam. If a student is not convinced with the marks awarded he/she can request the course coordinator to re-check on request.

e) No correction is permitted once the course coordinator submits the marks/grades to the controller of examination.

~~DISTRIBUTION OF WEIGHTAGE~~				
~~S. No~~	~~Nature of examination~~	~~Marks %~~	~~Type of examination and mode of Assessment~~	~~Scheme of examination~~
~~1~~	~~*Theory~~	~~60~~	~~Semester end examination~~	~~This examination question paper in theory subjects will be for a maximum of 60 marks.~~
		~~40~~	~~The distribution of weightage should be decided and announced by the course coordinator (compulsory towards the beginning of the course).~~	~~5 marks for attendance and for the balance marks, the scheme of examination & evaluation procedure should be decided and announced by the course coordinator (towards the beginning of the course).~~
~~2~~	~~*Practical~~	~~50~~	~~Semester – end Lab examination~~	~~50 marks are allotted for semester end laboratory/drawing examination. The examination pattern will be decided by the course coordinator in consultation with Group Head.~~
		~~50~~	~~The distribution of weightage should be decided and announced by the course coordinator~~	~~Based on Projects submitted~~
~~3~~	~~Mini Project / Industrial Training~~	~~100~~	~~The distribution of weightage should be decided and announced by the course coordinator~~	-
	~~Term paper~~			
~~4~~	~~Final year Project~~	~~100~~	~~50 marks for External evaluation~~	~~Semester end Project Examination.~~
			~~The distribution of weightage should be decided & announced by course coordinator~~	
	~~Practice School~~	~~100~~	~~The distribution of weightage should be decided by authorities of Practice School.~~	~~Fortnightly progress reports, interim evaluation and final evaluation.~~

~~***Note-1:** 1. for pure Theory & pure Lab courses follow the above evaluation.~~

~~2. For Combined Theory & Lab courses follow the proportion rule as given below. 3-0-2 nature Theory Credits & Lab Credits are in 3:1 ratio. Hence the Internal marks evaluated for Theory & Lab as above to be divided in the ratio 3:1 and clubbed.~~

~~3-1-2 nature Theory & Lab credits are in 4:1 ratio. Hence the Internal marks evaluated for Theory & Lab as above to be divided in the ratio 4:1 and clubbed.~~

5.2 Comprehensive evaluation

(1) All regular courses will be evaluated as per the L-T-P structure and graded as shown table 5.4B.

(2) All audited courses are evaluated and awarded satisfactory/not satisfactory grade. In case of award of non-satisfactory the student has to reappear the end comprehensive examination

(3) For non credit courses as per the L-T-P structure grading will be done and grades are awarded as X, A, B, C, D, E or F. In case of F grade the student has to re-appear the end Comprehensive examination

5.3 Betterment

a) A student may reappear for end comprehensive examination (theory part only) for improving the grade in any course/courses, through betterment subject to the following conditions:

- The student has obtained the lowest pass grades in the course concerned, and
- For improvement, their CGPA shall be ≤ 6.75. In the case of reappearing, the grade obtained in reappearance or the earlier grade whichever is better will be considered.

b) A Student having D or E grade and CGPA less than 6.75 can Re-register in a course at any time before the completion of his graduation program provided the University facility permits. However, a student who secured CGPA less than 5 should obtain prior permission of Dean-Academics, before he / she Re-registers for a course.

c) For Re-registering to a course / reappearing for comprehensive examination, the student has to pay the pre-requisite fee as prescribed by the University.

d) A student cannot Re-register/reappear for comprehensive examination in courses like Professional Practice in Industries, summer internship, courses having course Structure 0-0-P, Mini Project, Project Work, Practice School/Term Paper or any other courses which are conducted as vocational courses.

e) A student who has completed the formalities of graduation cannot Re-register a course / reappear for evaluation components.

f) A student Re-registering for comprehensive examination for improving the grade must ensure that the dates of evaluation components do not clash with any of his courses in the regular semester is not permitted to Re-register for comprehensive examination

g) Director (Registration) can counsel the student in Academic Counseling Board (ACB) to Re-register a course for evaluation components to improve his/her grade so that he/she can come out of ACB purview. However, decision taken by the student in this regard shall be final. Student who is advised to Re-register a course / semester does not extend his/her graduation period.

h) In case of Re-registration for betterment he/she is exempted from attending the course and the marks obtained by the student for attendance earlier for that course will be carried forward.

i) A student repeating a course after obtaining NA report has to attend all the classes

j) Further the student has to attend all the evaluation components and ensure that the dates don't clash with any of his regular course.

k) The grade obtained by the student while repeating will be final and in no case the grade obtained in previous attempt will be considered.

l) However such an improvement is not considered for the award of Rank or Gold medal.

Re-appearing with Registration:

A student can repeat a course by re-registering for two reasons:

i) To improve the grade – i.e. betterment
ii) When he/she is detained in a course.

*Repeating a course implies that the student will re-register for the course.

Re-appearing without Registration:

A student can reappear and clear the course in which he/she failed by taking supplementary examinations. In such a case the marks obtained in internal components and all lab components earlier are carried forward.

5.4 Grading Process

a) The overall performance of the student is described by **Cumulative Grade Point Average (CGPA)** and is calculated taking into consideration grade obtained by the student in all credited courses and credits attached to it. It is the weighted average of the grade points of all the letter grades obtained in credited courses by the student from his entry into the University. CGPA is computed as follows:

$$CGPA = \frac{c_1 g_1 + c_2 g_2 + ... + c_n g_n}{c_1 + c_2 + ... + c_n}$$

where c_1, c_2 ..... c_g denotes credits associated with the course applied and g_1, g_2...denotes grades obtained by the student.

~~b) At the end of all evaluation components based on the performance of the student, each student is awarded with **letter grade** on a **relative scale**. The list of letter grades and its connotation are given below:~~

~~Grade~~	~~Qualitative Meaning~~	~~Grade Point attached~~
~~X~~	~~Excellent~~	~~10~~
~~A~~	~~Very Good~~	~~9~~
~~B~~	~~Good~~	~~8~~
~~C~~	~~Fair~~	~~7~~
~~D~~	~~Satisfactory~~	~~6~~
~~E~~	~~Pass~~	~~5~~
~~F~~	~~Fail~~	~~0~~

~~The grades 'X' and 'F' will be earned and remaining grades will be awarded.~~

b) Absolute grading for 201314 admitted batch onwards vide amendment in XIII Academic Council meeting dated 26th February 2014.

Resolved to adopt the absolute grading system instead of the absolute-cum-relative grading system, by suitably amending the Academic Regulations of all programs for the batches of students admitted from the Academic year 201314 and onwards. The following modifications as given below.

GRADE	GRADE POINTS	**% OF MARKS = AICTE EQUATION (10XCGPA-7.5)**	**RANGE**		AVERAGE
O	10	92.5	85	100	92.5
X	9	82.5	80	<85	82
A	8	72.5	65	<80	72
B	7	62.5	60	<65	62
C	6	52.5	45	<60	52.5
D	5	42.5	40	<45	42.5
F	0	-----	<40	-	Failed

c) A student getting less than 40% of overall score and 40% in the comprehensive examination will be considered to have earned F grade. In combined theory and lab courses along with overall 40% score, the student should get independently 40% in both theory and lab components else treated as failed in both.

d) A student who obtains 'F' grade has to reappear for the comprehensive examination. However, such a student need not attend the classes and marks obtained in session tests, surprise quiz, case analysis and attendance will be carried for the subsequent attempts of the student.

e) In case of a student who has earned F grade, after the student has fulfilled all the requirements for passing it will be converted into a valid grade by considering grade cutoffs of the batch in which he/she had appeared for the course for 1st time.

f) A non-credit course also will be evaluated as a regular course and grades will be allotted.

g) Audited courses are graded as satisfactory or Un-satisfactory only.

h) At the end of each semester the University issues grade sheet indicating the CGPA of the student. However, grade sheet will not be issued to the student if he/she has any outstanding dues.

To convert CGPA into equivalent marks the equation to be used is

% OF MARKS = (10 X CGPA – 7.5)

5.5 Reports/Grades

a) The Course Coordinator can award the following Reports/Grades depending on the cases:

(i) **Grade** from O, **X, A, B, C, D** and **F** is awarded to the student if the student satisfies the corresponding requirements as specified in the section 5.4 (grading).

(ii) **NA** (Not Attended) is awarded to the student if the student has shortage of attendance. When student is given NA he/she has to repeat the course. It should be noted here that NA is different from F grade. For a student with F grade his/her marks obtained in internal evaluation component will be carried forwarded. While for a student awarded with NA Report has to reregister for such a course and attend the classes.

(iii) **GP** (Grade Pending) is awarded in situations where Course Coordinator cannot communicate the grade in time because of operational difficulties. The GP report has to be converted into valid grade by the Course Coordinator at a later stage.

(iv) **RC** (Registration Cancelled) is awarded to a student for various reasons when the registration for the course is cancelled by the University. Such a student will have to re-register for the course in subsequent semesters/summer term whenever the course is offered.

(v) **DIP** (Discontinued from Program) is awarded in situations where a student wants to discontinue from the program with the prior approval of University.

(vi) **W** (Withdrawal from Program) awarded in situations where a student decided not to attend for the semester must cancel their classes before the first day of the semester to avoid having the classes be recorded on their transcript and being financially responsible.

6.0 CALENDAR MANAGEMENT FOR UG ENGINEERING PROGRAMS

a) The Academic Council approves the schedule of academic activities prescribed for an academic year.

b) Inclusive of dates for registration, class test and end-semester examinations etc. which shall be mentioned in the Academic Calendar of the year, there will be a total of about 90 working days in each semester excluding the period of Comprehensive examinations.

7.0 REGISTRATION DURING SEMESTERS

All courses are categorized into three streams even, odd and dual semester courses. Even semester courses offered only during Even Semester i.e., January-May, Odd Semester courses offered only during Odd Semester, i.e., July-December and Dual semester courses offered during both even and Odd Semesters.

Admission to all courses will be made in the Odd Semester of each session for the 1st and 2nd Semester levels based on the eligibility criteria specified in the section 3.0. A student who satisfies the University eligibility criteria should be present at the University on stated date for further admission procedures.

- Every student is required to be present and register at the commencement of each semester on the day(s) fixed for and notified in the Academic calendar.
- It is the responsibility of the individual student to register for either semester i.e., Even / Odd. Registration in the summer term is optional.
- The University has the right to refuse registration process if a student does not turn up on the day of registration.
- Normally, no late registration shall be permitted after the fifth working day from the scheduled date of commencement of classes, except in special cases such as serious medical problem, family calamity or participation in a national event, considering such compelling reason, a student may be permitted for late registration (within one week of

commencement of semester) with prior approval from the Director, Academic Registration with payment of requisite fine as prescribed by the University.

- However, under no circumstances late registration after 15 calendar days from the scheduled date of registration is allowed.

- In the rare case of transfer from other universities after the semester commences, such a student must produce his/her attendance statement from the concerned institution in each course at the time of admission.

7.1 Registering for a course

a) A student either newly admitted or on rolls has to register for a course in each semester on the day of registration as notified in the Academic calendar. Students failing to register for the course will not be permitted to attend the corresponding classes.

b) The right of offering a particular course in a semester is only at the discretion of University authorities.

c) The students registering for the first semester and second semester have to choose the courses prescribed by the University subject to the maximum permissible limit as specified by the University.

d) Students registering for the second semester and fourth, sixth and eighth Semesters of their study will be permitted to register only if they have:

    - Cleared all the fees, outstanding dues of University and / or Hostel of previous semesters.

    - Paid all prescribed fees for the current semester.

    - Not been debarred from registering for a specified period on disciplinary or any other grounds

e) From third Semester onwards a student can choose a minimum of seven courses per semester of his choice (or) register for a maximum of 24 credits whichever is less from the curriculum as prescribed by the University, subject to the fulfillment of pre-requisites as defined for each course.

f) A student shall not be allowed to withdraw from compulsory courses prescribed by the University.

g) Students, who have opted for minor degree, Honors program or dual degree, can register for more number of credits in a Semester over and above permitted on regular basis by obtaining written permission from Dean Academics, if the student timetable permits.

h) While doing project work or practice school a student is not permitted to register in any other course except in case of student opting for honors, minor, dual degree etc.

i) The following conditions apply for a student registering for elective courses

(i) The student can register for an elective course within or across the disciplines only if he/she has completed prerequisite courses with eligible grade.
(ii) The student is permitted to register for a particular elective course only if the total course load is within the limit decided by the Director Academic Registration.

j) The student has to register for one management elective course in either seventh (or) eighth Semester.

k) The University reserves the right to withdraw any elective course offered within one week of the commencement of the semester if sufficient number of students is not registered or for any other reasons.

l) In such cases, the students are permitted to register for any other elective course of their choice provided they have fulfilled the eligibility conditions.

m) The University reserves the right to cancel the registration of a student from a course or a semester or debar from the degree on disciplinary grounds.

7.2 Substituting a Registration

a) Within one week of the commencement of the semester, a student is permitted to substitute an elective course (substitution) subject to availability with prior approval of Dean-Academics.

b) However, a student is not permitted to withdraw from compulsory course and substitute the same with an elective course.

7.3 Withdrawing from a Registration

a) A Student is permitted to withdraw from an elective course within one week after the commencement of the semester with the approval of Dean-Academics.

b) Each application for semester withdrawal (through BOS Chairman) will be examined by the Dean-Academics and depending on the merit of the case an appropriate recommendation will be made to the Chairman Academic Council.

c) A Student is normally not permitted to withdraw from compulsory course(s) of the discipline.

d) If a student desires to withdraw from compulsory courses of the discipline, he/she must and should seek prior permission from Dean-Academics provided he/she must have to complete the course whenever the same course(s) are offered later in the academic curriculum before completing his/her graduation. This implies a student has to complete all the compulsory courses prescribed by the department for obtaining the degree of graduation.

7.4 Cancelation of a registration

A student is solely responsible to ensure that all conditions for proper registration are satisfied, and there are no timetable clashes. The registration may be cancelled for a course or the entire semester either by the student or by the University if any irregularity is found at a later stage. A student's registration for the semester may be cancelled, if he does not meet the statutory requirement of Minimum of number of credits or as part of disciplinary action Leave beyond permissible limits may also result in cancellation of registration for a semester.

8.0 TEACHING UG ENGINEERING PROGRAMS

a) Course(s) taught by a single instructor (theory) is referred to as single section course and course(s) taught by group of instructors in more than one section is referred to as multi-section courses.

b) The teacher for single section course or associated with multi-section courses are referred to as Instructor.

c) A team of instructors, under the leadership of Course Coordinator (shall be an instructor of any one the theory section) shall work together to meet all requirements of teaching, evaluation and administrative aspects of the course.

d) A course is conducted and evaluated by the course coordinator with the cooperation of all instructors as a team.

e) The internal evaluation pattern will be announced by the course coordinator well before the commencement of the class work with the prior approval from the Dean Academics.

f) Every course coordinator must specify the program outcomes, objectives, credits to be earned and issue of course handouts to the students either in soft copy or in hard copy.

g) All course handouts are posted in e-learning site one week in advance.

h) The solution key of internal examinations conducted during the semester will be displayed on the notice board and in the e-learning site immediately after the evaluation component with evaluation scheme by the course coordinator.

9.0 ATTENDANCE

a) It is mandatory for a student to attend all the classes, tutorials, laboratories and other evaluation components conducted by the University. A student may be detained from appearing for an examination on grounds of shortage of attendance.

b) Attending the Co-curricular activities like Seminars, Group discussion, Colloquia etc., are mandatory.

c) In each course attendance will be treated as evaluation component and marks are awarded as shown below:

% of Attendance in Theory & Practical classes	Marks awarded
≥ 95	5
≥ 90 and < 95	4
≥ 85 and < 90	3
≥ 80 and < 85	2
≥ 75 and < 80	1

d) Required minimum attendance is >= 75% attendance in all courses. On medical grounds a student can avail a condonation of Maximum 10% attendance. However to avail the condonation student has to submit a medical certificate from not below the Rank of Civil asst surgeon and to condone or not is at the sole discretion of Dean-Academics. The condonation list should be sent to the examination section duly signed by the Dean-Academics well in advance..

e) 75% attendance is mandatory to attain eligibility to appear for the comprehensive examination in a course. If a student fails to maintain 75% attendance and 40% internal marks in a course he/she will be awarded with NA Report in that course. In such cases, student will not be permitted to attend the comprehensive examination of that course(s) where he/she has obtained NA Report. He/she has to register and repeat the course whenever it is offered.

f) However, some relaxation to this rule is possible in the case of students participating in extra -curricular activities as identified below:

- One week for state level competitions.
- Two weeks for National level competitions and
- Three weeks for International events

Subjected to a maximum of two such participations in a Semester.

g) If the period of absence in a semester is for a short duration (of not more than one week) prior application for leave should be submitted to the Head of the Department clearly stating the reasons for absence along with supporting documents. The Head of the Department will grant such leave at his/her discretion.

h) He/ She may be allowed for makeup of Laboratory/workshop classes conducted during the period of absence.

i) If the student is continuously absent for more than 4 weeks, his name will be removed and registration stands cancelled.

j) Absence for a period not exceeding one week in a semester due to sickness or any other unavoidable reason for which prior application could not be made, may be condoned by the Dean of the School/College, provided he is satisfied with the explanation.

k) This request should be supported by medical certificate from a recognized medical officer not below the rank of Assistant civil surgeon.

l) This is also applicable in those cases who have attended for conferences, paper presentations and sports with permission from the authorities where the student has valid reason for absence.

m) In such cases the student can approach the course coordinator/ instructor for the makeup test or assignment immediately on rejoining.

n) No makeup examination will be conducted for End semester examinations under any circumstances.

o) If the period of absence is likely to exceed one week, a prior application for grant of leave should be submitted to the Head of the Department in all the cases.

p) If the valid period of absence (on medical grounds) is more than 20 continuous working days during the semester the student may apply for withdrawal from the entire semester at any time clearing all the fee dues of the entire course and no fee are refunded at any cost.

q) The Vice-Chancellor may relax above rules in special situations which arise due to extraordinary circumstances.

10.0 DETENTION

(i) A student getting less than 40% marks in internals and/ or 75% of attendance in each course will be treated as detained and will not be permitted to appear for the end examinations, he has to repeat the course whenever the University offers it.

~~(ii) (A student shall be permitted to register for 5th semester only if he/she fulfills the academic requirement of total 47 credits from regular and supplementary examinations of 1st, 2nd, 3rd and 4th Semesters. Similarly for registering in 7th semester a student shall fulfill the academic requirement of total 72 credits from regular and supplementary examinations of 1st to 6th Semesters. He will be allowed to register further for new courses only after clearing the backlogs and acquiring the requisite credits.)~~

Subsequently dropped vide amendment in XIV Academic Council meeting dated 7th August 2015

11.0 ACADEMIC FLEXIBILITIES

University offers flexibility for B. Tech. Degree students in doing the courses. In addition to the prescribed courses a student can register for more electives, summer term courses, evening courses provided his/her timetable &University facility permits. He / she can either change from one branch to another branch or the transfer of credits from one branch to another branch for which the details are as follows

11.1 Change of Branch

A student admitted to a particular Branch of the B. Tech course will normally continue studying in that branch till the completion of the programme. However, in special cases the University may permit a student to change from one branch to another after the second semester.

a) Only those who have cleared all the first and second semester subjects of first year are eligible to apply for change of branch.

b) Change of branch shall be made strictly on the basis of merit of the applicants and availability of seats category wise subjected to the following conditions:

(i) Top 1% students of the admitted students will be permitted to change their branch subject to availability of seats.

(ii) For others, change will be permitted strictly on merit basis and category basis. Students without fail grades, backlogs and with CGPA ≥ 8 will be eligible to apply. Transfer may be allowed subject to availability of seats and strength of the department does not exceed 5% of intake strength. However a weak student having low CGPA requesting to transfer to other program may be permitted basing on recommendations of ACB.

(iii) The request for change (in the order of merit) for student from department A to department B will be considered if:

- Strength of department B does not exceed 5% of intake strength.
- Number of students on rolls in the department A does not fall below 85% of the intake strength.
- The request of student will be reconsidered (again in the order of merit) if student does not violate (b) above, due to another student getting transferred to department A.
- In case of a tie the Grade and / or marks scored by the student in the course of the Department for which he is seeking transfer will be considered.
- **Bio Technology students are also eligible for transfer to other Engineering** Programmes provided they are with the MPC background and satisfy the eligibility. However, other Engineering programme students are eligible for transfer to Bio Technology provided they complete the biology course by registering themselves.

(iv) All changes of Branches made will be made effective from second year first semester. Change of branch shall not be permitted thereafter.

(v) Change of branch once made will be final and binding on the student. No student will be permitted, under any circumstances, to refuse the change of branch offered.

(vi) Change of branch is not applicable for post graduate programmes.

11.2 Credit Transfer

(i) Credit transfer from KL University to other University or vice versa is permitted only for under graduate programmes.

(ii) Credit transfer from KL University to other University: Student studying in KL University can take transfer to another University under the following conditions:

- KL University has signed MOU with the University.
- A student has to pay the fees for all the remaining years when he/she seeks transfer.
- However, a student, after seeking transfer from KL University can return to KL University after a semester or year. Based on courses done in the other University, equivalent credits shall be awarded to such students.

(iii) Credit transfer from another University to KL University: A student studying in another University can take transfer to KL University under the following conditions:

- When a student seeks transfer, equivalent credits will be assigned to the student based on the courses studied by the student.
- The student, when transferred from other Universities, has to stick to the rules and regulations of KL University.
- To graduate from KL University, a student must study at least half of the minimum duration prescribed for a program at KLU.

11.3 Overloading and Under Loading

a) When a student is permitted to register for more courses during regular semester than normally prescribed by the University, it is known as overloading.

b) In general overloading is permitted to those who have CGPA greater than 8, do not have any backlog course and/or registered for integrated program, Honors program, and Minor degree options etc.

c) However, registering in a summer term or vocational courses is not considered as overloading.

d) Synonymous to overloading, the University also permits a student to register for fewer courses than normally prescribed. Such cases are known as under-loading.

e) For both overloading and under-loading, a student has to seek permission from Dean-Academics and also Director Academic Registration, who gives permission on a case to case basis, based on the CGPA of the student.

f) The University reserves all rights to decelerate the degree program of the student at any time.

g) The student opting for deceleration of the degree programme will not be allowed to repeat the course in the same semester.

11.4 Academic Counseling Board (ACB)

A student will be put under Academic Counseling Board under the following circumstances:

(i) Has CGPA of less than 5.

(ii) Has 'F' grade in more than four courses.

The students under Academic Counseling Board may not be allowed to register for all regular courses in the semester based on the recommendation of Academic Council Board. The ACB will counsel and guide the students for proper registration of the courses

12.0 BACKLOG COURSES

A course is considered to be a backlog if the student has obtained 'F' grade / NA Report in the course; the following regulations apply to a student who has backlog(s):

a) A student having backlogs has to clear backlog courses first.

b) A student, who is having more number of backlog courses, shall come under all regulations mentioned in ACB.

~~c) A student shall be permitted to register for 5th semester only if he/she fulfills the academic requirement of total 47 credits from regular and supplementary examinations of 1st year and 2nd year.~~

d) ~~Similarly for registering in 7th semester a student shall fulfill the academic requirement of total 72 credits from regular and supplementary examinations of 1st, 2nd and 3rd year.~~

e) A student can avail any number of chances to clear a backlog course, however the student may be asked to register for a regular course or to do a substitute course if the same course becomes obsolete and is not being offered anymore. Hours allocated for revision, extra learning are not accountable for credits.

f) A student must clear all backlog courses before he/she opts for Practice School (PS) programme, i.e. a student who has backlog course(s) is not eligible for PS.

g) Students who are doing their project work/ Practice school are not allowed to register for any other course.

h) A student detained due to lack of credits / more number of backlogs in a semester has to register only for that semester after acquiring the eligibility for promotion.

i) Under no circumstances he/she is allowed to register for next semester without registering for the detained one. This is applicable for those joined from Academic Year 2010-11 onwards.

13.0 GRADUATION REQUIREMENTS

A student must fulfill the following requirements for graduating in a course:

a) Must have cleared minimum of 170-180 credits for under graduate B. Tech programmes. For graduation with dual degree/ integrated B. Tech and M.Tech programmes student must have earned 256 – 270 credits, for B. Tech with MBA should earn 245-260 credits ~~and for MCA with M.Tech programme should earn 235 – 245 credits~~.

b) Must have cleared compulsory certificate, audited, non-credited courses including one in sports/yoga

c) Cleared all courses prescribed for him/her in the discipline.

d) Must have undergone industrial training programme (other than Practice School) for a period of not less than 4 weeks.

e) A Student shall complete 9 elective courses in the undergraduate program. (5 prof core+1 Management +3 open electives)

~~f)~~ Must have obtained minimum number of 9 credits by choosing courses from University Electives/Open Electives category. ~~Students can also earn extra credits by doing courses of their interest for better prospectus in Higher Education/Public, private and MNC sector jobs/Foreign Education/Entrepreneurship development etc.~~

g) A Student shall complete all audited courses and Non-credit courses including one in sports/games/yoga and NCC/NSS/NSO as prescribed by their respective BOS.

h) Successful completion of Mini projects & term papers are mandatory as a part of their curriculum.

i) Obtained a minimum CGPA of 5.5 for undergraduate or dual degree/Programs.

j) Obtained a minimum CGPA of 8.5 for obtaining Honors degree.

k) Must have finished all the above mentioned requirements in less than twice the period mentioned in the Academic structure for each programme which includes deceleration period chosen by the student, deceleration imposed by University or debarred from the University.

l) Must successfully undertake specific trainings in focused areas that enable students to be successful in their chosen career tracks. The focused areas are : (a) Employment in MNCs, (b) Civil Services (c) Higher Studies (d) Research and (e) Entrepreneurship.

14.0 RUSTICATION

A student may be rusticated from the University on disciplinary grounds based on the recommendations of any committee or examination committee by the Vice Chancellor.

15.0 AWARD OF DEGREES

A student having cleared all the courses and met all the requirements for the award of degree with

CGPA < 6.75 will be awarded second class

1) CGPA ≥6.75 will be awarded first class and with
2) CGPA ≥7.5 will be awarded first class with distinction provided the student has cleared all the courses in first attempt (Regular) within the stipulated time.

16.0 AWARD OF MEDALS

University has instituted Gold and silver medals to the highest and second highest rank holders respectively as per CGPA and other academic conditions in each programme of specialization.

1. The grade obtained by betterment, will not be considered for the award.
2. He/she must be obtained minimum distinction for the award of Gold or silver medal.

COURSE STRUCTURE FOR B.TECH PROGRAMS FOR 2014 BATCH

S.No.	CourseCode	Course Title	Offered in (Even/ Odd Sem.)	L-T-P	Credits	Prerequisite	Offered for
Humanities courses							
1	13HS101	English	Odd	2-0-2	3	Nil	ALL B.TECH
2	13HS102	Language and Reasoning skills	Even	2-0-2	3	Nil	ALL B.TECH
3	11BS105	Ecology & Environment	Even & Odd	2-0-0	2	Nil	ALL B.TECH
3	13HS104	Human values	Even & Odd	2-0-0	2	Nil	ALL B.TECH
Basic Science courses							
1	13BS101	Linear Algebra & Multivariant Calculus	Even	3-0-2	4	Nil	ALL B.TECH
2	13BS102	Differential Equations	Odd	3-1-0	4	Nil	ALL B.TECH
3	13BS103	Engg Physics	Odd	3-0-2	4	Nil	ALL B.TECH
4	11BS104	Engg Chemistry	Odd	3-0-2	4	Nil	ALL B.TECH
5	13BS104	Basic Mathematics	Odd	3-1-0	4	Nil	BT(Bi.PC)
6	13BS107	Organic Chemistry	Even	2-0-0	2	Nil	BT
7	13BS108	Fundamentals Of Biology	Odd	3-1-0	4	Nil	BT(MPC)
8	13BS109	Cell And Molecular Biology	Even	3-1-0	4	Nil	BT
9	13BS201	Mathematical Methods	Odd	3-0-0	3	Nil	ALL B.TECH EXCEPT BT
10	13BS202	Complex Variables & Discrete Mathematics	Even	3-0-0	3	Nil	ECE, EEE, ME
11	13BS203	Compelx Variables And Finite Difference Methods	Even	3-0-0	3	Nil	CE
12	13BS206	Discrete Mathematics	Even	3-0-0	3	Nil	CSE, ECM
13	13BS204	Probability And Statistics	Even	3-0-0	3	Nil	BT
Engineering Science courses							
1	13ES101	Problem Solving through Programming	Even	3-0-2	4	Nil	ALL B.TECH
2	13ES102	Measurements	Even	3-0-2	4	Nil	ALL B.TECH
3	13ES103	Engineering Materials	Even	3-0-0	3	Nil	ALL B.TECH
4	11ES104	Engineering Graphics with CAD	Even	0-0-4	2	Nil	ALL B.TECH
5	13ES105	Workshop Practice	odd	0-0-4	2	Nil	ALL B.TECH
6	13ES106	Engineering Mechanics	odd	3-0-2	4	Nil	ALL B.TECH
7	13ES201	Thermodynamics	Odd	3-0-0	3	Nil	ALL B.TECH
8	13ES202	Object Oriented Programming	Even	3-0-2	4	**13ES101**	ALL B.TECH EXCEPT CE
9	13ES203	Network Theory	Even	3-0-2	4	Nil	ALL B.TECH
10	13ES204	Data Structures	odd	3-0-2	4	**13ES101**	ALL B.TECH EXCEPT CE
11	13ES205	Signal processing	Even	3-0-2	4	Nil	ALL B.TECH EXCEPT CE

12	13ES206	Biochemical thermodynamics	Even	3-1-0	4	13 ES 101	BT
13	13ES207	Biomedical signals and systems	Even	3-2-0	4	NIL	BT

PROFESSIONAL CORE COURSES							
1	13BT201	Biochemistry	Odd	3-0-2	4	Nil	BT
2	13BT202	Microbiology	Odd	3-0-2	4	Nil	BT
3	13BT203	Process Engineering Principles	Odd	3-1-0	4	Nil	BT
4	13BT204	Bioanalytical Techniques	Even	3-0-2	4	Nil	BT
5	13BT301	Fluid Mechanics & Heat Transfer	Odd	3-0-2	4	Nil	BT
6	13BT302	Genetic Engineering	Odd	3-0-2	4	Nil	BT
7	13BT303	Bioinformatics	Odd	3-0-2	4	Nil	BT
8	13BT304	Fermentation Technology	Odd	3-0-2	4	Nil	BT
9	13BT305	Biochemical Reaction Engineering	Even	3-0-2	4	Nil	BT
10	13BT306	Immunology	Even	3-0-2	4	Nil	BT
11	13BT307	Food Technology	Even	3-0-2	4	Nil	BT
12	13BT308	Plant & Animal Biotechnology	Even	3-0-2	4	Nil	BT
13	13BT401	Mass Transfer Operations	Odd	3-0-2	4	Nil	BT
14	13BT402	Downstream processing	Odd	3-0-2	4	Nil	BT
15	13CE201	Mechanics of Materials	Odd	3-0-2	4	13ES106	CE
16	13CE202	Fluid Mechanics	Odd	3-0-2	4	13ES106	CE
17	13CE203	Structural Analysis	Even	3-0-2	4	13CE201	CE
18	13CE204	Hydraulics & Hydraulic Machines	Even	3-0-2	4	13CE202	CE
19	13CE205	Surveying	Even	3-0-2	4	NIL	CE
20	13CE206	Soil Mechanics	Odd	3-0-2	4	NIL	CE
21	13CE207	Environmental Engineering	Odd	3-0-2	4	NIL	CE
22	13CE208	Building Planning and Construction	Odd	3-0-2	4	13CE203	CE
23	13CE301	Construction material and concrete Technology	Even	3-0-2	4	NIL	CE
24	13CE302	Engineering Geology	Odd	3-0-2	4	NIL	CE
25	13CE303	Transportation Engineering	Odd	3-0-2	4	NIL	CE
26	13CE304	Foundation Engineering	Even	3-0-2	4	13CE206	CE
27	13CE305	Design of reinforced concrete Structures	Even	3-0-2	4	13CE203	CE
28	13CE306	Design of Steel Structures	Even & Odd	3-0-2	4	13CE203	CE
29	13CE307	Water Resources Engineering	Even	3-1-0	4	Nil	CE
30	13CE308	Advanced structural analysis	Odd	3-0-2	4	13CE203	CE

31	13CE309	Advanced Design of reinforced concrete Structures	Odd	3-0-2	4	13CE305	CE
32	13CE310	Quantity Surveying and Estimation	Even & Odd	3-0-2	4	13CE203	CE
33	13CS201	Digital Logic Design & Computer Organization	Odd	3-0-2	4	Nil	CS
34	13CS202	Human Computer Interaction	Odd	3-0-2	4	13ES101	CS
35	13CS203	Operating Systems	Even	3-0-2	4	NIL	EM,CS
36	13CS204	Database Management Systems	Even	3-0-2	4	13ES204	EM,CS
37	13CS205	Computer Networks	Even & Odd	3-0-2	4	Nil	CS,EC, EM
38	13CS301	Software Engineering	Even	3-0-2	4	13ES202	EM,CS
39	13CS302	Design and Analysis of Algorithms	Odd	3-0-2	4	13ES204	CS
40	13CS303	Information Assurance and Security	Odd	3-0-2	4	13CS205	CS
41	13CS304	Artificial Intelligence	Even	3-0-2	4	13ES204	CS
42	13CS305	Distributed Computing	Even	3-0-2	4	13CS205	CS
43	13CS306	Automata Theory and Formal Languages	Even	3-0-2	4	13BS206	CS
44	13CS401	Compiler Design	Odd	3-0-2	4	13CS306	CS
45	13CS402	Simulation and Modeling	Odd	3-0-2	4	13BS206	CS
46	13EC201	Design of Electronic Systems	Odd	3-0-2	4	13BS103	EC, EE, EM
47	13EC202	Electromagnetic Field Theory	Even	3-0-2	4	13BS103	EC
48	13EC203	Basics of Digital Systems	Odd	3-0-2	4	13BS101	EC, EE, EM
49	13EC205	Analog Electronic Circuits	Even	3-0-2	4	13EC201	EC, EE, EM
50	13EC206	CMOS VLSI Design	Even	3-0-2	4	13EC201	EC, EM
51	13EC207	Analog Communication	Odd	3-0-2	4	13ES205	EC
52	13EC308	Digital Communications	Even	3-0-2	4	13EC207	EC
53	13EC312	Design with PLDs and FPGAs	Even	3-0-2	4	13EC203	EC, EM
54	13EC313	Antenna and Wave Propagation	Odd	3-0-2	4	13EC202	EC
55	13EC314	Microwave Engineering	Even	3-0-2	4	13EC202	EC
56	13EC415	DSP Processors and Architecture	Even & Odd	3-0-2	4	13ES205	EC
57	11EC311	Micro-Processors & Micro Controllers	Odd	3-0-2	4	13EC203 OR 13CS201	EC, EE,EM,CS
58	13EE201	DC Machines & Transformers	Odd	3-0-2	4	Nil*	EEE
59	13EE202	Fields & Networks	Odd	3-0-2	4	13ES203	EEE
60	13EE203	AC Machines	Even	3-0-2	4	13EE201	EEE
61	11EE203	Electrical Power Generation and Distribution	Even	3-0-2	4	13ES203	EEE
62	11EE205	Electrical Power	Odd	3-0-2	4	11EE203	EEE

		Transmission					
63	11EE302	Power System Analysis	Even	3-0-2	4	11EE205	EEE
64	11EE303	Power Electronics	Odd	3-0-2	4	13ES203	EEE
65	11EE304	Control Systems	Odd	3-0-2	4	13ES203	EC, EE,EM
66	11EE305	Power System Protection	Odd & Even	3-0-2	4	11EE302	EEE
67	11EE307	Electrical Drives	Even	3-0-2	4	11EE303	EEE
68	11EE402	Power System Operation & Control	Odd & Even	3-0-2	4	11EE302	EEE
69	13EM201	Computer Organization	Even	3-0-2	4	13EC203	EC, EM
70	13EM202	Communication Systems	Odd	3-0-2	4	13ES205	ECM
71	11EM301	Internet Programming	Odd	3-0-2	4	13ES202	EM,CS
72	11EM401	Embedded Systems	Even	3-0-2	4	NIL	ECM
73	13ME201	Fluid Mechanics & Hydraulic Machines	Odd	3-0-2	4	13ES106	ME
74	13ME202	Applied Thermodynamics	Even	3-0-2	4	13ES201	ME
75	13ME203	Metallurgy	Odd	3-0-2	4	13ES107, 13ES103	ME
76	13ME204	Manufacturing Processes	Even	3-0-2	4	13ES103	ME
77	13ME205	Strength of Materials	Odd	3-0-2	4	13ES106	ME
78	13ME206	Mechanisms and Machine theory	Even	3-0-2	4	13ES106	ME
79	13ME301	I C Engines & Gas Turbines	Odd	3-0-2	4	13ES201	ME
80	13ME302	Machine Tool Engineering	Odd	3-0-2	4	13ES105	ME
81	13ME303	Operations Research	Even	3-0-2	4	NIL	ME
82	13ME304	Metrology and Instrumentation	Odd	3-0-2	4	13ES102	ME
83	13ME305	Finite Element Methods	Odd	3-0-2	4	13ME205	ME
84	13ME306	Mechanical Engineering Design	Even	3-0-2	4	13ME205	ME
85	13ME401	Heat Transfer	Odd	3-0-2	4	13ES201	ME
86	13ME402	Machine Design	Odd	3-0-2	4	13ME205	ME
87	13ME403	Industrial Engineering Techniques	Odd	3-0-2	4	NIL	ME
88	14 PE 201	Material & Energy Flow Computation	ODD	3-0-0	3	NIL	PE
89	14PE 202	Chemical reaction engineering	ODD	3-0-2	4	NIL	PE
90	14 PE 203	Introduction to petroleum engineering	ODD	3-0-0	3	NIL	PE
91	13 CE 205	Surveying	ODD	3-0-2	4	NIL	PE
92	14 PE 204	Momentum Transfer	EVEN	2-2-2	4	NIL	PE
93	14 PE 205	Geology for Petroleum Engineers	EVEN	3-0-2	4	NIL	PE
94	14 PE 206	Drilling and Well Completion techniques	EVEN	2-2-2	4	NIL	PE
95	14 PE 207	Petroleum Refining Process and Testing	EVEN	2-2-2	4	NIL	PE

96	14 PE 301	Petroleum Exploration Methods	ODD	3-0-0	3	14 PE 205	PE
97	14 PE 302	Reservoir Engineering	ODD	2-2-2	4	14 PE 205	PE
98	14 PE 303	Process Heat Transfer	ODD	2-2-2	4	13 ME 201	PE
99	14 PE 304	Natural Gas Engineering & Processing	ODD	3-0-0	3	NIL	PE
100	14 PE 305	Petroleum Formation Evaluation	EVEN	3-0-0	3	14 PE 301	PE
101	14 PE 306	Pipeline Engineering & Transportation of Oil & Gas	EVEN	3-0-0	3	NIL	PE
102	14 PE 307	Environmental Hazardous and Safety Management	EVEN	3-0-0	3	NIL	PE
103	14 PE 401	Petroleum Production Engineering	Odd & Even	3-0-0	3	14 PE 302	PE
104	14 PE 402	Oil and Gas Well Testing	Odd & Even	3-2-0	4	14 PE 302	PE

Professional electives							
Genetic Engineering- Specialization Stream							
1	13BT331	Molecular Genetics and DNA Forensics	Even	3-0-0	3	Nil	BT
2	13BT332	Transgenic technology	Even	3-0-0	3	Nil	BT
3	13BT431	Genomics and Proteomics	Odd	3-0-0	3	Nil	BT
4	13BT432	Molecular Expression Technology	Odd	3-0-0	3	Nil	BT
5	13BT433	Molecular markers and Diagnostics	Odd	3-0-0	3	Nil	BT
Bioinformatics - Specialization Stream							
1	13BT333	Molecular modeling and drug design	Even	3-0-0	3	Nil	BT
2	13BT334	Bioperl and PERL programming	Even	3-0-0	3	Nil	BT
3	13BT434	Biomedical Informatics	Odd	3-0-0	3	Nil	BT
4	13BT435	Structural Biology	Odd	3-0-0	3	Nil	BT
5	13BT436	Data base management systems	Odd	3-0-0	3	Nil	BT
Immunology - Specialization Stream							
1	13BT335	Immunotechnology	Even	3-0-0	3	Nil	BT
2	13BT336	Stem cell technology	Even	3-0-0	3	Nil	BT
3	13BT437	Medical Biotechnology	Odd	3-0-0	3	Nil	BT
4	13BT438	Cancer Biology	Odd	3-0-0	3	Nil	BT
5	13BT439	Neurobiology	Odd	3-0-0	3	Nil	BT
Industrial Biotechnology - SPECIALIZATION STREAM							
1	13BT337	Microbial Technology	Even	3-0-0	3	Nil	BT
2	13BT338	Pharmaceutical Biotechnology	Even	3-0-0	3	Nil	BT
3	13BT440	Bioprocess Economics and Plant Design	Odd	3-0-0	3	Nil	BT
4	13BT441	Algal Biotechnology	Odd	3-0-0	3	Nil	BT
5	13BT442	Metabolic Engineering	Odd	3-0-0	3	Nil	BT

STRUCTURAL ENGINEERING - SPECIALIZATION STREAM								
1	11CE331	Green Buildings	Odd	3-0-0	3	NIL	CE
2	13CE332	Advanced Structural Analysis	Even	3-0-0	3	13CE203	CE
3	11CE333	Earthquake Resistant Design of Structures	Even & Odd	3-0-0	3	NIL	CE
4	11CE334	Prestressed Concrete	Even & Odd	3-0-0	3	13CE305	CE
5	11CE335	Bridge Engineering	Even & Odd	3-0-0	3	13CE305 & 13CE306	CE
GEOTECHNICAL ENGINEERING - SPECIALIZATION STREAM							
1	11CE341	Ground Improvement Techniques	Odd	3-0-0	3	13CE304	CE
2	11CE342	Advanced Foundation Engineering	Even	3-0-0	3	13CE304	CE
3	11CE343	Geotechnical Earthquake Engineering	Even & Odd	3-0-0	3	13CE206	CE
4	11CE344	Design of Earth Retaining Structures	Even & Odd	3-0-0	3	13CE206	CE
5	11CE345	Rock Mechanics	Even & Odd	3-0-0	3	13CE206	CE
ENVIRONMENTAL & WATER RESOURCE ENGINEERING - SPECIALIZATION STREAM							
1	11CE351	Advanced Open Channel Hydraulics	Odd	3-0-0	3	13CE202	CE
2	11CE352	Design Of Hydraulic Structures	Even	3-0-0	3	13CE202	CE
3	11CE353	Environmental Impact Assessment	Even & Odd	3-0-0	3	13CE207	CE
4	11CE354	Solid Waste Management and Landfills	Even & Odd	3-0-0	3	13CE207	CE
5	11CE355	Rural Water Supply & Sanitation	Even & Odd	3-0-0	3	13CE207	CE
TRANSPORTATION ENGINEERING - SPECIALIZATION STREAM							
1	11CE361	Railway, Airport and Dock & Harbour Engineering	Odd	3-0-0	3	13CE303	CE
2	11CE362	Advanced Highway Engineering	Even	3-0-0	3	13CE303	CE
3	11CE363	Traffic Engineering	Even & Odd	3-0-0	3	13CE303	CE
4	11CE364	Advanced Pavement Design Engineering	Even & Odd	3-0-0	3	13CE303	CE
5	11CE4365	Urban Transportation Systems Planning	Even & Odd	3-0-0	3	13CE303	CE
DATA ENGINEERING - SPECIALIZATION STREAM							
1	13CS331	Data warehousing and Mining	Even	3-0-0	3	13CS204	CS, EM
2	13CS332	Advanced Database Management System	Even	3-0-0	3	13CS204	CS, EM
3	13CS333	Database Security	Odd	3-0-0	3	13CS204	CS, EM
4	13CS431	Distributed Databases	Odd	3-0-0	3	13CS204	CS, EM
5	13CS432	Big data Analytics	Odd	3-0-0	3	13CS204	CS, EM
COMPUTER NETWORKS- SPECIALIZATION STREAM							
1	13CS334	TCP/IP Protocol Suite	Even	3-0-0	3	13CS205	CSE,ECM,ECE
2	13CS335	Network Programming	Even	3-0-0	3	13CS205	CSE,ECM,ECE
3	13CS336	Routing Algorithms	Odd	3-0-0	3	13CS205	CSE,ECM,ECE
4	13CS433	High speed Optical Communication Networks	Odd	3-0-0	3	13CS205	CSE,ECM,ECE
5	13CS434	Wireless Communications and	Odd	3-0-0	3	13CS205	CSE,ECM,ECE

		Networking					
SOFTWARE ENGINEERING - SPECIALIZATION STREAM							
1	13CS337	Object Oriented Analysis and Design	Even	3-0-0	3	13CS301	CS
2	13CS338	Requirement Engineering	Even	3-0-0	3	13CS301	CS
3	13CS339	Software Testing & Quality Assurance	Odd	3-0-0	3	13CS301	CS
4	13CS435	Software Reliability	Odd	3-0-0	3	13CS301	CS
5	13CS436	Software Project Management	Odd	3-0-0	3	13CS301	CS
SECURITY- SPECIALIZATION STREAM							
1	13CS340	Secure Programming	Even	3-0-0	3	13CS205	CS, EM
2	13CS341	Crypt Analysis	Even	3-0-0	3	13CS205	CS, EM
3	13CS342	Elliptic curve Cryptography	Odd	3-0-0	3	13CS205	CS, EM
4	13CS437	Cyber Security	Odd	3-0-0	3	13CS205	CS, EM
5	13CS438	Trust Worthy Computing	Odd	3-0-0	3	13CS205	CS, EM
PARALLEL & DISTRIBUTED COMPUTING - SPECIALIZATION STREAM							
1	13CS343	Advanced Computer Architecture	Even	3-0-0	3	13CS201/ 13EM201	CS, EM
2	13CS344	Parallel Computing	Even	3-0-0	3	13CS201/ 13EM201	CS, EM
3	13CS345	Grid Computing	Odd	3-0-0	3	13CS201/ 13EM201	CS, EM
4	13CS439	Cloud Computing	Odd	3-0-0	3	13CS201/ 13EM201	CS, EM
5	13CS440	High Performance Computing	Odd	3-0-0	3	13CS201/ 13EM201	CS, EM
GRAPHICS & MULTIMEDIA - SPECIALIZATION STREAM							
1	13CS346	2D/3D Graphics	Even	3-0-0	3	13CS202	CS
2	13CS347	Digital Image Processing	Even	3-0-0	3	13CS202	CS
3	13CS348	Animation	Odd	3-0-0	3	13CS202	CS
4	13CS441	Video and Audio Streaming	Odd	3-0-0	3	13CS202	CS
5	13CS442	Multimedia Technologies	Odd	3-0-0	3	13CS202	CS
INTELLIGENT COMPUTING - SPECIALIZATION STREAM							
1	13CS349	Soft Computing	Even	3-0-0	3	13CS304	CS
2	13CS350	Machine Learning	Even	3-0-0	3	13CS304	CS
3	13CS351	Natural Language Processing	Odd	3-0-0	3	13CS304	CS
4	13CS443	Multi Agent Systems	Odd	3-0-0	3	13CS304	CS
5	13CS444	Computer Vision	Odd	3-0-0	3	13CS304	CS
COMMUNICATION SYSTEMS- SPECIALIZATION STREAM							
1	13EC340	Information Theory & Coding	Odd	3-0-0	3	13EC207 OR 13EM202	ECE,ECM
2	13EC341	TV and Video Engineering	Even	3-0-0	3	13EC207 OR 13EM202	ECE,ECM
3	13EC342	Optical Communications	Even	3-0-0	3	13EC207 OR 13EM202	ECE,ECM
4	13EC443	Satellite Communications	Odd	3-0-0	3	13EC207 OR 13EM202	ECE,ECM

5	13EC444	Cellular Communications	Odd	3-0-0	3	13EC308 OR 13EM202	ECE,ECM
6	13EC345	EMI/EMC	Odd	3-0-0	3	13EC202	ECE
7	13EC346	RF System Design	Even	3-0-0	3	13EC414	ECE
8	13EC447	Radar & Navigational Aids	Even	3-0-0	3	13EC313	ECE
9	13EC448	Microwave and Millimetric Wave Circuits	Odd	3-0-0	3	13EC313	ECE
10	13EC349	Radiating Systems	Odd	3-0-0	3	13EC313	ECE
VLSI- SPECIALIZATION STREAM							
1	13EC461	Analog VLSI Design	Odd	3-0-0	3	13EC206/ 13EC312	ECE
2	13EC362	Low Power VLSI Design	Even	3-0-0	3	13EC206/ 13EC312	ECE
3	13EC363	ASIC Design	Even	3-0-0	3	13EC206/ 13EC312	ECE
4	13EC364	Design for Testability	Odd	3-0-0	3	13EC206/ 13EC312	ECE
5	13EC465	Mixed Signal Circuits & Systems	Odd	3-0-0	3	13EC206/ 13EC312	ECE
DIGITAL SIGNAL PROCESSING- SPECIALIZATION STREAM							
1	13EC470	Array Signal Processing	Odd	3-0-0	3	13ES205	ECE,ECM
2	13EC371	Modern Digital Signal Processing	Even	3-0-0	3	13ES205	ECE,ECM
3	13EC372	Digital Image Processing	Even	3-0-0	3	13ES205	ECE,ECM
4	13EC373	Multi-rate Signal Processing	Odd	3-0-0	3	13ES205	ECE,ECM
5	13EC474	Speech Processing	Odd	3-0-0	3	13ES205	ECE,ECM
EMBEDDED SYSTEMS - SPECIALIZATION STREAM							
1	11EM330	Real Time Operating Systems	Odd	3-0-0	3	13CS203	ECM, CS
2	13EM332	PCB Design	Even	3-0-0	3	NIL	ECM, CS
3	11EM334	Micro Controllers Interfacing & System Design	Even	3-0-0	3	11EC311	ECM, CS
4	11EM430	Advanced Embedded Processor Architecture	Odd	3-0-0	3	11EC311	ECM, CS
5	11EM432	Hardware Software Co Design	Odd	3-0-0	3	11EC311	ECM, CS
6	13EM336	Embedded Networking	Odd	3-0-0	3	11EC311	ECM, CS
WEB TECHNOLOGIES - SPECIALIZATION STREAM							
1	13EM331	Web Programming	Odd	3-0-0	3	11EM301	ECM, CS
2	13EM333	Visual Programming	Even	3-0-0	3	11EM301	ECM, CS
3	13EM335	Web Middleware And Web Services	Even	3-0-0	3	11EM301	ECM, CS
4	13EM431	Enterprise Programming	Odd	3-0-0	3	11EM301	ECM, CS
5	13EM433	Semantic Web	Odd	3-0-0	3	11EM301	ECM, CS
POWER SYSTEM - SPECIALIZATION STREAM							
1	13EE330	Smart Grid Technologies	Odd	3-0-0	3	11EE203	EEE
2	11EE334	Operation of Restructured Power Systems	Even	3-0-0	3	11EE205	EEE
3	11EE338	Distribution System Planning & Automation	Even	3-0-0	3	11EE205	EEE
4	11EE431	Power Quality	Odd	3-0-0	3	11EE303	EEE
5	11EE435	HVDC & FACTS	Odd	3-0-0	3	11EE303	EEE

POWER ELECTRONICS SPECIALIZATION STREAM							
1	11EE331	Machine Modeling Analysis	Odd	3-0-0	3	13EE203	EEE
2	11EE335	Advanced Power Electronics	Even	3-0-0	3	11EE303	EEE
3	11EE339	Switched Mode Power Supplies	Even	3-0-0	3	11EE303	EEE
4	11EE431	Power Quality	Odd	3-0-0	3	11EE303	EEE
5	11EE435	HVDC & FACTS	Odd	3-0-0	3	11EE303	EEE
CONTROL SYSTEM SPECIALIZATION STREAM							
1	11EE332	State Estimation & System Identification	Odd	3-0-0	3	11EE304	EEE
2	11EE336	Digital Control Systems	Even	3-0-0	3	11EE304	EEE
3	11EE340	Non Linear Control Systems	Even	3-0-0	3	11EE304	EEE
4	11EE432	Optimal Control Systems	Odd	3-0-0	3	11EE304	EEE
5	11EE436	Adaptive Control Systems	Odd	3-0-0	3	11EE304	EEE
ENERGY SYSTEMS SPECILIZATION STREAM							
1	11EE333	Solar Energy	Odd	3-0-0	3	13AC201	EEE
2	11EE337	Wind Energy	Even	3-0-0	3	13AC201	EEE
3	11EE341	Nuclear Energy	Even	3-0-0	3	13AC201	EEE
4	11EE433	Nano Materials for Energy & Environment	Odd	3-0-0	3	13ES103	EEE
5	11EE437	Energy Conservation & Audit	Odd	3-0-0	3	13AC201	EEE
DIGITAL SYSTEMS SPECILIZATION STREAM							
1	13EE501	Computer Architecture	Odd	3-0-0	3	13EC203	EEE
2	13EE502	PLD’s & FPGAs	Even	3-0-0	3	13EC203	EEE
3	13EE503	VLSI DESIGN	Even	3-0-0	3	13EC203	EEE
4	13EE504	Embedded Systems	Odd	3-0-0	3	13EC203	EEE
5	13EE505	DSP Processors	Odd	3-0-0	3	13EC203	EEE
MECHANICAL ENGINEERING GENERAL ELECTIVES -SPECILIZATION STREAM							
1	13ME331	R & AC	Even & Odd	3-0-0	3	13ME202	ME
2	13ME332	Alternative Energies	Even & Odd	3-0-0	3	NIL	ME
3	13ME333	Energy Management	Even & Odd	3-0-0	3	NIL	ME
4	13ME334	Power Plant Engineering	Even & Odd	3-0-0	3	13ME202	ME
5	13ME341	Advanced Strength of Materials	Even & Odd	3-0-0	3	13ME205	ME
6	13ME342	Theory of Elasticity & Plasticity	Even & Odd	3-0-0	3	13ME205	ME
7	13ME343	Principles of Product Design	Even & Odd	3-0-0	3	NIL	ME
8	13ME344	Vibrations Engineering	Even & Odd	3-0-0	3	13ME206	ME
9	13ME351	Robotics: Sensing and Control	Even & Odd	3-0-0	3	13ME206	ME
10	13ME352	Mechatronics Product Design	Even & Odd	3-0-0	3	13ME204	ME
11	13ME353	Industrial Automation	Even & Odd	3-0-0	3	13ME302	ME
12	13ME354	Intelligent Visual Surveillance	Even & Odd	3-0-0	3	NIL	ME

13	13ME361	Reverse Engineering & Rapid Prototyping	Even & Odd	3-0-0	3	13ME204	ME
14	13ME362	Powder Metallurgy	Even & Odd	3-0-0	3	13ME203	ME
15	13ME363	Non-Destructive Testing	Even & Odd	3-0-0	3	13ME204	ME
16	13ME364	Concurrent Engineering	Even & Odd	3-0-0	3	13ME204	ME
17	13ME371	Facility layout & Material Handling	Even & Odd	3-0-0	3	NIL	ME
18	13ME372	Work Study & Ergonomics	Even & Odd	3-0-0	3	NIL	ME
19	13ME373	Total Quality Management	Even & Odd	3-0-0	3	NIL	ME
20	13ME374	Operations Management	Even & Odd	3-0-0	3	NIL	ME
AUTOMOBILE ENGINEERING -SPECILIZATION STREAM							
1	13ME335	Automobile Engineering	Even & Odd	3-0-0	3	NIL	ME
2	13ME345	Computer Aided Design	Even & Odd	3-0-0	3	13ME205	ME
3	13ME346	Vehide Dynamics	Even & Odd	3-0-0	3	13ME206	ME
4	13ME364	Automobile Chassis and Body Engineering	Even & Odd	3-0-0	3	13ME106	ME
5	13ME336	Energy Systems & Performance	Even & Odd	3-0-0	3	13ES201	ME
AEROSPACE ENGINEERING -SPECILIZATION STREAM							
1	13ME337	Computational Fluid Dynamics	Even & Odd	3-0-0	3	13ME201	ME
2	13ME347	Rotor Dynamics	Even & Odd	3-0-0	3	13ES106	ME
3	13ME348	Aero Structures	Even & Odd	3-0-0	3	13ME205	ME
4	13ME338	Propulsion Engineering	Even & Odd	3-0-0	3	13ME301	ME
5	13ME355	Mechatronics Systems and Control	Even & Odd	3-0-0	3	13ME109	ME
FLEXIBLE MANUFACTURING SYSTEMS -SPECILIZATION STREAM							
1	13ME349	Fatigue, Creep and Fracture	Even & Odd	3-0-0	3	13ME205	ME
2	13ME365	Flexible Manufacturing Systems	Even & Odd	3-0-0	3	13ME204	ME
3	13ME366	Modern Manufacturing Processes	Even & Odd	3-0-0	3	13ME204	ME
4	13ME367	Cellular Manufacturing	Even & Odd	3-0-0	3	13ME204	ME
5	13ME368	Computer Integrated Manufacturing	Even & Odd	3-0-0	3	13ME204	ME
MECHATRONICS-SPECILIZATION STREAM							
1	13ME355	Mechatronic Systems & Control	Even & Odd	3-0-0	3	NIL	ME

2	13ME357	Modeling & Simulation of Mechatronic Systems	Even & Odd	3-0-0	3	NIL	ME
3	13ME358	Signal Processing in Mechatronic Systems	Even & Odd	3-0-0	3	13ES205	ME
4	13ME359	Fuzzy Sets and Artificial Intelligence	Even & Odd	3-0-0	3	NIL	ME
5	13ME360	Engineering Smart Materials for Mechatronics Applications	Even & Odd	3-0-0	3	13ME203	ME
UPSTREAM SPECIALIZATION							
1	14 PE 331	Well intervention & Stimulation Techniques	Odd & Even	3-0-0	3	14 PE 206	
2	14 PE 332	Reservoir Modelling & Simulation	Odd & Even	3-0-0	3	14 PE 302	
3	14 PE 333	Enhanced Oil Recovery	Odd & Even	3-0-0	3	14 PE 302	
4	14 PE 334	Coal Bed Methane (CBM), Gas Hydrates and Shale Gas	Odd & Even	3-0-0	3	NIL	
5	14 PE 335	Directional Drilling & Offshore Structures	Odd & Even	3-0-0	3	14 PE 206	
6	14 PE 336	Petroleum Production System Design	Odd & Even	3-0-0	3	NIL	
DOWNSTREAM SPECIALIZATION							
7	14 PE 337	Mass Transfer	Odd & Even	3-0-0	3	NIL	
8	14 PE 338	Petroleum Refining & Petrochemical Technology	Odd & Even	3-0-0	3	NIL	
9	14 PE 339	Refining Process, Modeling & Simulation	Odd & Even	3-0-0	3	NIL	
10	14 PE 340	Polymer Science & Technology	Odd & Even	3-0-0	3	NIL	
11	14 PE 341	Petrochemical Processes	Odd & Even	3-0-0	3	NIL	
12	14 PE 342	Chemical Process Equipment Design & Drawing	Odd & Even	3-0-0	3	NIL	

Additional Courses for B.Tech with Honor's Degree (Biotechnology)							
1	13BT547	Biocatalysis and enzyme mechanisms	Even & Odd	3-0-2	4	13BT201	BT
2	13BT507	Bioreactor modelling and simulation	Even & Odd	3-0-2	4	13BT305	BT
3	13BT530	Protein Engineering	Even & Odd	3-0-2	4	13BT302	BT
4	13BT535	Transport phenomenon in bioprocess	Even & Odd	3-0-2	4	13BT401	BT
5	13BT536	Biomining	Even & Odd	3-0-2	4	13BT401	BT
Additional Courses for B.Tech with Honor's Degree (CE)							
1	11CE502	Theory of Elasticity	Even & Odd	3-2-0	4	Nil	CE
2	11CE504	Advanced Prestressed Concrete	Even & Odd	3-0-2	4	Nil	CE
3	11CE531	Repair and Rehabilitation of structures	Even & Odd	3-0-2	4	Nil	CE

4	11CE601	Finite Element Analysis	Even & Odd	3-0-2	4	Nil	CE
5	14CT533	Special Concrete	Even & Odd	3-0-2	4	Nil	CE
Additional Courses for B.Tech with Honor's Degree (CSE)							
1	15CS5178	Optimization Techniques	Even & Odd	3-0-2	4	NIL	CSE
2	15CS5180	Computational Complexity	Even & Odd	3-0-2	4	NIL	CSE
3	15CS5182	Device Management	Even & Odd	3-0-2	4	NIL	CSE
4	15CS5280	Machine Intelligence	Even & Odd	3-0-2	4	NIL	CSE
5	15CS5284	Formal Methods	Even & Odd	3-0-2	4	NIL	CSE
Additional Courses for B.Tech with Honor's Degree (ECE)							
1	15EC 5206	ANTENNA MEASUREMENTS	Even & Odd	3-0-2	4	13EC308	ECE
2	15EC 5216	Statistical Signal Processing	Even & Odd	3-0-2	4	13ES205	ECE
3	15EC 5109	WAVELETS, FILTER BANKS & APPLICATIONS	Even & Odd	3-0-2	4	13ES205	ECE
4	15EC 5112	ADAPTIVE SIGNAL PROCESSING	Even & Odd	3-0-2	4	13ES205	ECE
5	15EC 5234	VLSI System Design	Even & Odd	3-2-0	4	13EC206	ECE
Additional Courses for B.Tech with Honor's Degree (ECM)							
1	11EM501	Micro Controllers for Embedded System Design	Even & Odd	3-0-0	3	NIL	ECM
2	12EM502	REAL TIME CONCEPTS FOR EMBEDDED SYSTEMS	Even & Odd	3-0-0	3	NIL	ECM
3	13EM602	Digital Signal Processors and Architectures	Even & Odd	3-0-0	3	NIL	ECM
4	13EM513	Sensors and Sensing Principles	Even & Odd	3-0-0	3	NIL	ECM
5	13EM516	Communication Protocols and Standards	Even & Odd	3-0-0	3	NIL	ECM
Additional Courses for B.Tech with Honor's Degree (EEE)							
1	13EE601	Power Electronic control of Drives	Even & Odd	3-1-0	4	11EE307	EEE
2	13EE602	Optimization Techniques	Even & Odd	3-1-0	4	Nil*	EEE
3	13EE603	Design of power converters	Even & Odd	3-0-2	4	11EE303	EEE
4	13EE604	Power system dynamics & stability	Even & Odd	3-1-0	4	11EE302	EEE
5	13EE605	Real time control of power system	Even & Odd	3-0-2	4	11EE302	EEE
Additional Courses for B.Tech with Honor's Degree (ME)							
1	13TE531	Heat Exchanger Design	Even &	3-0-0	3	13ME401	ME

			Odd				
2	13TE602	Computational Fluid dynamics	Even & Odd	3-0-0	3	13ME201	ME
3	13TE642	Renewable Energy Technology	Even & Odd	3-0-0	3	13ME202	ME
4	11ME547	System Dynamics	Even & Odd	3-0-0	3	NIL	ME
5	13ME349	Fatigue, creep and Fracture analysis	Even & Odd	3-0-0	3	13ME205	ME
OPEN ELECTIVES							
1.	11OE408	IPR & Patent Laws	Even & Odd	3-0-0	3	NIL	ALL B.Tech except BT
2.	11OE411	Regulatory affairs and Clinical trails	Even & Odd	3-0-0	3	NIL	ALL B.Tech except BT
3.	13OE432	Biosafety and Bioethics	Even & Odd	3-0-0	3	NIL	ALL B.Tech except BT
4.	13OE433	Environmental Biotechnology	Even & Odd	3-0-0	3	NIL	ALL B.Tech except BT
5.	13OE434	Product validation & Quality Control	Even & Odd	3-0-0	3	NIL	ALL B.Tech except BT
6.	11OE309	Remote Sensing & Gis	Even & Odd	3-0-0	3	NIL	ALL B.Tech except CE
7.	11OE310	Environmental Pollution Control Methods	Even & Odd	3-0-0	3	NIL	ALL B.Tech except CE
8.	11OE311	Spatial Data Analysis And Modelling	Even & Odd	3-0-0	3	NIL	ALL B.Tech except CE
9.	11OE414	Disaster Management	Even & Odd	3-0-0	3	NIL	ALL B.Tech except CE
10.	11OE415	Image Interpretation Using Remote Sensing	Even & Odd	3-0-0	3	NIL	ALL B.Tech except CE
11.	11OE416	Solid And Hazardous Waste Management	Even & Odd	3-0-0	3	NIL	ALL B.Tech except CE
12.	11OE422	Optical Engineering	Even & Odd	3-0-0	3	NIL	ALL B.Tech except ECE
13.	13OE423	Image Processing	Even & Odd	3-0-0	3	NIL	ALL B.Tech except ECE
14.	11OE424	Mobile Communication	Even & Odd	3-0-0	3	NIL	ALL B.Tech except ECE
15.	11OE431	Radar Systems	Even & Odd	3-0-0	3	NIL	ALL B.Tech except ECE
16.	11OE425	Linear Control Systems	Even & Odd	3-0-0	3	NIL	ALL B.Tech except EEE
17.	11OE426	Renewable Energy Resources	Even & Odd	3-0-0	3	NIL	ALL B.Tech except EEE
18.	11OE427	Power System Engineering	Even & Odd	3-0-0	3	NIL	ALL B.Tech except EEE
19.	11OE428	Illumination & Traction	Even & Odd	3-0-0	3	NIL	ALL B.Tech except EEE
20.	11OE430	Energy Estimation & Audit	Even & Odd	3-0-0	3	NIL	ALL B.Tech except EEE
21.	11OE432	Dataware Housing And Mining	Even & Odd	3-0-0	3	NIL	ALL B.Tech except ECM,CSE

22.	11OE433	E-Commerce	Even & Odd	3-0-0	3	NIL	ALL B.Tech except ECM,CSE
23.	13OE421	Linux Programing	Even & Odd	3-0-0	3	NIL	ALL B.Tech except ECM,CSE
24.	12OE447	Internet Technologies	Even & Odd	3-0-0	3	NIL	ALL B.Tech except ECM,CSE
25.	12OE441	Television Engineering	Even & Odd	3-0-0	3	NIL	ALL B.Tech except ECM, ECE
26.	11OE439	Embedded Technologies	Even & Odd	3-0-0	3	NIL	ALL B.Tech except ECM, ECE
27.	13OE429	Fundamentals of IT	Even & Odd	3-0-0	3	NIL	ALL B.Tech except CSE,ECM
28.	12OE445	Fundamentals of DBMS	Even & Odd	3-0-0	3	NIL	ALL B.Tech except CSE,ECM
29.	12OE443	Robotics	Even & Odd	3-0-0	3	NIL	ALL B.Tech except ME
30.	12OE442	Mechatronics	Even & Odd	3-0-0	3	NIL	ALL B.Tech except ME
31.	13OE427	Operations Research	Even & Odd	3-0-0	3	NIL	ALL B.Tech except ME
32.	13OE430	Self Development	Even & Odd	3-0-0	3	NIL	ALL B.TECH
33.	13OE431	Indian Culture and History	Even & Odd	3-0-0	3	NIL	ALL B.TECH
34.	13OE 432	Animation For Engineers	Even & Odd	3-0-0	3	NIL	ALL B.Tech
35.	13OE433	Photography	Even & Odd	3-0-0	3	NIL	ALL B.Tech
36.	13OE435	Intelligent Visual Surveillance	Even & Odd	3-0-0	3	NIL	ALL B.Tech except ME
37.	13OE436	Total Quality Management	Even & Odd	3-0-0	3	NIL	ALL B.Tech except ME
38.	13OE437	Industrial Engineering & Management	Even & Odd	3-0-0	3	NIL	ALL B.Tech except ME
39.	13OE475	Measurements & Instrumentation	Even & Odd	3-0-0	3	NIL	ALL B.Tech except ECM, ECE
40.	12OE453	Nano Materials and Technology	Even & Odd	3-0-0	3	NIL	ALL B.TECH
41.	13ES202	Object Oriented Programming	Even	3-0-2	4	13ES101	Only for CE
42.	13ES204	Data Structures	odd	3-0-2	4	13ES101	Only for CE
43.	13ES205	Signal processing	Even	3-0-2	4	Nil	Only for CE
Additional Courses for B.Tech with Minor's Degree NANO TECHNOLOGY(MINOR GROUP)							
1	11OE401	Polymer Nano Composites	Even & Odd	3-0-0	3	NIL	ALL B.Tech
2	13OE451	Introduction to Nano Technology	Even & Odd	3-0-0	3	NIL	ALL B.Tech
3	13OE452	Nano Materials for Energy & Management	Even & Odd	3-0-0	3	NIL	ALL B.Tech
4	11OE403	Characterization of Nano Materials	Even & Odd	3-0-0	3	NIL	ALL B.Tech
5	13OE453	Micro & Nano	Even &	3-0-0	3	NIL	ALL B.Tech

		Fabrications	Odd				
6	11OE405	Nano Fluids / Science & Technology	Even & Odd	3-0-0	3	NIL	ALL B.Tech
INDUSTRIAL ENGINEERING (MINOR GROUP)							
7	12OE440	Industrial Engineering Techniques	Even & Odd	3-0-0	3	NIL	BT,CE,CS,EC,EM,EE, PE
8	11OE434	Operations Research	Even & Odd	3-0-0	3	NIL	BT,CE,CS,EC,EM,EE, PE
9	13OE454	Engineering Management	Even & Odd	3-0-0	3	NIL	BT,CE,CS,EC,EM,EE, PE
10	11OE404	Work study & Ergonomics	Even & Odd	3-0-0	3	NIL	BT,CE,CS,EC,EM,EE, PE
11	11OE406	Operations Management	Even & Odd	3-0-0	3	NIL	BT,CE,CS,EC,EM,EE, PE
COMPUTING(MINOR GROUP)							
12	13OE455	Principles of Operating System	Even & Odd	3-0-0	3	NIL	BT,CE,EC,EE,ME,PE
13	13OE456	Algorithm design and analysis	Even & Odd	3-0-0	3	NIL	BT,CE,EC,EE,ME,PE
14	13OE457	Theory of Computation	Even & Odd	3-0-0	3	NIL	BT,CE,EC,EE,ME,PE
15	13OE458	Parallel Processing	Even & Odd	3-0-0	3	NIL	BT,CE,EC,EE,ME,PE
16	13OE459	Data Analytics	Even & Odd	3-0-0	3	NIL	BT,CE,EC,EE,ME,PE
Additional Courses for B.Tech with Minor's Degree in WEB PROGRAMMING							
1	13OE461	Foundations for web development	Even & Odd	3-0-0	3	NIL	BT,CE,EC,EE,ME,PE
2	13OE462	Client side web Development	Even & Odd	3-0-0	3	NIL	BT,CE,EC,EE,ME,PE
3	13OE463	Web Application development on server side	Even & Odd	3-0-0	3	NIL	BT,CE,EC,EE,ME,PE
4	13OE464	Web Application development through .NET Framework	Even & Odd	3-0-0	3	NIL	BT,CE,EC,EE,ME,PE
5	13OE465	Component based Web Development through EJB	Even & Odd	3-0-0	3	NIL	BT,CE,EC,EE,ME,PE
BIO INFORMATICS(MINOR GROUP)							
24	13OE466	Basic Biology	Even & Odd	3-0-0	3	NIL	CE,CS,EC,EE,ME,PE, EM
25	13OE467	BIOINFORMATICS	Even & Odd	3-0-0	3	NIL	CE,CS,EC,EE,ME,PE, EM
26	13OE468	Molecular Modelling & Drug Design	Even & Odd	3-0-0	3	NIL	CE,CS,EC,EE,ME,PE, EM
27	13OE469	Bio Perl & Perl Programming	Even & Odd	3-0-0	3	NIL	CE,CS,EC,EE,ME,PE, EM
28	13OE470	Bio Mining Genomics & Proteomics	Even & Odd	3-0-0	3	NIL	CE,CS,EC,EE,ME,PE, EM
ELECTRONICS(MINOR GROUP)							
29	13OE471	Electronic Devices	Even &	3-0-0	3	NIL	BT,CE,CS,EE,ME,PE

			Odd				
30	13OE472	Digital Electronics	Even & Odd	3-0-0	3	NIL	BT,CE,CS,EE,ME,PE
31	13OE473	Analog Electronics	Even & Odd	3-0-0	3	NIL	BT,CE,CS,EE,ME,PE
32	13OE420	Pulse & Digital Circuits	Even & Odd	3-0-0	3	NIL	BT,CE,CS,EE,ME,PE
33	13OE474	Linear Integrated Circuits	Even & Odd	3-0-0	3	NIL	BT,CE,CS,EE,ME,PE
34	13OE475	Measurements & Instrumentation	Even & Odd	3-0-0	3	NIL	BT,CE,CS,EE,ME,PE
ELECTRICAL POWER ENGINEERING(MINOR GROUP)							
35	13OE476	Electrical Circuits	Even & Odd	3-0-0	3	NIL	ECE, ECM, ME
36	13OE477	Electrical Machines	Even & Odd	3-0-0	3	NIL	ECE, ECM, ME
37	13OE478	Electrical Power Generation	Even & Odd	3-0-0	3	NIL	ECE, ECM, ME
38	13OE479	Transmission & Distribution	Even & Odd	3-0-0	3	NIL	ECE, ECM, ME
39	13OE480	Power System Analysis & Protection	Even & Odd	3-0-0	3	NIL	ECE, ECM, ME
40	11OE429	Utilization of Electrical Power	Even & Odd	3-0-0	3	NIL	ECE, ECM, ME
ELECTRICAL MACHINES(MINOR GROUP)							
41	13OE476	Electrical Circuits	Even & Odd	3-0-0	3	NIL	ECE, ECM, ME
42	13OE477	Electrical Machines	Even & Odd	3-0-0	3	NIL	ECE, ECM, ME
43	13OE483	Advanced Control Systems	Even & Odd	3-0-0	3	NIL	ECE, ECM, ME
44	13OE484	Power Electronics Devices & Circuits	Even & Odd	3-0-0	3	NIL	ECE, ECM, ME
45	13OE485	Power Semi-Conductor & Drives	Even & Odd	3-0-0	3	NIL	ECE, ECM, ME
46	13OE486	Special Machines	Even & Odd	3-0-0	3	NIL	ECE, ECM, ME
DIGITAL DESIGN(MINOR GROUP)							
47	13OE487	System on Chip Architecture	Even & Odd	3-0-0	3	NIL	ALL B.TECH EXCEPT ECE
48	13OE488	Digital Signal Processing	Even & Odd	3-0-0	3	NIL	ALL B.TECH EXCEPT ECE
49	13OE489	VLSI Design	Even & Odd	3-0-0	3	NIL	ALL B.TECH EXCEPT ECE
50	13OE490	Switching Theory & Logic Design	Even & Odd	3-0-0	3	NIL	ALL B.TECH EXCEPT ECE
51	13OE491	Computer Organization	Even & Odd	3-0-0	3	NIL	ALL B.TECH EXCEPT ECE
52	13OE492	Microprocessors & Interfacing	Even & Odd	3-0-0	3	NIL	ALL B.TECH EXCEPT ECE
GEO INFORMATICS(MINOR GROUP)							
53	13OE493	Fundamentals of	Even &	3-0-0	3	NIL	ALL B.TECH EXCEPT

		Geospatial Technology	Odd				CE
54	13OE494	Geographical Information system	Even & Odd	3-0-0	3	NIL	ALL B.TECH EXCEPT CE
55	13OE495	Environmental Geoinformatics	Even & Odd	3-0-0	3	NIL	ALL B.TECH EXCEPT CE
56	13OE496	GIS data Analysis& Modelling	Even & Odd	3-0-0	3	NIL	ALL B.TECH EXCEPT CE
57	13OE497	Geospatial technology for Natural Resources &Disaster Management	Even & Odd	3-0-0	3	NIL	ALL B.TECH EXCEPT CE
58	13OE498	Geospatial Applications	Even & Odd	3-0-0	3	NIL	ALL B.TECH EXCEPT CE
Management(HS) Electives							
1	11HS201	Emotional Intelligence	Even & Odd	3-0-0	3	NIL	ALL B.TECH
2	11HS202	Paradigms in Management Thought	Even & Odd	3-0-0	3	NIL	ALL B.TECH
3	11HS203	Indian Economy	Even & Odd	3-0-0	3	NIL	ALL B.TECH
4	11HS205	Professional Ethics & Values	Even & Odd	3-0-0	3	NIL	ALL B.TECH
5	11HS206	Behavioral Sciences	Even & Odd	3-0-0	3	NIL	ALL B.TECH
6	11HS208	Managing Personal Finances	Even & Odd	3-0-0	3	NIL	ALL B.TECH
7	11HS209	Basics of Marketing for Engineers	Even & Odd	3-0-0	3	NIL	ALL B.TECH
8	11HS210	Self Management	Even & Odd	3-0-0	3	NIL	ALL B.TECH
9	11HS211	Organization Management	Even & Odd	3-0-0	3	NIL	ALL B.TECH
10	13HS212	Construction Project Management	Even & Odd	3-0-0	3	NIL	ALL B.TECH
11	11OE414	Disaster Management	Even & Odd	3-0-0	3	NIL	ALL B.TECH
12	11HS212	Resource Safety & Quality Management	Even & Odd	3-0-0	3	NIL	ALL B.TECH
13	13OE422	Water	Even & Odd	3-0-0	3	NIL	ALL B.TECH
14	13HS214	Event Management	Even & Odd	3-0-0	3	NIL	ALL B.TECH
15	13HS215	Public Administration	Even & Odd	3-0-0	3	NIL	ALL B.TECH
AUDITED COURSES							
1	13AC201	Energy & Society	Even & Odd	2-0-0	NIL	NIL	ALL B.TECH
2	13AC202	Employability Skills	Even & Odd	1-0-2	NIL	NIL	ALL B.TECH
3	13AC301	Advanced Employability Skills	Even & Odd	1-0-2	NIL	13AC202	ALL B.TECH
4	13AC203	Sports / Games / Yoga	Even & Odd	0-0-2	NIL	NIL	ALL B.TECH
5	13AC204	NCC /NSS /NSO/ CEA	Even & Odd		NIL	NIL	ALL B.TECH
6	13AC302	Quantitative Aptitude and Reasoning	Even & Odd	0-0-2	NIL	NIL	ALL B.TECH
NON-CREDIT COURSES:							
1	13NC201	Certificate Courses-1		--	NIL	NIL	ALL B.TECH
2	13NC202	Certificate Courses-2		--	NIL	NIL	ALL B.TECH
Term Paper							
1	13TP401	Term Paper		0-0-4	2	NIL	ALL B.TECH
1	13PW401	Final year Project	Even	0-0-24	12	NIL	ALL B.TECH
2	13PS401	Practice School	Even			NIL	ALL B.TECH
3	13IS201	Industrial Training		4 Weeks	NC	NIL	ALL B.TECH

SYLLABUS

HUMANITIES & SOCIAL SCIENCES
ENGLISH

Course Code: 13HS101 **L –T – P: 2-0-2**
Prerequisite: Nil **Credits: 3**

Kinesics

Body language--Postures –Gestures---Eye Contact
How they work in social context
Kinesics -- The Psychological aspect
Personality traits
Self-awareness---Self-confidence-----Self-esteem---Self-image----Hubris
Evaluation Components : i) Case Studies involving application of concepts
ii) Quiz questions

LEXIS & LANGUAGE PROFICIENCY

GRE word list

800 words and 200 foreign expressions

Synonyms
Analogies
Antonyms
One word substitutes
Idioms and Phrases

English Usage and Mechanics.

Correction of sentences

Sentence completion (GRE model : each blank should be filled with two synonyms out of six choices)

Jumbled sentences

Office communication

Letter writing
Formats of letter writing – full block and semi block models----Types of letters – formal and informal letters----Personal, business, Sales, collection, regret letters.

ROUTINE FORMS OF COMMUNICATION

Writing Circulars -------- Writing product and process descriptions ------- Brochures and handouts -------- Writing/ designing User manuals
Memo writing------- Office memos----Routing slips
Note making and note taking

Reading skills

Reading comprehension
- Reading for information
- Reading for specifics
- Skimming and scanning.

Reading speed – Practice and tests
Reading recall

TEXT BOOKS:

1.ENGLISH : an ESP curriculum 201314
2.Business Communication : Lesikar

REFERENCE:

1. Common Mistakes in English : T J Fitikides Longman Group Ltd. 1986
2.Harrap's Dictionary of English Idioms : John O.E.Clark Harrap, London 1990
3. How to read faster and better: Norman Lewis

LANGUAGE AND REASONING SKILLS

Course Code: 13HS102 **L –T – P: 2-0-2**
Prerequisite: Nil **Credits: 3**

INTERPERSONAL SKILLS

The team concept – Team work processes --- Building effective teams---Stages of team formation ---- Team player styles --- Outbound training --- Objectives of outbound ---Leadership : duties and skills

CRITICAL REASONING (GRE, GMAT,CAT, NDA)

Definition --- methods and classification ---- the weak sense critical thinker --- the strong sense critical thinker

Skills: Observation--- interpretation --- analysis --- inference --- evaluation --- explanation--- metacognition

Critical thinking ---a learning paradigm --- training in ----Independent judgement----Critical thinking------Ethical reasoning

Three types of thinking: 1. Receptive 2. Appreciative 3. Critical

Practice sessions: Analytical reasoning tests -----Situation Reaction Tests ----Verbal Reasoning Tests-------Situation Analysis tests (Problem solving and case studies)

a) Writing thematic analysis b) Structuring arguments

ENGLISH FOR THE MEDIA

Writing headlines ------ Caption writing ---- cutlines---- taglines
Writing agenda--- writing minutes---- preparing pressnotes--- briefing and debriefing

ADVANCED GRAMMAR

1.Parallelism
2. Dangling Modifiers
3. Tautology
4. Ambiguity
5. Needless shifts in tense, voice and mood.

COMPOSITION SKILLS

1.Writing Paragraphs
Topic sentence--- linkers---- transitions---- kernels, coordinates and subordinates --- sequencing ideas.
2.Writing essays--- connecting and organizing paragraphs --- Introduction--- development--- conclusion--- editing and revising
3. Precis writing
4. Writing summaries and abstracts.

TEXT BOOK:

1.Technical Communication Skills KL University 201314

REFERENCE BOOKS:

1.The Winner's Manual : Essential Life and Work Skills Dorling Kindersley London New York
2.Writing Effectively : Beth S. Neman Charles E. Merril Publishing company, Ohio
3. Smart's Handbook of Effective Writing: Harper& Brothers 1963
4.Effective Writing : Christopher Turk and John Kirkman Spon press , London New York

ECOLOGY AND ENVIRONMENT

Code: **11 BS 105** **L –T – P: 2-0-0**

Prerequisite: Nil **Credits: 2**

The Multidisciplinary nature of Environmental Studies Environment: Definition – scope – importance – Need for public awareness. Institutions and people in Environment;

Natural Resources: Renewable and Non- Renewable Resources: **Forest resources**: Use – over exploitation – deforestation – case studies- mining, dams and their effects on forests and tribal people. **Water resources**: Use – over utilization of surface and ground water – floods – drought – conflicts over water, dams- benefits and problems, Water conservation – rain water harvesting – watershed management, Cloud seeding **Mineral resources**: Use – exploitation – environmental effects – 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 – 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.

Ecosystems: Concept of an ecosystem: Structure and function of an ecosystem -Producers – consumers – decomposers, Energy flow in the ecosystem – Ecological succession – Food chains – food webs and ecological pyramids. Types of ecosystem.

Biodiversity and its Conservation: Introduction – Definition, Levels, Values of biodiversity: India as a mega diversity nation. Hotspots of biodiversity. Threats to biodiversity: Endangered and endemic species of India. Conservation of biodiversity: Assessment of Biodiversity and its impact on Environment.

Environnemental Pollution: Définition – Causes – effects – control measures of Air pollution – Water pollution – Soil pollution – Marine pollution – Noise pollution – Thermal pollution – Nuclear hazards. **Soil waste management**. Role of an individual in prevention of pollution - case studies. **Disaster management**: floods – earthquake – cyclone – landslides. Climate change – global warming – acid rain – ozone layer depletion – case studies. **Environmental Legislation** and objectives of 1. Environment Protection Act, 2. Air (Prevention and Control of Pollution) Act, 3.Water (Prevention and control of Pollution) Act, 4. Wildlife protection Act, 5. Forest conservation Act, 6. Biodiversity Act – Public awareness. **Environmental Impact Assessment** - overview.

TEXT BOOK

1.Deeksha Deve and P.UdayBhaskar, 2011"Environmental studies", CENGAGE Learning, Delhi

2.Erach Bharucha, 2010 "Text Book of Environmental Studies", United Grants Commission, Universities Press (India) Pvt Ltd., Hyderabad

REFERENCE BOOKS

1. Anubha Kaushik, C.P. Kaushik, 2011, Environmental Studies, New Age International
2. Benny Joseph,2009 Environmental Studies, The McGraw-Hill companies, New Delhi
3. P. Ananadam and R. Kumaravelam, Environmental Science and Engineering, SciTech Publications India, Chennai
4. G.Tyler Miller Jr,2006 CENGAGE learning, Environmental Science and Engineering
5. Mukkanti. K, 2010, Environmental Studies, S.Chand & Co, New Delhi.
6. S.V.S. Rana, 2010, Essentials of Ecology and Environmental Science,
7. P.D. Sharma, 2005. Environmental Biology, Rastogi Publications, Meerut.
8. R.Rajagopalan, 2005. Environmental Studies, Oxford University.

HUMAN VALUES

Code: 13HS 104 **L –T – P: 2-0-0**
Prerequisite: Nil **Credits: 2**

Introduction to Value Education: Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity - The Basic Human Aspirations, Right Understanding, Relationship and Physical Facilities, Happiness and Prosperity – Current Scenario, Method to fulfill the Basic Human Aspirations.
Harmony in the Human Being: Understanding the Human Being as Co-existence of Self ('I') and Body, Discriminating between the Needs of the Self and the Body, The Body as an Instrument of 'I', Understand Harmony in the Self ('I'), Harmony of the Self ('I') with the Body, Program to Ensure Sanyam and Svasthya.
Harmony in the Family and Society: Harmony in the Family - the Basic Unit of Human Interaction, Values in Human-to-Human Relationships, 'Trust' – the Foundational Value in Relationships, 'Respect' – as the Right Evaluation, Understand Harmony in the Society, Vision for the Universal Human Order.
Harmony in the Nature (Existence): Understand Harmony in the Nature, Interconnectedness, Self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing 'Existence is Co-existence' at All Levels, The Holistic Perception of Harmony in Existence.
Implications of the Right Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Holistic Technologies, Production Systems and Management Models - Typical Case Studies, Strategies for Transition towards Value-based Life and Profession.

TEXT BOOK

1. A Foundation Course in Human Values and Professional Ethics - R R Gaur, R Sangal and G P Bagaria, First Edition, Excel Books.

REFERENCE BOOKS

1. Ivan Illich, Energy & Equity , The Trinity Press, Worcester and Harper Collins, USA.
2. E F Schumacher, 1973, small is beautiful: A study of Economics as if People Mattered, Blond & Briggs, Britain
3. Sussan George, 1976, How the Other Half Dies, Penguin press, reprinted 1986, 1991.
4. Donella H. Measows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972,
5. Limits to GrowthClub of Rome's report, Universe Books.
6. P.L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publisher
7. A.N. Tripathy,2003, Human Values, New Age International Publishers
8. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
9. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press.
10. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow, Reprinted 2008.

BASIC SCIENCES

LINEAR ALGEBRA AND MULTIVARIATE CALCULUS

Code: 13BS101 **L –T – P: 3-0-2**
Prerequisite: Nil **Credits: 4**

Linear Algebra: Rank of a matrix, solving linear system of homogeneous & non-homogeneous simultaneous equations using elementary methods, iterative methods: Jacobi's method and Gauss - Seidal method, orthogonal, symmetric, skew-symmetric, Hermitian, Skew-Hermitian and unitary matrices, Eigen values, Eigen vectors and their properties, Cayley -Hamilton theorem (without proof), quadratic forms, Electrical circuit problems, eigen value problems.

Differential calculus: Limit, continuity, differentiability, Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem (without proofs) and their applications, Taylor's series and Maclaurin's series, Partial derivatives, Jacobian, total differentiation and their applications, chain rule, Taylor's series for function of two variables, maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers.

Integral Calculus: Improper integrals, Beta, Gamma functions and their relationship. Line integrals- length of the arc, double and triple integrals and applications to area, volume, mass & moment of inertia. Change of order of integration, change of variables in polar, cylindrical and spherical polar coordinates.

Vector Calculus: Scalar, vector, differentiation of vectors, gradient, divergence, curl of vector point functions. Line, surface and volume integrals, Green's, Gauss divergence and Stoke's theorems and their applications.

TEXT BOOKS

1. Advanced Engineering Mathematics (second edition), Michael Greenberg.
2. Advanced Engineering Mathematics (Tenth Edition), Erwin Kreyszig.

REFERENCE BOOKS

1. Higher Engineering Mathematics, By Dr. B.S. Grewal. Publisher: Khanna, New Delhi.
2. Elementary Differential Equations, By W.E.Boyce and R.Diprima
3. Differential equations and their applications, ZAFAR AHSAN, PHI, second edition.
4. Advanced engineering mathematics, RK Jain, SRK Iyengar, Narosa publishers, second edition.

DIFFERENTIAL EQUATIONS

Code: 13BS102 **L –T – P: 3-1-0**
Prerequisite: Nil **Credits: 4**

Ordinary Differential Equations and its applications : Practical approach to differential equations, First order differential equations, Variable separable method, linear equations, Bernoulli's equation and exact differential equations. Models for the real world problems: Newton's Law of Cooling, Law of natural growth and decay. **Numerical solutions of first order ODE :** Taylor's series method, Euler's method, modified Eulers's method, Runge-Kutta method of fourth order

Second and High order differential Equations : Linear differential equations of higher order with constant coefficients, complimentary function, particular integral, method of variation of parameters, Higher order linear differential equations with variables coefficients (Cauchy's and Legendre's differential equations). Applications such as LCR electric circuits with and without e.m.f., deflection of beams, free and forced oscillations and resonance.

Laplace Transforms and its applications: Motivation, Definition, Linearity property, Laplace transforms of elementary functions, Shifting theorem, Laplace transforms of periodic, Unit step and Impulse functions. Inverse Laplace transforms of derivatives and integrals, Convolution theorem, Application of Laplace transforms in solving ordinary differential equations and Simultaneous linear differential equations.

Partial Differential Equations and their applications: Formation of Partial differential equations, direct integration method, models of first order partial differential equations. Solutions of first order linear PDE: Lagrange's multiplier method, nonlinear equations of standard forms, Charpit's method. Second order linear partial differential equations with constant coefficients, complementary functions, particular integrals, homogeneous/non homogeneous linear partial differential equations. Engineering Applications dimensional wave and heat equations, two dimensional Laplace equations and their general solutions

TEXT BOOKS

1. Differential equations and their applications, ZAFAR AHSAN, PHI, Second edition.
2. Advanced Engineering Mathematics (Tenth Edition), Erwin Kreyszig.

REFERENCE BOOKS

1. Higher Engineering Mathematics, By Dr. B.S. Grewal. Publisher: Khanna, New Delhi.
2. Elementry Differential Equations, By W.E.Boyce and R. Diprima
3. Advanced Engineering Mathematics (second edition), Michael Greenberg.
4. Applied numerical methods with MATLAB for engineers and scientists, Steven C. Chapra, third edition, Tata McGraw-hill edition, New Delhi.

ENGINEERING PHYSICS

Code: 13BS103 **L –T – P: 3-0-2**
Prerequisite: Nil **Credits: 4**

ELECTROMAGNETISM: Coulomb's law, Gauss's law, Electric current and equation of continuity, motion of charged particles in electric and magnetic fields, Lorentz force, Hall effect, Cyclotron, Biot- Savart's law, Ampere's law, Faraday's law of induction, Generalization of Ampere's law.

OPTO ELECTRONIC DEVICES: Introduction – working of PN junction diode, light emitters – LED; light detectors – Photo diode, Photo transistor, photovoltaic effect, solar cells – principle and its applications.

OPTICS: Ray Optics – Lens aberrations (chromatic, achromatic, spherical, distortion, astigmatism, coma), measures of correct aberrations. Interference – coherence (spatial, temporal) in thin films of uniform thickness (derivation); Newton's rings, Application – wavelength, refractive index; Fiber Optics including Introduction, Optical fiber as a dielectric wave guide- total internal reflection, Numerical aperture and various fiber parameters, losses associated with optical fibers, step index and graded index fibers, application of optical fibers. **Infrared principles and devices (Thermal Imaging) and Night vision devices.**

SUPERCONDUCTIVITY: Introduction, properties, Experimental facts – Resistance Vs Temperature, Meissner effect, Josephson Effect, critical parameters, type I and II superconductors, HTS, applications.

ULTRASONICS: Properties, phenomenon of Magnetostriction, production – Piezoelectric methods, detection – piezoelectric detector, acoustic grating, Kundt's tube method. Applications – Industrial (drilling, welding, soldering, cleaning, SONAR), NDT (pulse echo, transmission, resonance technique), Medical (echo cardiogram, ultrasonic imaging).

LASERS: Fundamentals of LASER- absorption of light, spontaneous emission of light, Stimulated emission of light – population of energy levels, Einstein A and B coefficients, Metastable state, population inversion, resonant cavity, excitation mechanisms, Lasing action; Properties of laser, characteristics of different types of laser; Types of laser- Solid State Laser: Ruby Laser, Gas Laser – He-Ne, Semiconductor Laser: GaAs Laser; Applications of Laser in Engineering – drilling, welding, cutting, measurement of long distances, in Medicine as a surgical tool (blood less surgery).

TEXT BOOKS

1. Physics Volume II 5th Edition, Resnick, Halliday and Krane.
2. Laud B.B., Lasers and Non-Linear Optics, New Age Publications.
3. Engineering Physics, M R Srinivasan, New Age Publications.
4. Engineering Physics, 2nd edition, P. K Palanisamy, Sci Tech publications (India) Pvt.Ltd, Chennai.

REFERENCE BOOKS

1. University Physics, 6th edition, Francis W.Sears, Mark W Zemansky, Hugh D Young, Norsa Publishing House.
2. Solid State Physics, 6th Edition, S.O.Pillai, Newage International Publishers.
3. Optics, 2nd Edition by Ajay Ghatak, Tata Mc Grahill Publications.
4. Applied Physics, P.K.Palanisamy, Scitech publications (India) Pvt.Ltd, Chennai.
5. Engineering Physics, 8th Edition, R K Gaur and S L Gupta, Dhanpat Rai Publications.

ENGINEERING CHEMISTRY

Code: 11BS104 **L –T – P: 3-0-2**
Prerequisite: Nil **Credits: 4**

Electrochemical energy systems: Basics, electrode potential, emf of a cell, reference electrodes (calomel, glass), determination of pH. Concentration cell. **Conversion and storage** of electrochemical energy: Zn-C dry cell, lead acid, nickel-cadmium, Lithium cells. Chemistry of H_2, H_2-O_2 fuel cell, future water powered car and solar cell. **Corrosion Science:** Definition, atmospheric corrosion-mechanism, electrochemical corrosion-mechanism, microscopic galvanic cell corrosion, concentration galvanic cells, galvanic cells created by differences in composition, structure and stress, factors affecting corrosion, Corrosion control-material selection, design, alteration of environment, cathodic and anodic protection, Electroplating of Cu. **Water Technology:** Sources, impurities, hardness, types of hardness, estimation of hardness by EDTA, alkalinity – numericals, ill effects of water in steam generation, preventive measures - internal and external treatments (cold and hot lime soda processes, numericals and ion exchange process), Quality standards and treatment for drinking water desalination methods: Electrodialysis and reverse osmosis. **Polymers:** Polymers – definition - polymerisation – types - addition and condensation polymerization-free radical and coordination polymerisation mechanisms – plastics, classification – preparation, properties and uses of PVC, Teflon, Bakelite, UF resin and PET. Chemistry and applications of conducting polymers (poly acetylene and poly aniline), FRP composites and abrasives – classification, properties and uses. **Phase Rule**: Statement and explanation of terms involved – one component system – water system – condensed phase rule – construction of phase diagram by thermal analysis – simple eutectic system (Pb-Ag).

TEXT BOOK

1.Applied Chemistry – A text book for Engineers and Technologists; Roussak, Hymand.Gesser

REFERENCE BOOKS

1.Industrial Chemistry by Helen Njeri Njenga, African Virtual University.

2.Engineering Chemistry by Mary Jain Shultz

3.Chemistry in Engineering and Technology, Volume 2, J C Kuriacose & J Rajaram, The Tata McGraw Hill, New Delhi.

BASIC MATHEMATICS

Code: 13BS104 **L –T – P: 3-1-0**

Prerequisite: Nil **Credits: 4**

Ordinary Differential Equations and its Applications : Practical approach to differential equations, First order differential equations, Variable separable method, linear equations, Bernoulli's equation. Models for the real world problems: Newton's Law of Cooling, Law of natural growth and decay. System of first order differential equations (Prey-Predator models). Applications on Chemical reactions. **Numerical solutions of first order ODE :** Taylor's series method, Euler's method, Runge- Kutta method of fourth order. **Second and High order differential Equations :**Linear differential equations of higher order with constant coefficients, complimentary function, particular integral, method of variation of parameters, **Laplace Transforms and its applications**: Motivation, Definition, Linearity property, Laplace transforms of elementary functions, Shifting theorem, Laplace transforms of periodic,. Inverse Laplace transforms of derivatives and integrals, Convolution theorem, Application of Laplace Transforms in solving ordinary differential equations. **Partial Differential Equations:** Formation of Partial differential equations, direct integration method, models of first order partial differential equations.

Text Books:

1. Differential equations and their applications, ZAFAR AHSAN, PHI, Second edition.
2. Advanced Engineering Mathematics (Tenth Edition), Erwin Kreyszig,John-Wiley publications

Reference Books:

1. Higher Engineering Mathematics, By Dr. B.S. Grewal. Publisher: Khanna, New Delhi.
2. Elementry Differential Equations, By W.E.Boyce and R. Diprima.
3. Applied numerical methods with MATLAB for engineers and scientists, Steven C. Chapra,third edition, Tata McGraw-hill edition, New Delhi.
4. Differential equations and Mathematical Biology by D.S.Johns,Michael plank,B.D.Sleeman: C.R.C press

ORGANIC CHEMISTRY

Code: 13BS107 **L –T – P: 2-0-0**

Prerequisite: Nil **Credits: 2**

Isomerism, Configuration & Mechanism: Isomerism – stero isomerism, optical and geometrical isomerisms. Absolute configuration. R & S configuration, Enantiomers, diastereomers, epimers. Types of organic reactions – substitution, elimination, rearrangement reactions, SN^1 and SN^2 reactions. Anomers (α,β). **Aromatic compounds:** Benzene – Aromatic character, Mechanism of electrophilic substitution – Nitration, sulphonation, Halogenation, Friedel crafts alkylation and acylation, Orientation of distributed benzenes – activating and deactivating groups. **Heterocyclic compounds**: Basic nature, simple preparations and reactions of Furan, Thiophene, Pyrrole, Pyridine and Indole. **Carboxylic acids and its derivatives:** Effect of substituents on acidity, HVZ reaction, Hoffman Bromamide reaction, Claisen condensation, preparations and application of Malonic ester and Aceto acetic ester. Keto – enol tautomerism. **Amines**: Preparation of aniline & aliphatic amine, Reductive amination, Hoffman elimination, Benzidine rearrangement, effect of substituents on basicity, distinguishing tests for amines. Preparation of diazonium salts, properties and applications. **Alcohols:** Industrial preparation of ethyl alcohol, Grignard synthesis of alcohols, differentiation, tests of alcohols, Williamson's synthesis of ethers. **Aldehydes & Ketones:**

Preparation by oxidation of alcohols, differentiation tests, Nucleophilic addition reactions – Cannizaro, Aldol condensation, Perkin, Reformatsky and Wittig reactions.

Text book:

1. Text book of Organic Chemistry by I L Finar, Vol. 1 & 2.
2. Organic Chemistry by Clyaden, Greeves, Warren and Wothers.

Reference book:

1. Text book of Organic Chemistry by R T Morrison and R N Boyd
2. Text book of Organic Chemistry by Jerry March.

FUNDAMENTALS OF BIOLOGY

Code:13BS108 **L –T – P: 3-1-0**
Prerequisite: Nil **Credits: 4**

Scope: The main objective of this paper is to strengthen the fundamentals of living organisms ranging from simple to complex structures. It will help the students to analyze and apply the basic principles for development / production of useful products from biological organisms.

General Characteristics: General Characteristics of vertebrates and invertebrates, similarities and differences, General Characteristics of protozoa, Porifera, Annelida, Mollusca, Arthropoda, Amphibia, Aves, Reptiles,Mammals, Morphology, life cycle and reproduction of amoeba, plasmodium.

Animal Physisology: Organs and organelles of higher animals – biotechnological importance, Mode of nutrition, digestive system, gastro intestinal secretions, absorption and assimilation of digested food products. Respiratory and Excretory system- structure of kidney and functions.

Blood and cellular differentiation: Composition of blood, pumping action of heart, heartbeat and pulse, blood vessels and blood circulars. Hematopoietic differentiation. Animal tissues – Epithelial, muscle, connective, nerve tissues and functions.

Plant Physisology: Organs and organelles of plants and its role with reface to biotechnology, Plant cells and water. Diffusion, water potential,. osmosis, plasmolysis, imbibitions active and passive absorption. Mineral nutrition – criteria for essentiality, macro elements
(N2,P,K) and micro elements (Cu,Mn, Fe) biological nitrogen fixation (Eg. Rhizobium & Blue Green Algae). Structure of Nitrogenase and its correlation with photo system.

Plant Photosynthesis : Significance of photosynthesis – biotechnological perspectives, Chloroplast structure and functions. Light reaction, Emerson enhancement effect Photo system –I and II Photolysis of water, Photo phosphorylation, CO2 fixation – C3, C4 and CAM pathways, photorespiration, factors affecting photosynthesis.

Text Books:

1. **Chordate Zoology and elements of Animal Physiology, 10 th edition, E.L Jordan and P.S.Verma SChand company Ltd**
2. **Principles of Anatomy and Physiology by Tortora and Grabowski, 10 th edition Wiley International**
3. **A Text book of Animal Physiology A.K.Berry Emkay publications**

Reference Books:

1. **Introduction to Plant physiology by William G Hopkins**
2. **Modern text book of Zoology – Invertebrates by R.L Kotpal 8th edition, Rastogi Publishers**

CELL AND MOLECULAR BIOLOGY

Code:13BS109 **L –T – P: 3-1-0**
Prerequisite: Nil **Credits: 4**

Cell Biology: Characteristics of Prokaryotic & Eukaryotic cells. Cell receptors. Cell membrane proteins. Cell membrane transport mechanisms. Cell cycle and its regulation, Apotosis. Cell surface proteins; Cell signaling – G proteins, enzyme linked and tyrosine Kinases. Cell cytoskeleton – actin & myosin, tubulin & microtubules. Cell adhesion molecules – Cadherin, selectin. **Replication:** Replication of DNA-Semi conservative replication apparatus, unidirectional replication, bi-directional replication, rolling circle replication; DNA damage and repair: Types of DNA damages-deamination, alkylation, pyrimidine dimers; Repair mechanisms-Excision repair and mismatch repair, SOS repair, **rec** gene and its role in DNA repair. **Transcription:** Structure of Promoters-RNA Polymerases of Prokaryotic and Eukaryotic Organism; Transcription- Initiation, Elongation and Termination; Post Transcriptional Processes of Eukaryotic RNA; Structural features of RNA-r-RNA, m- RNA, t-RNA , and functions of RNA. Transcription apparatus and proteins involved in transcription. Prokaryotic & Eukaryotic transcription. Processing of t-RNA, r-RNA, m-RNA splicing, Concept of Ribozyme. **Translation:** Translation in prokaryotic and Eukaryotes-initiation of translation, elongation of polypeptide chain, termination of translation. Post-translational modifications-Glycosylation. **Regulation of Gene expression:** in bacteria-Operon concept, inducible and repressible opersons, positive and negative regulations, inducer molecules, repressor molecules, co repressor molecules; Induction and catabolic repression of **lac** Operon in **E.Coli**;Repression and attenuation of **trp** operon in **E.Coli**; Positive and negative controls in **ara** operon in **E.coli**;Control of gene expression by sigma factor and post transcriptional control. Absolute control by antisense RNA's; enhancers, upstream controlling elements, Structural Motifs of Transcription factors: helix turn, zinc finger motifs, leucine zippers and homeotic genes.

Recommended Text Books:

1. Molecular Biology of the Cell by Watson
2. Molecular Biology by David Freifelder; Narosa publications house.

Reference Books:

1. Molecular Biology by Weaver; Academic International Publication.
2. Gene IX by Benjamin Lewin; Pearson Publishing.

MATHEMATICAL METHODS

Code:13BS201 **L –T – P: 3-0-0**
Prerequisite: Nil **Credits: 3**

Numerical Methods: The Bisection Method, Regula-falsi method, Newton-Raphson Method, Newton's forward and backward interpolations, Lagrange's Interpolation, Newton's divided difference formula, Numerical Differentiation: first and second order derivatives by Newton's forward and backward interpolations. Numerical Integration: Trapezoidal rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule and applications.

Fourier series and transforms: Determination of Fourier coefficients, Fourier series, even and odd functions, Fourier series in an arbitrary interval, half-range Fourier sine and cosine series, Parseval's identities, Fourier integral theorem (without proof)– Fourier sine and cosine integrals. Fourier transforms, Fourier sine and cosine transforms and its properties, inverse transforms, finite Fourier transforms, discrete Fourier transforms

Z-transforms: Introduction, definition, some standard Z-transforms, initial and final value theorems, Z-transforms properties, inverse Z-transforms, convolution theorem, solution of difference equations using Z-transforms

Probability and distributions: Random variables, probability function, mathematical expectation, geometric, exponential and normal distributions.

Correlation and regression: Bivariate data, simple correlation and regression coefficients and their relations, least square's method for linear, curve linear and polynomial curve fitting

Statistical testing of hypothesis: Sampling distribution of mean and standard error, large tests (Test for an assumed mean and equality of two population means with known SD), small sample tests (t-test for an assumed mean and equality of means of two populations when observations are independent), Chi-square test - independence of attributes, goodness of fit

TEXT BOOKS

1. Advanced Engineering Mathematics (Second edition), Michael Greenberg.
2. Advanced Engineering Mathematics (Tenth Edition), Erwin Kreyszig.

REFERENCE BOOKS

1. Higher Engineering Mathematics, By Dr. B.S. Grewal. Publisher: Khanna, New Delhi.
2. Applied numerical methods with MATLAB for engineers and scientists, Steven C Chapra, third edition, Tata McGraw-hill edition.
3. Advanced engineering mathematics, RK Jain, SRK Iyengar, Narosa publishers, second edition.

COMPLEX VARIABLES & DISCRETE MATHEMATICS

Code:13BS202 **L –T – P: 3-0-0**

Prerequisite: Nil **Credits: 3**

Complex variables: Analyticity functions, Cauchy-Riemann equations in Cartesian and polar coordinates. Harmonic and conjugate harmonic functions, Milne – Thompson method. Line integral, Cauchy's integral theorem, Cauchy's integral formula, generalized integral formula. Expansion in Taylor's series, Maclaurin's series and Laurent series. Types of singularities. Residue, Cauchy's residue theorem, evaluation of integrals by using residues, bilinear transformation and its applications. (13)

Special functions: Bessel functions, recurrence relations for $J_n(x)$, orthogonality of Bessel functions, generating function for $J_n(x)$, integral form of Bessel's function, Jacobi's series, Legendre's equation, Rodrigues's formula, Legendre polynomials, generating function for $P_n(x)$, recurrence relation for $P_n(x)$, orthogonality of Legendre polynomials. (10)

Difference equations: introduction, definition, difference equation of first and second order, formation of difference equation, linear difference equation, rules for finding C.F and P.I, Simultaneous difference equation with constant coefficients, application to deflection of a loaded string.(9)

Graph theory: Basic Concepts of Graphs, Sub graphs, Matrix Representation of Graphs: Adjacency Matrices, Incidence Matrices, Isomorphic Graphs, Paths and Circuits, Eulerian and Hamiltonian Graphs, multi-graphs, (Problems and Theorems without proofs) ,Planar Graphs, Euler's Formula, Graph Colouring and Covering, Chromatic Number,(Problems and Theorems without proofs)Trees, Directed trees, Binary Trees, Decision Trees,Spanning Trees: Properties, Algorithms for Spanning trees and Minimum Spanning Tree.(13)

TEXT BOOKS

1. Advanced Engineering Mathematics (Tenth Edition), Erwin Kreyszig.
2. Discrete Mathematical Structures with Applications to computer science J.P Tremblery, R.Manohar, TMH
3. Discrete Mathematical for computer Scientists & Mathematicians " J.L. Molt, A.Kandel T.P.Baker, PHI

REFERENCE BOOKS

1. Higher Engineering Mathematics, By Dr. B.S. Grewal. Publisher: Khanna, New Delhi.
2. Discrete Mathematics, Malik, Sen, 6th ed., Cengage Learning, 2004
3. Discrete Mathematics for computer science, Bogart, Stein and Drysdale, Springer, 2005

COMPELX VARIABLES AND FINITE DIFFERENCE METHODS

Code:13BS203 **L –T – P: 3-0-0**

Prerequisite: Nil **Credits: 3**

Complex variables: Analyticity functions, Cauchy-Riemann equations in Cartesian and polar coordinates. Harmonic and conjugate harmonic functions, Milne – Thompson method. Line integral, Cauchy's integral theorem, Cauchy's integral formula, generalized integral formula. Expansion in Taylor's series, Maclaurin's series and Laurent series. Types of singularities. Residue, Cauchy's residue theorem, evaluation of integrals by using residues, bilinear transformation and its applications. Special functions: Bessel functions, recurrence relations for Jn(x), orthogonality of Bessel functions, generating function for Jn(x), integral form of Bessel's function, Jacobi's series, Legendre's equation, Rodrigues's formula, Legendre polynomials, generating function for Pn(x), recurrence relation for Pn(x), orthogonality of Legendre polynomials.

Finite Difference Method: boundary value problems, numerical solutions of second order linear PDEs, finite difference approximations of partial derivatives, elliptic equations-Laplace and Poisson's equations(two dimension), parabolic equations-heat equation (one dimension), hyperbolic equation- wave equation (one dimension).

Text Books:

1. Advanced Engineering Mathematics (Tenth Edition), Erwin Kreyszig.
2. Discrete Mathematical Structures with Applications to computer science J.P Tremblery, R.Manohar, TMH
3. Discrete Mathematical for computer Scientists & Mathematicians " J.L. Molt, A.Kandel T.P.Baker, PHI

Reference Books:

1. Higher Engineering Mathematics, By Dr. B.S. Grewal. Publisher: Khanna, New Delhi.
2. Discrete Mathematics, Malik, Sen, 6th ed., Cengage Learning, 2004.
3. Discrete Mathematics for computer science, Bogart, Stein and Drysdale, Springer, 2005

DISCRETE MATHEMATICS

Code:13BS206 **L –T – P: 3-0-0**

Prerequisite: Nil **Credits: 3**

Foundations: Basics, Sets and Operations of Sets, Relations and Functions, Some methods of Proofs and Problem Solving Strategies, Fundamentals of Logic, Logical Inferences, Methods of Proof of an Implication, First order logic and Other methods of Proof, Rules of Inference for Quantified Propositions, Mathematical Induction. **Elementary Combinatorics:** Basics of Counting, Combinations and Permutations, Enumeration of Combinations and Permutations, Enumerating Combinations and Permutations with repetitions, Enumerating Permutations with constrained repetitions, Binomial Coefficients, The binomial and multinomial theorems, The principle of inclusion - exclusion. **Recurrence Relations:** Generating Functions of Sequences, Calculating Coefficients of Generating Functions, Recurrence Relations, Solving Recurrence relations by Substituting and Generating Functions, The Method of Characteristic Roots, Solution of Inhomogeneous Recurrence Relations **Relations and Digraphs:** Relations and Directed Graphs, Special Properties of Binary Relations, Equivalence Relations, Ordering Relations, Lattices, and Enumerations, Operations on Relations, Paths and Closures, Directed Graphs and Adjacency Matrices, **Applications:** Sorting and Searching, Topological Sorting. **Graphs:** Basic Concepts, Isomorphism's and Sub graphs, trees and their Properties, Spanning

Trees, Directed Trees, Binary trees, Planar Graphs, Euler's Formula, Multi graphs and Euler Circuits,Hamiltonian Graphs, Chromatic Numbers, The Four-Color Problem.

TEXT BOOKS:

1. Joe L. Mott, Abraham Kandel, Theodare P.Baker "Discrete mathematics for Computer Scientists and mathematicians" 2007, Second Edition, PHI,.

REFERENCES:

1. Kenneth H Rosen, "Discrete Mathematics and its Applications", 2007,Tata McGraw
1. Hill Publishing Company Limited, New Delhi, Sixth Edition,.
2. Tremblay J P and Manohar R, "Discrete Mathematical Structures with Applications to
3. Computer Science", 2007, Tata McGraw Hill Publishing Company Limited, New Delhi,

PROBABILITY AND STATISTICS

Code:13BS204 **L –T – P: 3-0-0**
Prerequisite: Nil **Credits: 3**

Descriptive Statistics: Frequency distribution, graphical presentation of data by histogram, frequency curve and cumulative frequency curves. Mean medium, mode and their simple properties (without derivation) and calculation of median by graphs, range, mean deviation, standard deviation and coefficient of variation.

Correlation and Regression: Bivariate data, simple correlation and regression coefficients and their relations. Limits of correlation coefficients, effect of change of origin and scale on correlation coefficient, linear regression and equations of line of regression.

Probability measure and sampling distributions: Random experiments, events exhaustive, mutually exclusive and equally likely. Definition of probability and probability measures, definitions and simple properties of binomial, Poisson and normal distributions and their inter relations. Concept of population and sample, random sample, methods of taking simple random sample. Sampling distributions of mean both σ known and σ unknown.

Statistical tests of hypothesis: Sampling distribution of mean and standard error, Large sample tests (Test for an assumed mean and equality of two population means with known SD). Small sample tests (t-test for an assumed mean and equality of means of two populations when sample observations are independent). Chi-square test –independence of attributes, goodness of fit.

Text Books:

1. Miller & Freund's, "Probability and Statistics for Engineers", Richard A Johnson, PHI, New Delhi, 11th Edition (2011).

Reference Books:

1. Fundamentals of Mathematical Statistics", S C Gupta and V K Kapoor, S Chand & Sons, New Delhi, 11th Edition
2. "Higher Engineering Mathematics", by Dr.B.S.Grewal, Khanna Publishers, 40th Edition, New Delhi.

ENGINEERING SCIENCES

PROBLEM SOLVING THROUGH PROGRAMMING

Code:13ES101 **L –T – P: 3-0-2**
Prerequisite: Nil **Credits: 4**

Scalar Types and Input/output: Character set, Declaration, Integer types, Boolean type, Character type, Pointer type, Real floating-Point types, The pointer type, Typedefs, Initialization, Introduction to formatted input and output: the printf(), scanf() function. **Operators and Expressions**: Assignment, Arithmetic operators, Implicit type conversions, Precedence and associativity of operators, Relational, Logical, Compound assignment, Increment and Decrement, Cast operators type conversions, size of operator, Conditional operators. Comma operator, bitwise operators. **Statements and Control Flow:** Flow charts for Algorithm Development, simple and compound statements, Null and Expression statements, Selection statements, Repetition statements, Jump statements. Pseudo code for Procedures and algorithm development. **Functions:** Function Definition, Function prototypes, calling functions, Standard C Header files and libraries, Mathematical functions, and Recursive functions. **Arrays:** Declaration of Arrays, How arrays are stored in memory, Initialization of arrays , Processing Data in Arrays, Passing Arrays to Functions, Introduction to Vectors and Matrices. **Pointers:** Pointer variables, pointer Arithmetic, calling functions by Reference using pointers, constant pointer, Relation between pointers and arrays, using pointers to pass One-Dimensional arrays to functions, Dynamic Allocation of Memory, Functions Returning pointers, Pointers to pointers, Array of pointers, Pointers to functions: Functions with arguments of pointers to functions, functions returning pointers to functions. Generic pointer for passing arguments with different data types, Pointer to arrays, Dynamic allocation of 2D arrays. **File Processing:** Opening and closing files, reading and writing sequential files and random access files. **Structures, Enumerations, Unions:** Structures, Enumerations, Unions**,** **Characters and Strings :** Character Code, Character input and output, character-Handling functions, Stings, string input and output, The continuation character, converting strings to numerical values, string manipulation: length, copy, append, compare. Searching strings. The main() function and command line arguments. **Formatted Input and Output**: Formatting output for functions in the printf() family: Printing Integers, Floating point Numbers, Characters and Strings. Formatting input for functions in the scanf() family: Input an Integer, floating point Number, Characters and Strings. **Storage classes**. Global and local variables, storage classes, External functions and variables **Preprocessing Directives:** Macro replacement, Predefined Macros, Source file inclusion, Conditional inclusion.

TEXT BOOKS

1. C forEngineers and Scientists – An Interpretive Approach byHarryH. Cheng, McGraw Hill InternationalEdition 2010.

REFERENCES

2. The C Programming Language: ANSI C Version 2nd Edition by Brian W. Kernighan, Dennis M. Ritchie, Prentice-Hall/Pearson Education, 2005
3. A Book on C: Programming in C (4th Edition) by Al Kelley, Ira Pohl, Pearson Education 2001.
4. Problem Solving and Program Design in C (6th Edition) by Jeri R. Hanly, Elliot B. Koffman, Pearson Education 2004.
5. A Structured Programming Approach Using C(3rd Edition) by Behrouz A. Forouzan, Richard F. Gilberg, West Pub., 1997.

MEASUREMENTS

Code:13ES102 **L –T – P: 3-0-2**

Prerequisite: Nil **Credits: 4**

Fundamentals of Measurements

Introduction, types of measurements, generalized measurement system with examples, static & dynamic characteristics of measurement system, types of Errors, error sources and remedies, statistical analysis of data, regression analysis (using excel) of data, distortion.

Electrical measurements

Fundamentals: Basic parameters like Current, Voltage, RMS value, Average value, Power, Power factor, Resistance, Impedance, Inductance, and Capacitance.

Transduction principles: Magnetic, Induction, Electrostatic, Thermoelectric, Hall Effect.

Measurements using: PMMC, Extension of range, Rectifier type, MI, EDM, Electrostatic, Thermocouple type, Wheatstone bridge, Anderson’s bridge, Maxwell’s and Schering Bridge.

Project ideas.

Electronic measurements

Fundamentals of Cathode Ray Oscilloscope:

Block diagram, CRO probes, Delay line, types of Oscilloscopes.

Measurement of: Signal voltage, Current, Phase & Frequency using Lissajous patterns, Industrial applications of CRO.

Electro-physiological measurements: Electrodes, ECG – EEG – EMG – ERG typical waveforms.

Project ideas.

Mechanical measurements

Fundamentals: Displacement, Velocity, Speed, Force, Moment, Torque, Stress, Strain, Pressure, Flow, Temperature, Viscosity, Humidity.

Measurement of:Displacement – Flapper-Nozzle technique, LVDT, Interferometer.

Speed – Tachometer, Magnetic & Photo pick up. Force & Torque – Load cells, Prony brake.

Stress & Strain – Mechanical Strain gauge, Resistance strain gauge. Pressure – Manometers, McLeod gauge, Bourdon pressure gauge. Flow – Notches, Orifice meter, Rotameter, Turbine meter, Hot-wire anemometer. Temperature – Thermometer, Thermocouples, Thermistors, Pyrometers.Viscosity – Psychrometers, Falling ball type, Rotating vane type. Humidity – Hygrometers.

Project ideas.

TEXT BOOKS/REFERENCES:

1. Experimental methods for engineers – JP Holman – 7e – TMH
2. Mechanical measurements – Thomas G Beckwith – 6e – Pearson
3. Introduction to Instrumentation and Measurements – Robert B Northrop – 2e – CRC Press
4. Measurements and Instrumentation principles – Alan S Morris
5. Hand Book of Bio-Medical instrumentation – R.S. Khandpur, TMH
6. A course in electrical & electronic measurements and instrumentation – AK Sawhney.

ENGINEERING MATERIALS

Code:13ES103	**L –T – P: 3-0-0**
Prerequisite: Nil	**Credits: 3**

Crystal Structure And Crystallography: Crystal lattice – primitive and unit cell – crystal systems – Bravais lattice – Miller indices – Structure of Crystal – Simple Cubic, Body Centered Cubic, Face centered Cubic and Hexagonal Close Packed structure. Sodium chloride structure, X ray Spectrum – Moseley's law – diffraction of X-rays by crystals – Bragg's law in one dimension – Experimental methods in X-ray diffraction – Laue's method, rotating crystal method – powder photograph method – point defects - line, surface and volume defects – effects of crystal imperfections, Applications.

Magnetic Properties Of Materials:Basic concepts – magnetic moment, susceptibility, permeability; Types of materials – Diamagnetic, paramagnetic, ferromagnetic, anti ferromagnetic and ferrimagnetic materials, Weiss theory of ferromagnetism, domain theory of ferro magnetism, Ferrites, Hysteresis effect; Soft and hard magnetic materials; Applications- Fabrication of transformers, motors, magnetic storage devices- magnetic memories, magnetic tapes, magnetic recorder, relays and sensors

Electrical Properties Of Materials: Introduction to electrical materials – Band theory of solids- conducting materials -Ohm's law, electrical conductivity, electrical resistivity –, semiconducting materials, types – properties and effects of impurities and temperature. Insulating materials –. Requirements of good insulating materials: Some insulating materials – glass, mica, ceramics, asbestos, resins, rubber, transformer oil. Introduction to Dielectric materials – Polar and non-polar dielectrics, Dielectric constant, Dielectric Polarization – electronic, ionic, orientation or dipolar and space charge polarizations(qualitative treatment), frequency and temperature dependence of polarization, ferro electricity- spontaneous polarization and structure of barium titanate .Piezo electricity & Piezo electric materials- applications.

Mechanical And Thermal Properties Of Metals: Definitions – elasticity, plasticity, Stress, strain, strength, hardness, brittleness, ductility, creep, fatigue, fracture, and toughness. Relationship between stress and strain; Hardness – Hardness tests, Heat treatment processes (Tempering, Quenching Nitriding, Hardening), specific heat and thermal conductivity.

Micro And Nano Materials: Agile materials for microwave components, Terahertz meta materials and its applications (Radar Sensors, and Future wireless communications), Basic concepts of Nano Science and technology, Size effects of materials, Nano materials classification and Properties, Nano material preparation by sol-gel method and Chemical Vapor Deposition method..Introduction to Carbon nano tubes (CNT's), Synthesis of CNT's by bottom up Approach, Properties of Carbon nano tubes and their applications in science and techno technology.

BOOKS

1.Materials Science and Engineering by Callister, WILEY Publishers(2008)

2.Introduction to Solid State Physics – C.Kittel, John Wiley(2004)

3.Materials Science for Engineering Students-FISCHER,,Elsevier Publishing.USA

REFERENCE BOOKS:

1.Material Science by V.Raghavan (TMH)

2.Solid State Physics, 6th Edition, S.O.Pillai, New age International Publishers

3.Material Science – M. Arumugam, Anuradha Agencies, (2004)

4.Solid State Physics – A.J.Deckker(2004)

ENGINEERING GRAPHICS WITH CAD

Code:11ES104 **L –T – P: 0-0-4**
Prerequisite: Nil **Credits: 2**

Introduction to Computer Aided Drafting, AutoCAD Commands,Types of lines, Dimensioning, Theory of Projection – Elements of projection, planes of projection, methods of projection.

Projection of Points and Straight Lines – Projection of points,projections of straight lines, various positions of straight lines w.r.t. reference planes, traces of lines.

Projection of Planes – Types of planes, projection of planes, various positions of planes w.r.t reference palnes (Use First angle method of projection)

Projection of Solids – Types of solids, projection of solids in simple position, projection of solids with axis inclined to one reference plane and parallel to other. (Use First angle method of projection)

Orthographic Projection –Introduction to Orthographic projections,types of surfaces, invisible lines, precedence of lines, steps to draw orthographic views, orthographic projection of different objects. (Use First angle method of projection)

Isometric projection – Theory of isometric projection, isometric view, isometric views from orthographic views for simple objects. (Use First angle method of projection)

BOOKS:

Notes will be made available

REFERENCE BOOKS

1. Engineering Drawing by N.D.Bhatt
2. Engineering Drawing with an introduction to AutoCAD by Dhananjay A Jolhe,Tata McGraw-Hill Publishing company limited
3. Engineering Graphics with AutoCAD by D. M. Kulkarni, A. P. Rastogi and A.K.Sarkar; PHI Learning Private Limited, New Delhi, 2009.

WORKSHOP PRACTICE

Code:13ES105 **L –T – P: 0-0-4**

Prerequisite: Nil **Credits: 2**

General Introduction, Safety rules and regulations, First aid practice

MODULE -1:

CARPENTRY - Hands on practice on wood working operation using hand tools

FITTING - Hands on practice on preparing fits.

TIN SMITHY- Hands on practice on sheet metal working.

FOUNDARY - Hands on practice on moulding by preparing a sand mould

BASIC ELECTRONICS- Hands on practice on Soldering by mounting electronic components on leg board and related experiments.

HOUSE WIRING- Hands on practice on House wiring connections

MODULE 2:

Demonstration on Power tools in construction, Wood working, Electrical and Mechanical Engineering practices.

MODULE -3:

Information technology covering hardware:

Task 1: Identify the peripherals of a computer components in a CPU and its functions

Task 2: Disassemble and assemble the PC back to working condition

Task 3: Loading of operating system**.**

TEXT BOOKS

1. K.L.U Workshop Practice Lab manual.
2. P.Kannaiah and K. L. Narayana "Engineering Practices Laboratory", 2009, SciTech Publications, Chennai.
3. Anfinson, David and Ken Quamme(2008), IT Essentials PC Hard ware and Software Companion Guide, CISCO Press, Pearson Education

REFERENCES

1. K. Venkata Reddy, "Workshop Practice Manual", Sixth edition, 2011 print, BS Publications, Hyderabad.
2. B S Nagendra Parashar and R K Mittal, "Elements of Manufacturing Process", 2010 print, Prentice Hall of India, New Delhi
3. Gupta , Vikas (2010),Comdex Information Technology Course Tool Kit – WILEY Dream tech
4. Chris Grover, Mathew MacDonald, E.A., Vander Veer, (2007), Micro soft Office 2007: The Missing Manual, O reilly Media.

ENGINEERING MECHANICS

Code:13ES106 **L –T – P: 3-0-2**

Prerequisite: Nil **Credits: 4**

Force systems: Introduction, Forces acting at a point, Moment of a force about a point and about an axis, Couple moment, General case of forces in a plane.

Equilibrium of force system: Free body diagram, Equilibrium of a two-force and three force body in a plane, Analysis of trusses by method of joints and sections.

Force systems in space **(**Vector approach), forces in space-Resultant

Friction: Laws of Coulomb friction, problems involving dry friction, wedge friction.

Properties of areas: Centroid and Centre of gravity, Moments of inertia of an area, polar moment of inertia, Mass moment of inertia.

Virtual work: Principle, Potential energy and equilibrium, stability.

General principles of Dynamics: Kinematics of Rectilinear, Curvilinear and Rotary motion of a particle.

Kinetics of Rectilinear, Curvilinear and Rotary motion of a rigid body in a plane.

D'Alembert's principle- Motion of the mass center, Momentum and Impulse, Work and energy methods, plane motion.

TEXT BOOKS:

1."Vector Mechanics for Engineers (in SI units) Statics & Dynamics" by F.P. Beer and E.R. Johnston – Mc Graw Hill Publications.

2."Engineering Mechanics Statics & Dynamics" by Singer – B S Publications.

3."Engineering Mechanics" by S.Timoshenko, D.H.Young, J.V.Rao McGraw hill companies. Fourth edition.

REFERENCE BOOK:

1."Engineering Mechanics Statics & Dynamics" by R.C.Hibbeler – Pearson Publications

THERMODYNAMICS

Code:13ES201 **L –T – P: 3-0-0**

Prerequisite: Nil **Credits: 3**

Fundamental Concepts and Definitions: Thermodynamic system and control volume, Macroscopic and Microscopic points of view. Thermodynamic properties, processes, state, path, cycle. Thermodynamic equilibrium and Quasi-static process. Reversible and Irreversible processes, Zeroth law, concept of temperature.

Work and Heat: Definition of work, units, work done at the moving boundary of system, work done in various non-flow processes, definition of heat, units, comparison of heat and work.

First Law for Non-Flow Systems: First law of thermodynamics for a closed system undergoing a cycle and for a change of state, energy-a property of system, internal energy and enthalpy. Specific heat at constant volume and constant pressure.PMM1 and Converse of PMM1.

First Law for Flow Systems: Control mass and control volume, First law of thermodynamics for a control volume, Steady flow energy equation and applications to engineering equipment.

Second Law of Thermodynamics: Thermal reservoirs, Kelvin-Plank and Clausius statements of second law of thermodynamics, Equivalence of Kelvin-Plank and Clausius statements, Carnot cycle, Reversed heat engine, Carnot's theorem, Corollary of Carnot's theorem, Absolute thermodynamic temperature scale, problems.

Entropy: Definition of entropy, Clausius theorem, entropy change in reversible process Temperature-entropy plot, Inequality of Clausius, entropy change in an irreversible process, principle of increase of entropy, Applications of entropy principle, entropy change of an ideal gas, Availability and Irreversibility.

Thermodynamic Relations: Maxwell's equations, TdS equations, Difference in heat capacities, Ratio of heat capacities, energy equation, Clausius - Clapeyron equation

Air standard cycles: Otto, Diesel, Dual and Brayton cycles- Performance evaluation and mean effective pressure, Reversed Carnot cycle and Bell Coleman cycle.

TEXT BOOKS

1. Thermodynamics, An Engineering Approach - Younus A Cengel & Michael Boles, (6E) Tata McGraw Hill, New Delhi.
2. Engineering Thermodynamics - P.K.Nag, (4E) Tata McGraw Hill, New Delhi.

REFERENCE BOOKS

1. Fundamentals of Thermodynamics - G.J. Van Wylen., Sonntag (6E), Wiley India publications.
2. Engineering Thermodynamics Coheand Rogers (5 E)-Pearson education India limited.
3. Heat and Thermodynamics - Zemansky, Mc Graw Hill (5E).

OBJECT ORIENTED PROGRAMMING

Code:13ES202 **L –T – P: 3-0-2**
Prerequisite13ES101 **Credits: 4**

(for ECE , ECM and CSE): (for others see below)

Overview of C: Origins of C++, Object Oriented Concepts, Fundamentals of C++, Introduction to C++ Classes,Inheritance, Polymorphism- Function overloading, Operator overloading, Constructors, Destructors. Classes & Objects: Classes vs. Structures, Classes vs. Unions, Friend functions, Friend Classes, Inline functions, Parameterized Constructors, Static Class Members, Scope Resolution Operator, Passing Objects to Functions, Returning Objects, Object assignment. Array of Objects, Pointers to objects, this Pointer, References: Reference parameters, passing references to objects, returning references, independent references, references to derived types, restrictions to references. Dynamic Memory Allocation Operators: initializing allocated memory, allocating arrays, allocating objects". Function Overloading, Overloading constructors, Copy Constructors, Finding the address of an overloaded function, Default Function Arguments, Function overloading & Ambiguity. Operator overloading: creating a member operator function, operator overloading using a friend function, Overloading new and delete, overloading some special Operators. Inheritance: Base class Access Control, inheritance & Protected Members, Inheriting Multiple Base classes, Constructors, Destructors and inheritance, Granting Access, Virtual Base Classes. Virtual Functions and polymorphism, Virtual Attributes, Hierarchical Virtual Function, Pure Virtual Functions, Using Virtual Functions, Early vs. Late binding. Templates: Generic Functions, Applying Generic Functions, Generic Classes. Exception Handling: Fundamentals, options, Un-caught exception function, applying exception handling. I/O System Basics: C++ streams, Stream classes, Formatted I/O, Creating user defined inserter and extractors, Creating user defined manipulator functions. File I/O: Reading & writing Text Files, Unformatted and Binary I/O, Random Access, I/O Status. Run-Time Type Identification, Casting Operators, dynamic cast. Namespaces: fundamentals, using, the std namespace, Conversion Functions, const Member Functions and mutable, Volatile Member Functions, Explicit Constructors, Using the ASM Keyword, Linkage Specification. String Class: String Member Functions, Searching Strings, Comparing Strings. STL: Introduction, Containers, Algorithms, Iterators.

Text Book:

1. C++ The Complete Reference by Herbert Schildt, 4thedition,Reference Books:
2. The C++ Programming Language by Bjarne Stroustrup, Addison-Wesley Professional; 4th edition, 2012.
3. C++ How to Program by Deitel HM and Deitel PJ., 9th edition, PHI.
4. Object-Oriented Programming in C++ by Robert Lafore, 4th edition, Sams Publishing, 2001
5. Object-Oriented Programming using C++ by Joyce Farrell, 2008
6. A Complete Guide to Programming in C++, Ulla Kirch-Prinz, Peter Prinz, Jones & Bartlett
7. Big C++, Horstmann,John Wiley,2006.

(for all B.Tech except CSE,ECE and ECM of 2013 batch and for all B.Tech of 2014 batch):

Introduction: Object-Oriented Programming, OOP Principles, Encapsulation, Inheritance and Polymorphism Java as a OOPs & Internet Enabled language, The Byte code, Data types, Variables, Dynamic initialization, scope and life time of variables, Arrays, Operators, Control statements, Type Conversion and Casting, Compiling and running of simple Java program. Classes and Objects: Concepts of classes and objects, Declaring objects, Assigning Object Reference Variables, Methods, Constructors, Access Control, Garbage Collection, Usage of static with data and methods, usage of final with data, Overloading methods and constructors, parameter passing - call by value, recursion, Nested classes. Inheritance: Inheritance Basics, member access rules, Usage of super key word, forms of inheritance, Method Overriding, Abstract classes, Dynamic method dispatch, Using final with inheritance, The Object class. Packages and Interfaces: Packages, Classpath, Importing packages, differences between classes and interfaces, Implementing & Applying interface. I/O Streams- file, byte streams, character streams, Exception

Handling: Exception Handling fundamentals, Types of Exceptions, Usage of try and catch, throw, throws and finally keywords, Introduction to Multithreading.

Text books:

1. Herbert Schildt, "The Complete Reference Java2", 5th edition TMH, 2002.
2. Timothy A. Budd, "An Introduction to Object-Oriented Programming", 3/E, Pearson, 2008.

NETWORK THEORY

Code:13ES203 **L –T – P: 3-0-2**

Prerequisite: Nil **Credits: 4**

Circuit Concept, R, L, C parameters, concept of mutual inductance, dot convention, coefficient of coupling, voltage and current sources, source transformation, specifications of Active and Passive elements, voltage – current relationship for passive elements Kirchoff's Laws, Response of R-L, R-C, R-L-C (Series and parallel combinations) for impulse, step, ramp excitations, Magnetic Circuits – Analysis of series and parallel magnetic circuits AC Circuits: RMS and average values and form factor of different periodic wave forms (Sinusoidal, rectangular, triangle and sawtooth), steady state analysis of R, L and C (in series, parallel and series parallel combinations) with sinusoidal excitation, concept of reactance, impedance, susceptance and Admittance, Phase and Phase difference, concept of power factor, Real and Reactive powers, j-notation, complex and polar forms of representations, complex power Series and parallel resonance, bandwidth, selectivity, Q factor, current locus diagrams Three phase circuits: phase sequence, star and delta connection, Relation between line and phase voltages and currents in balanced systems, Analysis of balanced and unbalanced 3 phase circuits, star/delta transformation Network topology: definitions, graph, tree, basic cut-set and basic tie set matrices for planar network, Loop and Nodal methods of analysis of networks (including coupled circuits), duality and dual networks. Network theorems: (without proof): Superposition, Reciprocity, Thevinin's, Norton's, Maximum power transfer. Application to steady state analysis, network functions, driving point and transfer functions –poles and Zeros one port and two port networks Two port network parameters: Z, Y, Transmission and Hybrid parameters and their relationships Transient response of R-L, R-C, R-L-C circuits (Series and parallel combinations) for D.C and sinusoidal excitations, initial conditions, time domain and Laplace transform methods of solutions.

TEXT BOOKS

1. M. E. Van Valkenberg, "Network Analysis", Prentice-Hall of India Pvt. Ltd., 3rd edition, 1998
2. William Hayt and jack E. Kemmerly, "Engineering circuit analysis" Tata Mc Graw-Hill Companies, 5th edition.

REFERENCE BOOKS

1. Charles K Alexander, Mathew N O Sadiku, "Fundamentals of Electric Circuits", Tata McGraw Hill Education Pvt. Ltd., Third Edition.
2. D. Roy Choudhury, "Networks and Systems", New Age International Limited Publishers,
3. J. Edminister & M. Nahvi, "Electric circuits", Schaum's outlines Tata Mc Graw Hill Publishing Company Ltd., 1999.
4. Mohd. H. Rashid, "Spice for circuits & Electronics using PSPICE", Prentice-Hall of India, 2nd edition.

DATA STRUCTURES

Code:13ES204 **L –T – P: 3-0-2**

Prerequisite: 13ES101 **Credits: 4**

Algorithm Analysis: Mathematical Background, Model, Analyze, Running Time Calculations, Lists**.** **Stacks and Queues:** Abstract Data Types (ADTs), The List ADT, Implementation of list, The Stack ADT, The Queue ADT. **Trees:** Preliminaries, Binary Trees, The Search Tree ADT—Binary Search Trees, AVL Trees, Splay Trees, Tree Traversals (Revisited), B-Trees-INSERTIONS **Hashing:** General Idea, Hash Function, Separate Chaining, Hash Tables without Linked Lists, Rehashing. **Priority**

Queues (Heaps): Model, Binary Heap, Applications of Priority Queues. **Sorting:** Preliminaries, Insertion Sort, A Lower Bound for Simple Sorting Algorithms, Shell sort, Heap sort, Merge sort, Quick sort, Bucket Sort, External Sorting. **Graph Algorithms:** Definitions, Topological Sort.

Text Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2008 , Third Edition, Pearson Education.

Reference Books:

1. A.V.Aho, J. E. Hopcroft, And J. D. Ullman, "Data Structures And Algorithms", Pearson Education, First Edition Reprint 2003.
2. Horowitz, Sahni, Anderson Freed, "Fundamentals of datastructures in C" , Second Edition-2007.
3. R. F. Gilberg, B. A. Forouzan, "Data Structures", Second Edition, Thomson India Ed ition, 2005
4. Robert Kruse, C.L. Tondo, Bruce Leung, Shashi Mogalla, "Data Structures & Program Design in C", Fourth Edition-2007.
5. Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenebaum, "Data Structures using C & C++ " , Second Edition-1995.
6. Michael T.Goodrich,Roberto Tamassia, David M. Mount, Data Structures and algorithms in C++,2nd edition,John Wiley,2011.

SIGNAL PROCESSING

Code:13ES205 **L –T – P: 3-0-2** **Prerequisite: Nil** **Credits: 4**

Introduction to Discrete Time (DT) Sequences and Systems: Introduction to Signal processing: Elements of Continuous Time and Digital Signal Processing systems. Advantages of DSP systems over Analog processing systems.**Sampling and Reconstruction:** Graphical and analytical proof of sampling theorem. Reconstruction of signal from its samples.Flat Top Sampling, Effect of under sampling-Aliasing.Sampling of Band-pass Signals. **DT Sequences:** Representation of DT sequences, some elementary DT sequences, Classification of discrete time sequences and Elementary manipulation of DT sequences. **DT Systems:** Input-output Description of Systems, Classification of DT systems: Linearity, Static, Time-Invariant, Causality and Stability of systems. Interconnection of DT system. **Analysis of LTI Systems: Analysis of Discrete-Time Linear Time-Invariant (LTI) Systems:** Response of LTI systems to arbitrary inputs:The Convolution Sum. Properties of Convolution, Causality and Stability of LTI systems in terms of impulse response. **Frequency domain representation of discrete time signals and systems:** Discrete Time Fourier Transform (DTFT) and its Properties. **Review of Z-transforms**, System Function, Impulse Response, Causality and Stability of LTI systems in terms of System Function. **Applications of Z.Transforms**: Solutions of Linear Constant Coefficient Difference Equations. **Power and EnergyDensity Spectrum** Relations of LTI systems (both in continuous and discrete) **Fourier Transformation of Discrete Time Sequences: Discrete Fourier Series (DFS):** Introduction to DFS, DFS representation of periodic sequences. Properties of discrete Fourier Series. **Discrete Fourier Transforms (DFT):** Introduction to DFT, Properties of DFT, Circular convolution Linear convolution using DFT, Computation of DFT. Relation between Z-Transform and DFS. **Fast Fourier Transforms (FFT):** Introduction to FFT - Radix-2 Decimation in Time (DIT) and Decimation in Frequency (DIF) FFT Algorithms, Inverse FFT using direct FFT. **Design and Realization of Digital IIR Filters: Digital Filter-IIR Design:** Introduction, properties of IIR filters, Normalized Butterworth and Chebyshev Functions. Design of Digital filters using Bilinear Transformation, Impulse invariance and Step Invariance Transformation Methods, Frequency Transformation in Analog and Digital Domains.**Realization of IIR system structures:** Basic Elements of Digital Systems, Realization of Direct form structures, Cascade form Structures and Parallel form structures. **Design and Realization of Digital FIR Filters: Digital Filter-FIR Design:** Introduction, Characteristics of Linear Phase FIR filters, frequency Response, Designing FIR filters using Windowing Methods. Frequency

Sampling Method, Comparison of IIR & FIR Filters. **Realization of FIR system structures:** Realization ofDirect Form, Transposed Direct Form, Direct form for Linear-Phase FIR systems and Cascade Form structures.

TEXT BOOKS

1.John G Proakis, Dimtris G Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Pearson Education.
2. Ludeman" Fundamentals of Digital Signal Processing", Wiley India Pvt. Ltd.

REFERENCE TEXT BOOKS

1.Alan V Oppenherim, Ronald W Schafer, John R Back, Discrete Time Signal Processing, Pearson Education, 2nd Edition.
2.Emmanuel C Ifechor, Digital Signal Processing, Pearson Education, 2nd Edition.
3.Andreas Antonious, " Digital Signal Processing , Signals, Systems and Filters " Mc-Graw Hill,
4.Dimitris G. Manolakis, Vinay K. Ingle, "Applied Digital Signal Processing : Theory and practice", Cambridge University Press
5. Kumar, A. Anand, "Digital Signal Processing", PHI.

SIMULATION TEXT BOOKS

1. Vinay . Ingle, John G Proakis, "Digital Signal Processing Using Matlab" ,Pearson
2. Paul Tobin, "Pspice for Digital Signal Processing", Morgan & ClayPool.
3. Nasser Kehtarnavaz, Namjin Kim, "Digital Signal Processing System Level Design using LabVIEW", Elsevier.
4. E. S. Gopi, "Mathematical Summary for Digital Signal Processing Applications with Matlab", Springer
5. Forester W. Isen, "DSP for MATLAB™ and LabVIEW Volume III Digital Filter Design", Morgan & Clay Pool
6. Robert J. Schilling,Sandra L. Harris,"Fundamentals of Digital Signal Processing Using MATLAB, 2e ",Cengage Learning
7. Samuel D. Stearns, Don R. Hush,"Digital Signal Processing with Examples in MATLAB, 2e ",CRC Press, Inc.

BIOCHEMICAL THERMODYNAMICS

Code: 13ES206 L –T – P: 3-1-0
Prerequisite: 13 ES 101 Credits: 4

Basic concepts -Systems and Processes, Homogeneous and Heterogeneous systems, Closed and Open systems, intensive and extensive properties state & n path functions, equilibrium state and phase rule, zeroth law of thermodynamics, heat reservoirs & heat engines reversible & irreversible process, internal energy enthalpy first law of thermodynamics and its limitations, P.V.T. Behavior of pure fluids, equation of state, Joule Thomson coefficient. Processes involving ideal gasses: constant Volume process, adiabatic process, polytropic process. Equation of state for real gases: Van der equation, redlich-kwong equation, redlick kwong-soave equation, virial equation. Second law of thermodynamics -General statement of II Law of thermodynamics, entropy & Heat, entropy &Temperature, the carnot principle, calculation of entropy changes, process involving ideal gases, adiabatic mixing process, Applications of the law of thermodynamics: Flow processes continuity equation, energy equation, Bernoulli's equation, steam ejector, Joule-Thomson expansion, refrigeration, coefficient of performance, Carnot cycle and limitations, liquefaction process, Linde process for gas liquefaction. Thermodynamic properties of fluids -Classification, work function, Gibbs free energy, fundamental property relations, Maxwells equations Classics-Clapeyson equation, entropy-heat capacity relationships, Fugacity, standard state of Fugacity, fugacity coefficient, effect of temperature & pressure on fugacity,. Activity, effect of temp and pressure on activity. Properties of solutions: Partial molar properties and properties of solution, chemical potential, effect of temp & pressure on chemical potential fugacity in solutions, Lewis randall rule, Henry's law and dilute solutions, activity in solutions, activity coefficient, effect of pressure and temperature on activity coefficient. Phase equilibria -Criteria of phase equilibrium, phase equilibria in single and multi component systems, phase rule for non reacting systems, VLE, phase diagram for binary solutions, equilibrium diagrams, constant temperature equilibrium, Non-ideal solutions: Azeotrope, minimum & maximum B.P. azeotropes; Liquid-liquid equilibrium diagrams-binary liquid-liquid equilibria, Chemical reactions equilibria: Reaction stoichiometry, reaction coordination, criteria of chemical reaction equilibrium, equilibrium constant, equilibrium constant and standard free energy change, effect of temperature on equilibrium constant, Biochemical thermodynamics-Stoichiometry and energetic analysis of Cell Growth and Product Formation. Elemental balances, degrees of reduction of substrate and biomass, available electron balances, yield Coefficients of biomass and Product formation , Maximum possible yield. Thermodynamics of microbial growth.

Text books:

1. K.V.Narayanan," A text book of chemical engineering thermodynamics", edition, Phi learning (2009)
2. J.M.Smith, H.C.Vanness & Abbott, "Introduction to chemical engineering Thermodynamics", edition, Mcgraw Hill Higher Education (2001-05-01)

Reference books:

1. Vern Schramm,"Methods In Enzymology, Volume 308 - Enzyme Kinetics And Mechanisms, Part E, Energetics Of Enzyme Catalysis, (Hardcover) ", Publisher: Elsevier (1999).

BIOMEDICAL SIGNALS AND SYSTEMS

Course Code: 13 ES 207 L – T – P: 3 – 2 – 0
PREREQUISITE : NIL CREDITS: 4

Signals and systems: Continuous time (CT) signals, Discrete time (DT) signals, periodic, periodic, random, energy and power signals, step, ramp, impulse and exponential function, Transformation in independent variable of signals: time scaling, time shifting and time inverting, classification and properties of systems, LTI systems - convolution and stability, physiological signals and their properties, Time invariant and time varying physiological systems.Signal analysis: Basic concepts and development of the Fourier Series, Determination of the Fourier series representation of Continuous and Discrete time periodic signal, Properties of continuous and discrete time Fourier series, Continuous Time Fourier Transform (CTFT) and Discrete Time Fourier Transform (DTFT), ECG signal analysis. Sampling Theorem and Z-Transforms: Representation of continuous time signals by its sample, Sampling theorem, Reconstruction of a Signal from its samples, aliasing, Basic principles of z-transform, z-transform definition, Properties of z-transform, Poles and Zeros, inverse z-transform.Noise and Feed Back System:: Sources and types of noise, noise factor and temperature, equivalent noise resistance and noise factor in cascade amplifier, Basic Feedback concept, Positive and Negative Feedback, Sensitivity analysis, Effect of Feedback on disturbance or Noise, Distortion analysis by Feed Back, Control system, Open loop Control System, Control system With Feed Back, Application of feed back in physiological systems and its importance. Physiological System: Block diagram representation of cardio vascular system, Electrical circuit model of Blood Pressure, Electrical analog of blood vessels and its transfer function, model of coronary circulation ant its analysis, Germ, Plasma cell, Antibody, system equation and transfer function. Application of feedback and block diagram reduction techniques.

Text Books:

1. Signals and systems, A. Anand Kumar.
2. Introduction to Biomedical Signals and systems, James M.Jay.

Reference Books:

1. Biomedical Signals and systems, Michael L.Shuler Fikret Kargi

PROFESSIONAL CORE COURSES
OFFERED BY BIOTECHNOLOGY
BIOCHEMISTRY

Course Code: 13BT 201 **L – T – P: 3-0-2**
Prerequisite: Nil **Credits: 4**

Carbohydrates: Classification, structure and functions of Monosaccharides (Ribose, Glucose, And Fructose), Disaccharides (Maltose, Lactose and Sucrose) Polysaccharides (Starch, Cellulose and Glycogen) and Heteropolysaccharides . **AMINO ACIDS & Proteins;:** Classification and structures of standard amino acids, Physical properties of amino acids. **PROTEINS**: Classification, physicochemical properties, Physical Synthesis of Peptides (solid phase peptide synthesis) Primary, secondary, tertiary and quaternary structure and proteins. **LIPIDS**: Classification, abundance in microbial systems. Structure and physico-chemical properties of triglycerides, phospholipids and cholesterol. **NUCLEIC ACIDS:** Structure, properties and functions of purines, pyramidines, nucleotides and nucleic acids. Types of DNA and RNA. **Enzymes and Metabolism:** Introduction, IUBN Classification, Basic metabolic pathways; glycolysis, Krebs cycle**, ETC,** Beta oxidation of fatty acids and cholesterol metabolism. **Vitamins and coenzymes**: Chemical name, Structure, physiological role and deficiency symptoms of fat soluble and water soluble Vitamins (B_1, B_2, B_3, B_6, B_{12} and C.)

Recommended Text Books:

1) Principles of Biochemistry by A L Lehninger, Nelson & Cox, CBS publications
2) Biochemistry by U. Satyanarayana, Allied and Books Pvt. Ltd. Kolkata

Recommended References:

1) Harpers Biochemistry 25th edition 2000 Mc Graw Hill

LAB

1. Qualitative analysis of carbohydrates
2. Qualitative analysis of amino acids
3. Qualitative analysis of Proteins
4. Qualitative analysis of Lipids
5. Qualitative tests for Nucleic acids (Molisch, Bial's, Ammonium Molybdate and Sulfuric acid test)
6. Estimation of reducing sugar I biological samples by Anthrone and DNS method .
7. Estimation of free amino acids by Ninhydrin method.
8. Estimation of Proteins by Biuret. Lowry's and Bradford method
9. Estimation of DNA by Diphenylamine (DPA) method.
10. Estimation of RNA by Orcinol method.
11. Isolation of Casein from Milk and protein from albumin.
12. Determination of enzyme activity, determination of Km and V max

Group Experiments:

1. Determination of Iodine Number, Acid value and Saponification value of Fat.
2. Estimation of Phosphorous in biological materials.
3. Estimation of Calcium in serum in given biological materials.

Recommended laboratory manuals:

1. David T Plummer, Practical Biochemistry, Tata Mc Graw Hill Publication.
2. Harold Varley. Clinical Biochemistry, CBS Publishers.
3. Practical Biochemistry by J Jayaraman, New Age international Pvt Ltd.

MICROBIOLOGY

Course Code: 13BT 202 **L –T – P: 3-0-2**

Prerequisite: Nil **Credits: 4**

HISTORY AND CLASSIFICATION OF MICRO ORGANISMS Discovery of microorganisms;Theory of spontaneous generation, Germ theory of disease; Microbial taxonomy and diversity: Bacteria and their broad classification - Major characteristics used in taxonomy. Major contributors in field of Microbiology - Antony van leeuwenhoeks; Louis Pasteur; Robert Koch; Edward Jenner; Joseph Lister; Winogradsky; Beijerinck. Microscope- Simple, Compound and Fluorescence. **MORPHOLOGY & CELL STRUCTURE OF MICROORGANISMS** Ultra structure of bacteria, cell wall, flagella, pili, capsule, endospore and cell inclusions. Viruses – Chemistry & Morphology (size, shape and symmetry), replication of viruses, lytic and lysogenic cycles. Yeasts & Molds – Morphology, life cycle, economic importance of fungi (Eg. Aspergillus). Identification based on shape, staining reactions (Differential stain, Acid fast, capsule staining, Endospore staining). **GROWTH KINETICS OF MICROORGANISMS, Bacterial nutrition-** Nutritional classification of bacteria,Essential Macronutrients, Micronutrients and Growth factors. Microbial growth – Growth curve and factors affecting the growth – solutes, water activity, pH, Temperature, Oxygen concentration, Osmotic pressure, Radiation. Bacterial growth; synchronous growth and methods of growth estimation. One step growth curve, Physiology of Archaebacteria – thermophiles, psychrophiles, halophiles and methanogens.**GROWTH MEDIA AND CONTROL OF MICROORGANISMS**Culture media - synthetic and complex media, solidifying agents, types of media. Isolation of pure cultures - spread, pour and streak plate methods; Maintenance and Preservation of microorganisms. Control of microorganisms – Sterilization and disinfection, effects of physical (moist and dry heat, radiation and filtration) and chemical agents. Antibiotics – classification, mode of action and resistance. **MEDICAL MICROBIOLOGY** Disease reservoirs; Respiratory infections caused by bacteria and viruses, (tuberculosis); Disease transmitted by animals (rabies) and insects (malaria); Food and water-borne diseases (cholera); pathogenic fungi, Viriods& Prions.

Recommended Texts books:

1. Pelczar MJ, Chan ECS & Krieg NR, Microbiology Tata McGraw Hill.
2. Prescott & Dunn by General Microbiology- McGraw Hill publishers.

References Books:

1. C.B.Power. General Microbiology Vol I & II
2. Brock, Biology of microorganisms Prentice Hall Int.Inc.

LAB

1. Calibration of microscope and Identification of Animal, Plant and Bacterial cells
2. Sterilization techniques for preparation of pure culture media for cultivation of microorganisms and validation of proof.
3. Preparation of culture media nutrient broth and nutrient media and preparation of slants.
4. Culturing of Microorganisms on slants and nutrient broth.
5. Isolation of Bacterial culture using streak and pour plate methods
6. Identification of Microorganisms
   (a) Simple Staining technique
   (b) Differential staining testing
7. Microbiological Examination of water
8. A qualitative microbiological analysis for determining the quality of MILK
9. Characterization of bacterial strain by Biochemical tests –
   i. IMViC Test,
   ii. Catalase test,
   iii. Coagulase test,
   iv. Gelatinase test,
   v. Oxidase test.
10. Determination of bacterial growth.
11. Determination Zone of inhibition of an antibiotic by cup method.
12. Determination of MIC of any two antibiotics on same bacteria.

Recommended practical manuals:

1. Benson, Microbiological and applications, Laboratory, manual in general microbiology, Mc Graw Publications.
2. P. Gunasekharan, Laboratory manual in microbiology , New age international Publishers.

PROCESS ENGINEERING PRINCIPLES

Course Code: 13BBT203 **L –T – P: 3-1-0**
Prerequisite: Nil **Credits: 4**

Introduction to Engineering Calculations: Physical variables; dimensions and Units; Measurement conventions: Density, specific gravity; specific volume, mole, chemical composition, vapor pressures, concentration, Stiochiometry .composition of mixtures and solutions: molarity, molality, normality, weight fractions, mole fractions ,volumetric composition laws of chemical combination **Ideal gases** Ideal gas law ,differences between ideal and real gases, application of ideal gas law, Daltons law of additive pressures, amagats law of additive volumes, volume changes with change in composition, pure component volume method, partial pressure method, gases in chemical reactions. **Material balances** Introduction to system and process; difference between steady state and equilibrium, Law of conservation of mass: Types of material balances, Procedure for material balance calculations with and without chemical reactions, yield, conversion, limiting and excess reactants. E**nergy balances** Basic Energy concepts: law of conservation of energy, standard heat of formation, standard heat of reaction. latent heat of vaporization and condensation, specific heat, sensible heat of formation ,heat of reaction, heat of combustion Hess's law, effect of temperature and pressure on heat of reaction, kirchooff's law; **Material and energy balances in cell culture.** Material balance for continuous filtration, batch mixing, material balances with recycle, by pass and purge streams. Energy balance worked examples without reaction: cooling in downstream processing, continuous water heater, and fermentation energy balance.

Text Books

1) Bioprocess Engineering Principles, Pauline M.Doran, ELSEVIER publications.
2) Introduction to Biochemical Engineering, D G Rao, Mc Graw Hill publications.

Reference books

1) Bioprocess Engineering, basic concepts, Michael L.Shuler Fikret Kar

BIOANALYTICAL TECHINIQUES

Course Code: 13BT 204 **L –T – P: 3-0-2**
Prerequisite: NIL **Credits: 4**

CENTRIFUGATION Centrifugation – Basic principles (sedimentation, Sedimentation coefficient, Svedberg units) and types of rotors in centrifuges - Fixed angle rotor, Vertical rotor, Swing out rotor, Zonal rotors. Types of centrifuges – Ultra and Analytical centrifuges, Preparative and Density gradient centrifugations, Density gradients preparations – Sucrose, Cesium chloride. Determination of molecular weight and purity of macromolecules by centrifuges. **CHROMATOGRAPHY** Basic principle of chromatography - Partition chromatography, Counter Current distribution. Modes & Types of chromatography – Paper, TLC. Column Chromatography – Gel permeation, Ion exchange, Affinity chromatography, GLC, HPLC. **ELECTROPHORESIS** Electrophoresis: Principle of electrophoresis, Types of electrophoresis: Free Electrophoresis – Microelectrophoresis, Moving boundary; Zonal Electrophoresis – Paper, Cellulose Acetate, Starch gels, Agarose gels, SDS-PAGE. IEF (Isoelectric focusing), Pusle field gel electrophoresis (PFGE), 2-D gel electrophoresis, Capillary electrophoresis.**SPECTROSCOPY** Basic concepts of spectroscopy, Beer-Lamberts law, Colorimetry, Visible & UV Spectroscopy, Fluorescence spectroscopy, Flame photometry, Atomic absorption spectrophotometer, Infrared, FT-IR, NMR & Mass spectroscopy.**ISOTOPIC AND ELECTROCHEMICAL TECHNIQUES**Auto- radiography –

Principles and Applications of radioisotopes in biological sciences. Non- isotopic tracer techniques. Principles and range of electrochemical techniques – pH electrodes. Ion-selective, gas sensing electrodes and Oxygen electrodes, Immuno-histochemistry.

Recommended textbooks:

1. KeithWilson & John Walker, Principles & Techniques of Biochemistry and Molecular biology. Practical Biochemistry. Principles and Techniques. Keith Wilson & John, 1994, 5th ed. Cambridge University press
2. Biophysical Chemistry. Principles and Techniques. Uppadyay, Uppadyay & Nath 11th ed. Himalaya publishing house.

Reference Books:

1. Freifelder , Biophysical Chemistry. Freeman & Co.

LAB

1. The calibration of pH meter and measurement of pH for different solutions.
2. Preparation of buffers and adjustment of pH of buffer.
3. Estimation of Ascorbic acid by Titrimetry.
4. Estimation of unknown samples by using conductivity meter.
5. Verification of lambert-beers law by UV-VIS spectrophotometer.
6. Estimation of proteins & nucleic acids by U.V method.
7. Estimation of minerals by Flame photometry.
8. Estimation of Thiamine and Riboflavin by Fluorimetry.
9. The separation of different amino acids by Paper Chromatography.
10. The separation of Plant Pigments by Thin Layer Chromatography.
11. The separation of different blood proteins by Paper Electrophoresis.
12. The separation of known proteins by Native and SDS-PAGE.

Recommended practical manuals:

1. Boyer R, Modern Experimental Biochemistry (3rd Edition) - Pearson Education, 2000.
2. Sharma B.K, Instrumental Methods of Chemical Analysis (8th Edition), Gel Publishing House, 1999.

FLUID MECHANICS & HEAT TRANSFER

Course Code: 13BT301 **L –T – P: 3-0-2**

Prerequisite: Nil **Credits: 4**

BASIC CONCEPTS IN FLUID FLOW: Introduction, basic laws, nature of fluid, viscosity, shear stress, coefficient of viscosity, Newtonian and Non Newtonian fluids, Flow field, Reynolds experiment, Laminar and Turbulent; flow, fluid head, total energy balance for steady flow, Bernoulli's theorem, flow of a fluid past a solid surface. Friction losses in laminar flow through a circular tube (Hagen-Poiseulle equation) Friction losses in turbulent flow (Fanning equation).**TRANSPORTATION AND METERING OF FLUIDS: Manometers**: Simple, differential and inclined manometers. **Hydrodynamic methods**: Pitot tube, orifice and venturimeter, weirs, Rotameters. Centrifugal pump **PRINCIPLES OF STEADY STATE HEAT TRANSFER** Fourier's law of heat conduction, Thermal conductivity, convective HTC, conduction through a flat slab as wall, conduction through hollow cylinder, conduction through solids in series, plane walls in series, Log mean temperature difference and varying temperature drop. Introduction and basic equations for radiation. **HEAT EXCHANGE EQUIPMENT AND BASIC CONCEPTS IN EVAPORATION: Heat exchangers**: Types of exchanger's double-pipe heat exchanger shell & tube. **Evaporation**: Introduction, processing factors types of evaporation equipment and evaporation methods-general types of evaporators, methods of operation, overall heat transfer coefficients in evaporators. Heat and material balances for single-effect evaporator.

Evaporation of Biological materials – Introduction and properties of Biological materials, Fruit juices, sugar solutions, paper-pulp waste liquors. **DRYING OF PROCESS MATERIALS:** Equilibrium moisture content, Bound and unbound moisture, free moisture, rate of drying curves, drying rate curve for constant drying conditions, drying in the constant rate and falling rate periods, calculation methods for constant rate drying and falling rate drying periods.

Recommended Texts books:

1. S.K.Ghosal,S.K.Sanyal&S.Dutta.Introduction to Chemical Engineering
2. W.L.Badger and J.T.Banchero. Introduction to Chemical Engineering

Reference books:

1. Christie .J.Geankoplis. Transport processes and Unit operations
2. W.L.McCabe &J.C.Smith. Unit Operations in Chemical Engineering.

GENETIC ENGINEERING

Course Code: 13BT 302 **L –T – P: 3-0-2**
Prerequisite: Nil **Credits: 4**

Basics of Genetic Engineering Basic steps of gene cloning. Isolation & Purification of DNA & RNA. Enzymes used in cloning – Nucleases, Polymerases, Ligases, Transferases, DNases, RNases, Kinase, Phosphatase. Restriction Enzymes – Nomenclature, classification, uses, restriction sites, applications. Special DNA molecules – Linker, Adaptor, Polytailing. **Cloning Vehicles** Plasmids Vectors – Classification, Properties, pUC 18/19, pBR 322, Blue script vectors. Cosmid Vectors – essential features, strategies to generate genomic libraries. Chromosomal vectors: BAC's & YAC's. Phagemids – Insertional & Replacement; M13derived vectors. Expression vectors – pRT and pET vectors. Vectors for construction of cDNA libraries. **Polymerase Chain Reaction** PCR – History, Principle, Methodology, Applications, Primers, Designing of mutagenic primers. Identification of PCR products, Cloning of PCR products, Multiplex PCR, Anchored PCR, Asymmetric PCR, Nested PCR, Inverse PCR, fusion PCR , RAPD-PCR, RT-PCR, Hot Start PCR, Touch Down PCR and Real Time PCR. Genes to Clones Gene Transfer Techniques – Microinjection, Electroporation, Transformation, Particle bombardment, Macroinjection, Chemical methods. Screening of clones - Complementation method, genetic methods, Immunological methods, Hybridization methods. **Gene Technology** Sequencing of DNA by Maxam-Gilbert method and Sanger's method. RNA silencing, Molecular markers: RAPD, RFLP, AFLP. Restriction Mapping. Invitro mutagenesis - Site directed mutagenesis. Blotting Techniques – Southern, Northern & Western. Probe preparation, labeling and detection techniques (Phosphoimaging and Radioactive labeling). Applications of gene cloning in medicine and agriculture.

Recommended Textbooks:

1. Old R.W and Primrose S.B .1995. Principles of gene manipulation-An introduction to Genetic Engineering. 5th edition. Blackwell scientific publications. London.
2. Winnaker E.C. 1987. From genes to clones. Introduction to gene technology. VCH Publications.

Reference Books:

1. J.D.Watson Recombinant DNA (A short Course). W.H.Freeman (1983)
2. T.A Brown gene cloning and DNA analysis. Wiley Blackwell- Apr- 2010

LAB

1. Agarose Gel Electrophoresis.
2. Isolation & Visualization of plant genomic DNA.
3. Isolation & Visualization of plasmid DNA
4. Isolation of RNA from liver tissue.
5. Restriction digestion of DNA

6. Extraction of DNA from agarose gels.
7. SDS-PAGE analysis of proteins
8. Bacterial Transformation.
9. Amplification of DNA fragments by PCR.
10. Screening methods for recombinant clones.

Recommended laboratory manual:

1. Maniatis, Current protocols in Molecular biology; Wiley Publishers.

BIOINFORMATICS

Course Code:13BT 303 **L –T – P: 3-0-2**

Prerequisite: Nil **Credits: 4**

INTRODUCTION TO BIOINFORMATICS & DATABASES Need of Computers in Biotechnology Research- Biological Information on the web. Introduction to Biological databases - their Organization and management - Database search - Algorithms issues in database search - Information retrieval from Databases - Concepts of Data mining, data warehousing and Data integration. **SEQUENCE COMPARISIONS AND ALIGNMENTS** String similarity- Local, Global alignment; pair wise alignments – Dot plots, Dynamic Programming Methods, Heuristic methods - FASTA, BLAST; Amino acid substitution matrices- PAM and BLOSUM. **MULTIPLE SEQUENCE** Methods for Multiple sequence alignments- local and global multiple sequence alignment; Significance and applications of MSA- sequence comparisons- Profile analysis, Block analysis, pattern searching. **PHYLOGENETIC ANALYSIS** Origins of Molecular Phylogenetics; Methods of Phylogenetic analysis- Maximum Parsimony Maximum Likelihood and Distance based methods, Tree Evaluation, Problems in Phylogenetic Analysis, Automated Tools for Phylogenetic Analysis; **PROGRAMING USING PERL** Introduction to PERL. Programming basics, scalar, arrays and hashes. Control statements, I/O, Regular expressions, data formats, file handles, file tests. File and directory manipulations.

Recommended Texts:

1. Bioinformatics: A Machine learning approach – P. Baldi, S. Brunak, MIT press, 1988.
2. Bioinformatics: Methods and Applications- SC Rastogi, N Mendiratta & P Rastogi

Recommended References:

1. Introduction to Computational Molecular Biology by Joao Carlos Setubal, Joao Meidanis, Jooao Carlos Setubal

LAB

1. Basic Unix commands
2. Searching Bibliographic databases for relevant information
3. Sequence retrieval from DNA & Protein databases.
4. Sequence file format conversions.
5. Pair wise comparisons using Dotlet.
6. BLAST services.
7. FASTA services.
8. Multiple Sequence Alignment (CLUSTAL W) & Phylogenetic Analysis using Phylip, Phylodraw.
9. Protein Databank retrieval and Exploring protein structure using Rasmol& Spdbv
10. Restriction Mapping
11. Primer Design.
12. PERL Programming

FERMENTATION TECHNOLOGY

Course Code:13BT304 **L –T – P: 3-0-2**

Prerequisite: Nil **Credits: 4**

Introduction to Fermentation Process Different range of fermentation processes; Chronological development of fermentation industry; General requirements of fermentation processes; an overview of aerobic and anaerobic fermentation process, Design of reactor with respect to aspect ratios; Ancillary fittings for reactors (sampling port); Aseptic transfer of spore suspension. **Medium Requirements and Optimization** Medium requirements for fermentation processes, Carbon, Nitrogen, Minerals, Vitamins and Other Complex nutrients, Oxygen requirement. Introduction to medium optimization; Methods of media optimization (One factor method and Plackett- Burman design) **Fermentation Process & Sterilization Techniques** Classification of fermentation system (Batch, fed-batch, Continuous); Dual and multiple fermentations; Concept of Chemostat; Turbidstat; Monitoring and control of fermentation process. Kinds of sterilization techniques; Thermal death kinetics of microorganisms, Batch and Continuous sterilization of liquid media, Filter sterilization, Design of sterilization equipment. **Aeration and Agitation In Fermentor**Types of mixing mechanisms (bubble aeration & mechanical); mixing equipment; Types of spargers and impellers in fermentors; Significance of oxygen transfer in fermentations; Factors affecting oxygen transfer rates; importance of K_La in fermentors; Estimation methods of K_La (Sodium sulphite oxidation technique; Dynamic gassing out method; static method; oxygen balance method).**Scale Up And Rheology In Fermentations** Scale up of fermentation process; Principles; Theoretical considerations and techniques used; Scale down methods; The Rheology of fermentation broths; Rheological models; Measurement of rheological parameters.

Recommended Textbooks:

1. Peter F Stanbury, Principles of Fermentation Technology, Elsevier, 2009
2. Bailey & Ollis, Biochemical Engineering fundamentals Mcgraw Hill Higher Education (31-12-1988)

Reference Books:

1. F.C. Web Biochemical Engineering, BS publications, 1997
2. Harvey W Blanch, Biochemical Engineering. Taylor & Francis /b S Publication (Feb 1997).

LAB

1. Study of thermal death kinetics and estimation of delta factor for bacterial culture
2. Cell immobilization and degradation kinetics of substrate
3. Comparison of growth curve for bacterial and fungal culture
4. Determination of K_S for batch growth of microorganism
5. Microbial production and quantification of fine chemicals
6. Formulation of simple and complex media for fermentations
7. Bioreactor instrumentation and control
8. Preparation of buffers (Sodium Phosphate buffer pH).
9. Ethanol Fermentation in Continuous Stirred Tank Reactor.
10. Production of Cellulase using Solid State Fermentor.
11. Production of Xylanases using P.feniculosum.

Recommended laboratory manuals:

1. Peter F Stanbury, Principles of Fermentation Technology. Elsevier (2009).

BIOCHEMICAL REACTION ENGINEERING

Course Code:13BT305 **L: T: P – 3-0-2**
Prerequisite: Nil **Credits: 4**

Biochemical Reaction Engineering Over view of biochemical reaction Engineering; Classification of reactions; Reaction rate; Kinetics of homogenous reactions; Single and multiple reactions; Elementary and Non elementary reactions; Molecularity and order of reactions; rate constant; Kinetic models of non elementary reactions; Temperature dependency of rate equation. **Interpretation of Batch Reactor Data** Constant volume batch reactor; Analysis of total pressure data; The conversion; Integral method of analysis of data; Irreversible uni-molecular, bimolecular reactions; Zero order reactions. Half life of a reaction; Varying volume batch reactor; differential method of analysis; Integral method of analysis; Zero order; First order & second order reactions; Temperature & reaction rate.**: Bioreactor Systems** Definitions; Differences and similarities between chemical and bioreactors; Classification of bioreactors; Reactor configurations;Description of a conventional bioreactor with all aspects; Design and construction criteria of a bioreactor; Concept of ideal and nonideal reactors; Residence time distribution; stimulus response techinique; Models of non ideal reactors; Imperfect mixing. **Designing Of Bioreactors** Design equations for enzyme reactors; batch growth of microorganism; Design equation of a plug flow reactor; Design of CSTR with wash out concept; Stirred tank reactors with recycle of biomass; Continuous stirred tank fermentors in series with out and with recycle of biomass; Estimation of kinetic parameters. **Multiphase Bioreactors** Different types of reactors: Cell lift reactor; Multipurpose tower reactor; Liquid impelled loop reactor; Pumped tower loop reactor; Fluidized-bed reactor; Packed bed reactor; bubble column reactors, Airlift reactors Gas inducing reactors. Animal & plant cell reactor technology-Environmental requirements for animal cell cultivation; Reactors for large scale production using animal cells, plant cell cultivation

Recommended Textbooks:

1. Octave Levenspiel, Chemical Reaction Engineering, Third edition, Wiley India pvt.Ltd (October,2006)
2. D.G.Rao, Biochemical Engineering, McGraw Hill, 2008

Reference textbooks:

1. Bailey&Ollis, Fundamentals of Biochemical Engineering, McGraw Hill Higher Education
2. Atkinson&Mavituna, Biotechnology and Biochemical Engineering Springer .

LAB

1. Determination of Volumetric mass transfer coefficient in Fermentor (sodium sulphite technique, Static method)
2. Determination of gas holdup in sparged reactor
3. Determination of mixing time in bioreactor
4. Determination of circulation time using flow follower method
5. Estimation of Reynolds number for a given flow in pipes
6. Residence time distribution experiment in CSTR
7. Estimation of power number for stirrer in Fermentor
8. Estimation of conversion of a substrate in plug flow reactor
9. Kinetic studies in fluidized bed bioreactor
10. Scale up and Determination of KLA

IMMUNOLOGY

Course Code:13BT 306 **L –T – P: 3-0-2**
Prerequisite: Nil **Credits: 4**

BASICS OF IMMUNOLOGY: Types of immunity – Innate, acquired, Humoral & cell mediated; Organs of the immune system: Primary lymphoid organs – Bursa of fabraceous, Bone marrow, thymus; Secondary lymphoid organs – Spleen, lymph node. Cells of immunity – Lymphoid & Myeloid lineage. Antigens – Types, Chemical nature, characteristics of Antigen, Hapten and adjuvant.Cytokines –Types,receptors and functions.

IMMUNOLOGICAL TECHNIQUES Antigen-Antibody Reactions – Mechanism and types. Agglutination–blood grouping, Widal &VDRL. Precipitation–double immunodiffusion, Radial Immuno Diffusion; Immunoelectrophoresis, Rocket immuno electrophoresis, Complement fixation test. ELISA, Western blotting, FACS, IHC and RIA. **CELL ONTOGENY** B-Cell biology, BCR; Immune response – primary, secondary and tertiary response's; Theories of immune response. Immunoglobulins – Structure, types, subtypes and functions. Antibody genes and generation of diversity, Production of monoclonal antibodies. Complement System – Classical, alternative and MB Lectin pathway & regulation **T CELL ONTOGENY**T-Cell biology, TCR; Types of T cells – T_H, T_C and T_S cells. Structure of MHC – I & II, Professional Antigen Presenting Cells, Mechanism of Antigen processing and Antigen presentation. T cell effector mechanism. **CLINICAL IMMUNOLOGY** Hypersensitivity: IgE mediated, antibody dependant cell cytotoxicity, immune complex mediated reactions and delayed type of hypersensitivity; Auto immunity – systemic & organ specific. Transplantation immunity – MLR and MCA; Tolerance – Natural & Adaptive. Tumor immunity – Tumor antigens, Vaccinations – basic concept, types.

RECOMMENDED TEXT BOOKS:

1. Richard A. Goldsby, Thomas J. Kindt & Barbara A. Osborne, Kuby, Immunology. John Wiley publishers 6th ed. 2007.
2. Ivan M. Roitt, Peter J. Delves, Essential Immunology. Blackwell publishers. 10th addition.

References Books:

1. Ian R. Tizard, Immunology – An Introduction, Thomson publishers.

LAB

1. Total count of Red blood cells by Neubaur chamber method
2. Total count of white blood cells by Neubaur chamber method
3. Differential count of white blood cells
4. Purification of mono nuclear cells from peripheral blood
5. Estimation of Immunoglobulins by precipitation method
6. Estimation of hemoglobin by Sahali's method
7. Widal Test
8. VDRL Test
9. Blood Grouping Test
10. Quantitative precipitin Assay
11. Radial Immuno Diffusion
12. Immunoelectrophoresis
13. Rocket Immunoelectrophoresis
14. ODD for antigen-antibody patterns
15. ODD for antibody titration
16. ELISA for antigen capture
17. ELISA for antibody capture
18. Dot-ELISA
19. Electrophoretic analysis of serum proteins
20. Counter current Immunoelectrophoresis

FOOD TECHNOLOGY

Course Code:13BT 307 **L –T – P: 3-0-2**
Prerequisite: Nil **Credits: 4**

Introduction : Food microbiology; historical developments. Biotechnology in relation to the food industry,types of microorganism's associated with food, its sources, types and behavior in foods. Role and significance of microorganisms in food. Intrinsic and extrinsic parameters of foods that affect microbial growth, Utilization of microorganisms in food industries, genetic manipulations. Thermophiles and Radiation-resistant microorganisms, characteristics and growth of thermophilic microorganisms, Nature of Radiation resistance in microorganisms. Rheology of food production. Food processing Bioprocessing of meat, fisheries, vegetables, diary product, enzymes and chemicals used in food processing, biochemical engineering for flavor and food productions. Emerging processing and preservation technologies for milk and dairy products. Food preservation Food preservation using irradiation, Characteristics of Radiations of interest in food preservation. Principles underlying the destruction of Microorganisms by irradiation, processing of foods for irradiation. Application of radiation, Radappertization, Radicidation, and Radurization of foods. Legal status of food irradiation. Effect of irradiation of food constituents.torage of foods Stability of food preservation with low temperatures, high temperatures, drying. Indicator and food borne pathogens. Food borne illness, quality control, HFCS (High Fructose Corn Syrup) and mycoproteins. Air sampling, metabolically injured organisms, enumeration and detection of food-borne organisms.

Recommended textbooks:

1. Lidsay, Willis Biotechnology, Challenges for the flavour and food industries, Elsevier Applied Science. 1988.
2. Food Science and Food Biotechnology by F.F.G. Lopez & G.V. B. Canovas (2003), CRC Press, Florida, USA.

Reference Books:

1. George J.B. Basic Food Microbiology, CBS Publishers & Distributors, 1987.
2. Roger, A., Gordan B., and John T. Food Biotechnology, 1989.

PLANT AND ANIMAL BIOTECHNOLOGY

Course Code:13BT 308 **L –T – P: 3-0-2**
Prerequisite: Nil **Credits: 4**

Fundamentals of Tissue culture Introduction to cell and tissue culture, Nutritional components of culture media and different plant tissue culture medias. Regulation of cell differentiation, regeneration of plants through organogenesis and somatic embryogenesis. Concept of synthetic seeds. **Homozygous plants & Protoplast technology ;** Production of homozygous plants through anther and ovule culture. Protoplast technology – Isolation, protoplast fusion, identification and characterization of somatic hybrids, culture and plant regeneration. Concept of cybrids. ; **Genetic engineering of plants ;** Methods for production of transgenic plant – vector mediated (Agrobacterium) and Vector less methods. Development of transgenic plants with resistance to stress, disease, herbicides, drought and insects. Secondary metabolites production by tissue culture technology. ;**Animal Cells and Tissue Culture** ; History of animal cell culture; Basic requirements for animal cell culture; Cell culture media and reagents; Animal cell, tissue and organ cultures; Primary culture, secondary culture; Continuous cell lines; Suspension cultures; substrate on which cells grow; Micro-carrier cultures, cell synchronization, Tissue Engineering and biomaterials.; **Cell lines, Cloning and Gene transfer** Disaggregation of Tissue and Primary culture, Maintenance of cultures – cell lines, Somatic cell fusion. Transfection methods, Gene transfer using engineered and cultured stem cells, cloning of cell lines, Large-scale cell culture in Biotechnology. Transgenic animals - Mice, sheep, pig, goat, cow & fish. Bioreactor for animal cell culture. Applications of animal cell culture.

Recommended Text Books:

1. Robert smith, Plant tissue culture: Technique & Experiments 2nd ed; Academic press 2000.
2. MK Razdan. An Introduction to Plant Tissue Culture. 2nd Ed.2003. Oxford and IBH.

References Books:

1. C. Chawla. Plant Biotechnology. 2004. Oxford and IBH &Animal cell culture –Practical approach – Ed. John R.W. Masters, Oxford.
2. Cell culture Lab Fax. Eds.M. Butler & M. Dowson, bios Scientific Publications Ltd; Oxford. Cell growth & Division; A practical approach. Ed. R. Basega. IRC press.

LAB

1. Preparation of Media MS, B5
2. Selection, sterilization and inoculation of explants
3. Embryo culture
4. Callus induction
5. Plant regeneration from meristems callus
6. Androgenesis: Anther culture
7. Isolation and culture of protoplasts

8. Organ culture
9. Agro bacterium mediated gene transfer, selection of transformants (Reporter gene) (GUS) assays.
10. Sterilization process of glass and plastic ware.

MASS TRANSFER OPERATIONS

Course Code:13BT 401 **L –T – P: 3-0-2**

Prerequisite: Nil **Credits: 4**

Mass Transfer between phases Analogy between the momentum, heat and mass transfer, Ficks Law of Molecular diffusion, Diffusion in gases, liquids and solids-Convective mass transfer and mass transfer coefficients,: Concentration profiles in inter phase Mass Transfer, Film mass transfer coefficients. Equilibrium relations between phases; Gas-liquid equilibrium, Absorption, single stage equilibrium contact for Gas-liquid system, counter current multiple contact stages.

Absorption in plate and packed towers: Equipment for absorption and Distillation, Design of plate Absorption Towers, Vapour-liquid equilibrium relations, Vapour-liquid equilibrium-Simple, steam and flash Distillation-Distillation with reflux- McCabe Thiete method and enthalpy-concentration method.: Liq-Liq equilibrium staged and Continuous extraction-solid-liquid extraction-equilibrium relation and staged leaching. 4: Adsorption-equilibrium-Batch and fixed bed Adsorption-Ion exchange process. Types of adsorption, Nature of adsorbents Adsorption equilibria, adsorption isotherms, the freundrich equation, adsorption operations-single stage, multistage cross current and counter current, application of Freundlich equation. Crystallization: Importance of crystal size, crystal geometry. Invariant crystal, crystal size and shape factors. Nucleation, origins of crystals in crystallizers, primary nucleation, Homogeneous nucleation, ketin equation, and rate of nucleation, crystal growth- individual and overall growth coefficients –allow of crystal growth. Crystallization equipment-vacuum crystallizers, continuous crystallizer, draft tube crystallizer, MS MFR
crystallizer.

Text Books:

1. Transport processes and Unit Operations – Christie J.Geankoplis
2. Mass transfer operations – Robert E.Treybal

Reference Books

1. Unit operations in chemical Engg.-W.L. McCabe , J.C.Smith.&Peter Harriot

LAB

1. Diffusion of organic vapor in air
2. Liquid – liquid diffusivity
3. Wetted wall column
4. Vapor – liquid equilibrium
5. Simple distillation
6. Steam distillation
7. Packed bed distillation
8. Liquid – liquid equilibrium
9. Single & multi stage liquid extraction
10. Plate & frame filter press
11. Sedimentation
12. Batch reactor
13. Saponification in tubular flow reactor
14. Mixed flow reactors in series

Group experiments:

15. Leaching
16. Adsorption

17. Crystallization

Recommended laboratory manuals:

1. Unit operations by Mc Cab, Thiele and Smith, Tata Mc Graw Hill.
2. Heat Transfer by Y.V.C.Rao, Sangam Books Ltd.

DOWN STREAM PROCESSING

Course Code:13BT 402 **L –T – P: 3-0-2**

Prerequisite: Nil **Credits: 4**

Down Stream Processing In Biotechnology; Overview of Bioseparations, Characterization of Biomolecules, characterization of Bioprocess, characterization of fermentation broth: Morphology of cells, structure of the cell wall, product concentrations, Biomass density, Rheological Behavior of fermentation broth. **Primary Separation And Recovery Processes Recovery of intracellular products:** Cell disruption methods-physical methods (osmotic shock, grinding with abrasives, solid shear, liquid shear) – chemical methods (alkali, detergents)- enzymatic methods. **Removal of suspended solids**: Foam separation, filtration. Filtration equipment, centrifugation, tubular bowl centrifuge, disk. Bowl centrifuge, basket centrifuge, scale up of centrifuges. **Product Enrichment Operations**; Membrane **based separations –** Classification & characteristics of membrane separation, merits of the process. Micro filtration, ultra filtration, Reverse osmosis, dialysis & electro dialysis. Selection of membrane, operational requirements of membrane. Retention coefficient, concentration factor, permeates yield & solid yield in membrane separation processes. Membrane modules: Plate & Frame, hollow fiber, spiral wound, shell & tube, cross flow micro filtration. **Aqueous two-phase extraction process:** Applications of aqueous two-phase extraction, reversed micelles extraction principle, micelle structures, critical micelle concentration. Protein solubilization, limitation of reversed micelles. Precipitations of proteins with salts and organic solvents, kinetics of protein aggregation. **Product Purification Chromatographic Separations:** Classification of chromatographic techniques, column chromatography, elusion frontal displacement techniques, partition coefficient, retention time and volume, capacity factor, column efficiency, design and scale up of chromatography. Principles & practices of Gel Filtration, Ion Exchange and Affinity chromatography. **Alternative Separation Methods and Product Polishing;** Super critical extraction: principles of SCE, Flow scheme of a simple SCE system. **Formulation strategies**: Importance of formulation, formulation of beakers yeast, Enzymes, formulation of pharmaceutical products. **Polishing**: Crystallization, Principles of crystallization and equipment. Principles of drying and lyophilization, Freeze dryer.

Recommended Textbooks

1. Butterworth and Heinmann. Product recovery in bioprocess Technology- Elsevier India (2004),
2. B.Siva Sankar Bioseperations, Phi Learning (2009)

References Books:

1. Harvey Blanch. Biochemical Engineering, Taylor & Francis /b S Publication (Feb 1997)
2. Christie J.Geankoplis., Transport processes and Unit operations, Phi Learning (2009).

LAB

1. Extraction of proteins by Two-phase separation (PEG 3000 & Ammonium sulphate or Organic solvents)
2. Fractionation of proteins from Egg by Ammonium Sulphate Precipitation.
3. Desalting of Proteins by Dialysis ($CuSo_4$ + protein)
4. Isolation of Milk protein (Casein) by Iso-electric Precipitation.
5. Cell Disruption by Sonication and Enzymatic Reaction
6. Separation of proteins by Gel Filtration
7. Separation of Plant pigments by Adsorption Chromatography.
8. Separation of charged biomolecules by Ion Exchange Chromatography
9. Separation of proteins by Native/SDS Gel Electrophoresis (SDS PAGE)

10. Extraction and isolation of Enzymes from microbial cultures.
11. Separation of proteins by Affinity Chromatography
12. Separation of Biomolecules by High Pressure Liquid Chromatography
13. Separation of Volatile compounds by Gas Chromatography
14. Characterization of pure protein.
15. Separation of proteins by Tube Gel Electrophoresis.

Recommended laboratory manuals:

1. Handbook of Downstream Processing By Goldberg, Elliott, Chapman & Hall publishers

MECHANICS OF MATERIALS

Course Code: 13CE 201 **L –T – P: 3-0-2**
Prerequisite: 13ES106 **Credits: 4**

Shear Force and Bending Moment: Diagrammatic conventions for supports; Diagrammatic conventions for loading; Classification of beams; Concept of shear force and bending moment; relationship between load, shear force and bending moment, Shear force and bending moment diagrams for statically determinate beams and frames.
Pure Bending and Shearing Stresses of Beams: The flexure formula; Computation of the moment of inertia; Remarks on the flexure formula. The shearing stress formula for beams; Shear stress distribution for various sections; Shear centre**.**
Analysis of Plane Stress: Normal stress, shear stress, state of stress at a point, ultimate strength, allowable stress, factor of safety; normal strain, shear strain, Hooke's law, Poisson's ratio, analysis of axially loaded members. Equations for the transformation of plane stress; Principal Stresses; Principal planes; Maximum shearing stresses; Mohr's circle of stress; Construction of Mohr's circle of stress.
Torsion: torsional deformations of a circular bar, circular bar of elastic materials, stresses and strain in pure shear, relationship between E and G.
Columns: Stability of equilibrium; The Euler's formula for columns with different end restraints; Limitations of the Euler's formulas; Generalized Euler buckling - load formulas; The Secant formula; Rankine's empirical formula.
Thin pressure vessels: Concepts of hoop and longitudinal stresses, Analysis of cylinders and shells.
Text books:

1. Mechanics of materials by J.M. Gere, Thomsombrooks/Cole India edition, Sixth edition, 2006.
2. Strength of Materials by Andrew Pytel & F. L. Singer, Harper Collin Publisher's Pvt. Ltd. New Delhi, Fourth edition.

Reference Books:

1. Strength of Materials Part I & II by S P Timoshenko. CBS Publishers and distributors, New Delhi, 3rd Edition.
2. Mechanics of Materials by Riley, Strurges and Morris, John Wiley and Sons Inc. fifth Edition.

List of experiments

1. Uni-Axial Tension Test On A Specimen of Mild Steel
2. Direct Shear Test on Mild Steel Bar
3. Brinell's Hardness Test
4. Charpy Impact Test
5. Izod Impact Test
6. Torsion Test
7. Test on Spring

FLUID MECHANICS

Course Code:13CE 202 **L –T – P: 3-0-2**
Prerequisite: 13ES106 **Credits: 4**

Fluid properties: Definition of fluid, properties of fluid-density, specific weight, specific gravity, viscosity, classification of fluids, surface tension and capillarity, vapour pressure and cavitation.

Fluid statics: pressure, Pascal's law, hydrostatic law, measurement of pressure-simple and differential manometers, Total pressure and centre of pressure on vertical, horizontal and Inclined surfaces.

Fluid statics-buoyancy and floatation: Buoyancy, centre of buoyancy, Meta-centre, Meta-centric height.

Fluid kinematics: types of fluid flow, Discharge, Continuity equation, Continuity equation in three dimensional flow, velocity potential function and stream function. **Fluid dynamics:** Euler's equation of motion, computational approaches for solving Euler's equation Finite Volume Method**,** Bernoulli's equation and applications, Venturimeter, Orificemeter, Pitot-tube, coefficient of discharge, orifices and mouth pieces.

Momentum equation: Impulse-momentum equation, Force exerted by flowing fluid on pipe-bend.

Flow through pipes: Introduction, major and minor energy losses, hagen- poiseuille law, Hydraulic gradient and total energy line, pipes in series and parallel and Water hammer.

Turbulance: Introduction to Turbulance**,** Navier Strokes Equations,

Dimensional analysis & model similitude: Buckingham's PI theorem, Model analysis, Types of similarities, Dimensionless numbers, Classification of models, Model laws-Reynolds and Froude model law

TEXT BOOKS:

1. Fluid Mechanics by John F. Douglas, Tata McGraw Hill publications
2. Fluid Mechanics by S.K.Som, G Biswas, Tata McGraw Hill publications

References:

1. Fluid Mechanics by Frank M white, Tata McGraw Hill publications
2. Fluid Mechanics by A. Cengel and John M. Cimbala, Tata McGraw Hill publications
3. Fluid Mechanics by G. S Sawhney, IK International Publishing house (P) Ltd. New Delhi
4. Fluid Mechanics by Edward J. Shaughnessy, Oxford University Press, USA

LIST OF EXPERIMENTS

Determination of coefficient of discharge of rectangular notch
Determination of coefficient of discharge of V - notch
Determination of coefficient of discharge of orifice
Determination of coefficient of discharge of mouth piece
Determination of coefficient of discharge of orifice meter
Determination of coefficient of discharge of venturimeter
Determination of Darcy friction factor due to friction in a pipe flow
Determination of minor losses due to sudden expansion and contraction in a pipe flow
Verification of Bernoulli's theorem
Fluid flow analogy using Reynolds apparatus

NOTE: In addition to physical conduction of above experiment any simulation package / program will be used for simulating the same and further correlation with experimental results obtained.

STRUCTURAL ANALYSIS

Course Code:13CE 203 **L –T – P: 3-0-2**
Prerequisite:13CE201 **Credits: 4**

Energy Theorems: Principle of superposition, Maxwell's reciprocal theorem, Betti's theorem, Principles of virtual work, Application of virtual work, Castigliano's theorems, Applications of castigliano's theorem.

Deflection: Relation between curvature, slope and deflection, Deflection curves, Deflection by moment area method, Deflection by conjugate beam method, unit load method.

Propped Cantilevers and Fixed Beams: Analysis of propped cantilevers with point load, partially loaded u.d.l and uniformly varying load, fixed beam with point load, udl, Unsymmetrical concentrated load and varying load,
Analysis of Continuous beams: Clapereyon's theorem of Three moments, analysis of beam with constant EI for all span, varying EI for different span, sinking of supports.
Analysis of Structure by Slope Deflection Method: Difference between force method and displacement method. Advantage of displacement method. Analysis of indeterminate beams, Beams with uneven support settlement, rigid frames by slope deflection method.
Analysis of Structure by Moment Distribution Method: Advantage of moment distribution method, stiffness, carry over and distribution factor, analysis of indeterminate beams and rigid frames, uneven settlement of support for beam and rigid frame by moment distribution method.

TEXT BOOKS:

1. Intermediate Structural Analysis by C. K. Wang, McGraw Hill Book Company, 2010

REFERENCE BOOKS:

1. Basic Structural Analysis by C S Reddy, Tata McGraw Hill publishing Company ltd. Delhi. 2nd edition 2010.
2. Structural Analysis by T.S Thandavamoorthy, Oxford University Press, New Delhi, First edition, 2011.
3. Fundamentals of Structural Mechanics and Analysis by M L Gambhir, PHI learning private limited, New Delhi, 2011.

LIST OF EXPERIMENTS

Students are required to analyze the following structures using Software package (STAAD-Pro)

1. Analysis of continuous beam without sinking of support.
2. Analysis of continuous beam with sinking of support.
3. Analysis of continuous beam with internal hinge.
4. Analysis of portal frame without sinking of support.
5. Analysis of portal frame with sinking of support.
6. Analysis of portal frame with internal hinge.
7. Analysis of Truss without sinking of support.
8. Analysis of truss with sinking of support.
9. Analysis of space frame without sinking of support
10. Analysis of space frame with sinking of support.
11. Analysis of space frame with internal hinge.

HYDRAULICS AND HYDRAULIC MACHINES

Course Code: 13CE 204 **L –T – P: 3-0-2**
Prerequisite: 13CE202 **Credits: 4**

Open Channel Flow: classification, and Comparison between open channel flow and pipe flow, Types of channels, Chezy's and Manning's equation**,** Flow through rectangular, Trapezoidal and Circular channels, Most efficient channel section -Rectangular, Trapezoidal, Specific energy, Specific energy diagram, Critical flow, critical flow in rectangular channel, critical slope, Froude's number**,** Channel transitions.

Gradually Varied Flow: Gradually varied flow in rectangular channels – equation for GVF, Water surface slope w.r.t. channel bed and horizontal, Classification of channel slopes, classification of surface profiles, Backwater and draw down curves.

Rapidly Varied Flow: Hydraulic jump, elements and characteristics of hydraulic jump, Types of hydraulic jump, Location and applications of hydraulic jump, Energy loss in a hydraulic jump.

Impact of Jets: Force exerted by the jet on a stationary plate – vertical, inclined and curved, Force exerted by a jet on a hinged plate, on moving plates, force exerted by jet on flat plates and series of vanes.

Turbines: classification of turbines, pelton wheel, velocity triangles and work done on Pelton wheel, Design of Pelton wheel. Radial flow reaction turbine, Velocity triangles and work done by water on runner**,** Francis turbine, Design of Francis turbine, Axial flow reaction turbine – Kaplan turbine**,** head and efficiency, Draft tube – types, draft tube theory, efficiency of draft tube**,** Specific speed, Unit quantities, Selection of turbines, Cavitation.

Centrifugal Pumps: Manometric head; losses and efficiencies; work done; working principle; priming; velocity triangles; performance and characteristics curves; multistage and double suction pumps, Cavitation effects.

Reciprocating Pumps: Classification of reciprocating pump, working principle**,** Discharge through reciprocating pump, negative slip Discharge, work done and power required to drive double acting pump.

TEXT BOOKS:

1. Hydraulics & Fluid Mechanics by P. N. Modi & S. N. Seth; Standard Book house, New Delhi
2. Introduction to Fluid Mechanics by Robert W.Fox and Alan T. Mc Donald, Fourth Edition, John Willey & sons, New York, 1995

REFERENCE BOOKS:

1. Open Channel flow by V.T.Chow, Mc.Graw Hill book company
2. Flow in Open channels by K . Subramanya, Tata McGraw-Hill Publishing Company,1994.
3. Fluid Mechanics by A. K. Jain; Khanna Publishers, Delhi
4. Hydraulic Machines by Jagadhishlal; Metropoliton Company, Delhi

LIST OF EXPERIMENTS

1. Determination of Manning's and Chezy's coefficients in Open Channel flow.
2. Determination of Coefficient of impact of jets on different Vanes.
3. Performance studies on Pelton turbine.
4. Performance studies on Francis turbine
5. Performance studies on Kaplan turbine.
6. Performance studies on single stage Centrifugal pump.
7. Performance studies on variable speed on Centrifugal pump.
8. Performance studies on Reciprocating pump.
9. Determination of efficiencies of hydraulic Ram.
10. Water – hammer studies.

SURVEYING

Course Code:13CE 205 **L –T – P: 3-0-2**
Prerequisite: NIL **Credits: 4**

Surveying, Overview of plane surveying (chain, compass and plane table), Objectives, Principles and classifications.

Distances and Direction - Distance measurement conventions and methods; use of chain and tape, Electronic distance measurements, Meridians, Azimuths and Bearings, declination, computation of angle.

Leveling and Contouring - Concept and Terminology, Temporary and permanent adjustments- method of leveling. Characteristics and Uses of contours- methods of conducting contour surveys and their plotting.

Computation of Areas and Volumes - Area from field notes, computation of areas along irregular boundaries and area consisting of regular boundaries. Embankments and cutting for a level section and two level sections with and without transverse slopes, determination of the capacity of reservoir, volume of barrow pits.

Theodolite - Theodolite, description, uses and adjustments - temporary and permanent, measurement of horizontal and vertical angles. Principles of Electronic Theodolite, Trigonometrical leveling, Traversing.

Tachometric Surveying - Stadia and tangential methods of Tacheometry. Distance and Elevation formulae for Staff vertical position.

Curves - Types of curves, design and setting out – simple and compound curves. Introduction to geodetic surveying,

Total Station: Introduction – Accessories with description - Features of total station – Onboard software electronic data reading - Summary of total stations characteristics - Field procedure of total stations in topographic survey, Global positioning system, Introduction to Geographic information system (GIS).

Text Books:

1. Surveying and Levelling by R.Subramanian, Oxford University Press, 2nd edition, 2012
2. Surveying Vol - I, II, III - Dr. B.C . Punmia Laxmi publications, Delhi-6

Reference Books:

1. Surveying and levelling part I & II by Kanetkar.T.P. & S.V.Kulkarni, Puna vidyarthi girha, Prakashan,23rd edition,1993.
2. Arora K. R, “Surveying Vol-I”, Rajsons Publications Pvt. Ltd, 10th Edition, 2008.

LIST OF EXPERMENTS

1. Determination of area of a polygon by a ranging and taking offsets.
2. Measuring distance between two stations by indirect ranging when they are obstacles.
3. Measuring of bearing of sides of the traverse and preparation of map.
4. Plating of details by radiation method and intersection method of Plan table surveying methods.
5. Determination of elevation of various points with a level by (a) collimation method (b) rise & fall method.
6. Measurement of horizontal angles with theodolite.
7. Location of points in an area using total station.

SOIL MECHANICS

Course Code:13CE 206 **L –T – P: 3-0-2**
Prerequisite: NIL **Credits: 4**

Origin of Soils: Soil Origin, rock cycle. **Phase Relations**: Weight Relationships, Volume Relationships, Density and Unit Weight Relationships, Inter-relationships.**Soil Classification**: coarse grained soils, fine grained soils., IS soil classification. **Compaction**: variables in compaction, laboratory tests, field compaction, specification and control. **Effective Stress**: Effective stress Principle, effective stress, pore water pressure, and total stress variation with depth, vertical normal stress due to overburden, capillary effects in soils.**Permeability:** Bernoulli’s Equation, Darcy’s law, Laboratory and field measurement of permeability, factors affecting permeability. Stress in soils due to flow, Seepage Force, Downward Flow, Upward Flow, Quick Condition. **Vertical stresses beneath the loaded areas**: stresses due to point load, stresses due to line load, stresses under the corner of rectangular load, 2:1 distribution method.**Compressibility**: Compressibility as a function of effective stress, soil type, stress history; normally consolidated and over consolidated clay.

Consolidation: Terzaghi’s One-Dimensional Consolidation theory, consolidation test, Consolidation Settlement, Determining Coefficients of compressibility and consolidation, limitations in predicting consolidation behavior, amount of consolidation, time for consolidation, secondary compression.**Shear Strength**: Mohr's Circle, Mohr Coulomb failure criterion, Mohr circles and failure envelopes interms of effective and total stresses. Drained and undrained loading tests, direct shear test, traixial test, skempton pore water pressure parameters. Field vane shear test **Site Investigations**: Various geotechnical field investigations, geotechnical field report.

TEXT BOOK:

1. Geotechnical Engineering: A practical problem solving approach by N Sivakugan, and Braja M Das, Eureka series, J. Ross publishing, 2009.

REFERENCE BOOKS:

1. Basic and Applied Soil Mechanics by Gopal Ranjan and ASR Rao, New Age International Publishers, Second Edition, 2007.
2. Soil Mechanics and Foundation Engineering by V. N. S. Murthy, CBS Publishers & Distributors, New Delhi.
3. Geotechnical Engineering Principles and Practices by Donald P. Coduto, Man-Chu Ronald Yeung and William A.Kitch, PHI Learning Pvt. Ltd., Second Edition.

LIST OF EXPERIMENTS

1. Determination of specific gravity of soils by using
   (a) Density bottle method.
   (b) Pycnometer method
2. To determine classification of soil by using I.S sieve method
3. To determine clay & silt percentage in soils by using hydrometer method.
4. (a) To determine of liquid limit of soils
   (b) To determine of plastic limit of soils.
5. (a) To determine of field unit weight using core cutter method.
   (b) To determine of field unit weight using sand replacement method.
6. Determination of permeability of soils by constant head permeameter method
7. Determination of permeability of soils by variable head permeameter method
8. Determination of shear strength parameters of soil using direct shear apparatus
9. Determination of undrained shear strength soft clay using lab vane shear apparatus
10. Determination of compressive strength of soil by using unconfined compressive apparatus
11. (a) Determination of soil OMC & MDD by standard proctor compaction test
    (b) Determination of soils OMC & MDD by modified proctor compaction test
12. Determination of shear strength parameters of soil using triaxial cell apparatus

ENVIRONMENTAL ENGINEERING

Course Code: 13CE 207 **L –T – P: 3-0-2**
Prerequisite: NIL **Credits: 4**

Necessity of protected water supply. Role of Civil Engineer. Water demand, per capita consumption and factors affecting. Effect of variations of water demand on design of different components of water supply schemes. Design period – population forecasting, Sources of water - quality parameters and their significance. Drinking water quality standards in India. Intake structures – definition and site selection, Pipes, joints and valves.

Types and origin of impurities, Need for water treatment. Purpose, principles of operation and design considerations of plain sedimentation, sedimentation with coagulation, slow, rapid sand and pressure filters.

Chlorination, Ozonization, and UV radiation.

Special treatment processes for color, odor, taste and hardness removal from water.

Sewerage systems, Quantity estimation, Velocity in sewers, Storm water sewers- Strom water estimation by rational method. Sewerage system design, Sewage conveyance- Sewer types and appurtenances
Objectives and extent of wastewater treatment, Quality parameters – physical, chemical and microbial. Standards of discharge of effluents on surface waters, sewers and for agricultural use.
Purpose, principle and design considerations of Preliminary treatment -. Screens, grit chambers; Primary treatment- Sedimentation – rectangular and circular tanks; Secondary treatment- Activated sludge process & Trickling filter and Secondary clarifiers. Septic tanks - design parameters and working principles.
Sludge digestion and sludge dewatering beds.
Air Pollution-Types, Impacts on environment, and Principles of control techniques
Solid Wastes-Types, sources and composition of solid wastes, Methods of collection, Transportation and disposal methods; Landfills, composting, incineration, pyrolysis, gasification

Text Books:

1. Environmental Engineering (Vol I), Water Supply Engineering, S. K. Garg, Khanna Publishers, New Delhi, Twelfth Revised Edition, 2010
2. Environmental Engineering (Vol II), Sewage Disposal and Air Pollution Engineering, S. K. Garg, Khanna Publishers, New Delhi, Twenty-second Revised Edition, 2010

Reference Books:

1. Environmental Engineering by Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, Mc Graw-Hill International Editions, New York
2. Wastewater Engineering Treatment, Disposal & Reuse by Met Calf & Eddy, Tata McGraw – Hill publishing Co. Ltd., New Delhi.
3. Water and Waste water Technology, Mark. J Hammer and Mark. J Hammer, Eastern Economy Edition, PHI-Learning, New Delhi (2008)
4. Environmental Engineering by Davis Cornvel, McGraw Hill Book Co., New York. (2000)
5. Water and waste water Engineering by G.M. Fair, J.C. Geyer, and Okun, John Wiley & Sons, New York (1998)
6. Waste water Engineering by M.N Rao and A.K Dutta, Oxford & IBH Publishing Co. Ltd. (2000)

LIST OF EXPERIMENTS

Determination of the following parameters present in the given water/waste water sample:

1. a) pH, b) Electrical Conductivity
2. a) Turbidity b) Jar test
3. Hardness
4. a) Acidity b) Alkalinity
5. Available chlorine and Residual Chlorine
6. Fluoride
7. Iron
8. Total solids, Dissolved solids, Suspended solids & Settleable solids
9. Dissolved Oxygen(DO)
10. Biochemical Oxygen Demand (BOD)
11. Chemical Oxygen Demand (COD)
12. Chlorides

BUILDING PLANNING AND CONSTRUCTION

Course Code:13CE 208 **L –T – P: 3-0-2**
Prerequisite: 13CE203 **Credits: 4**

Brick Masonry: Technical terms; Types of bonds in brickwork and their suitability. **Stone Masonry**: Technical terms; Classification of stone masonry. Dampness and Damp Proofing:

Introduction, Methods of preventing dampness; Damp proofing materials and their classification; Methods of providing DPC under different situations.

Floors: Technical terms; Different types of floors – concrete, mosaic, terrazzo, stone floors, ceramic tile floors, vinyl floors and wood floors. Roofs: Technical terms; Classification of roofs; Steel sloping roofs; Roof covering materials; Types of flat roofs. Scaffolding, Shoring, Under Pinning and Form Work: Types of scaffolding; Types of shoring; Methods of underpinning; Types of formwork; Centering

Building Planning: Introduction to Buildings, Classification of Buildings, National Building Code Building Planning: Selection of Site, Orientation, Ventilation, Furniture requirements, Roominess, Sanitation, Lighting, Space for equipment for air–conditioning, Space for machinery etc.; Aspect and prospect, Privacy, Elegance and economy; Climatic considerations; Materials selection, Wall thickness and Scales

Building Bye–Laws & Regulations: Objectives of Building Bye–Laws, Building regulations; Calculation of Plinth Area (PA), floor area and carpet area; Floor Area Ratio (FAR), Floor Space Index (FSI), Height of Buildings as per local code book

Cement: General; Cement and lime; Chemical composition of ordinary Portland cement; Functions of cement ingredients; Hydration of cement; Structure of Hydrated cement; Water requirements for hydration; Types of cement and its properties; Field tests for cement; Chemical composition test; Laboratory tests for cement; Grades of cement as per IS specifications.

Aggregates: Classification; Source; Grading of Aggregates; IS: 383 requirements for aggregates; Tests on aggregates; Alkali - Aggregate reaction.

Water: General; Quality of water; Use of sea water; IS: 456 requirements.

Mortar: Functions of sand in mortar; Classification of mortars; Properties of good mortar mix and mortar; Preparation of mortar; Uses of mortar; Precautions in using mortar; Selection of mortar; Tests for mortars.

Cement Concrete: Definition; Properties of cement concrete; Proportioning of concrete; Water/cement ratio.

Admixtures in Concrete: General; Air-entraining agents; Plasticizers; Pozzolanic admixtures; Accelerators; Retardars; Miscellaneous admixtures such as damp proofers and Surface hardeners.

Fresh Concrete: Workability of concrete; Measurement of workability; Segregation; Bleeding; Yield of Concrete.

Manufacture of Concrete: Batching of concrete; Mixing; Transporting Concrete; Placing concrete; Compaction of concrete; Curing of concrete; Finishing.

Tests on Hardened Concrete: Compression test; Moulds and compacting; Curing; Failure of compression specimen; Effect of height / diameter ratio on strength; Flexural strength of concrete; Tensile strength of concrete; Non - destructive testing methods; Tests on composition of hardened concrete; Elastic properties of concrete; Relation between modulus of Elasticity and strength; Factors affecting modulus of elasticity; Creep; Factors affecting creep; Shrinkage; Plastic shrinkage; Mechanism of shrinkage; Factors affecting shrinkage.

Durability of Concrete: Permeability of concrete; Sulphate attack; Methods of controlling sulphate attack; Durability of concrete in sea water; Action of foreign matter on concrete.

Special Concrete & Concreting Methods: Special concretes such as light weight concrete and no fines concrete; High density concrete; Polymer concrete and Fibre reinforced concrete; special concreting methods Cold weather concreting, Hot weather concreting; Gunite or shortcrete; Ferro cement.

Concrete Mix Design: Concept of mix design; Variables in proportioning; Nominal mix and design mix; Indian standard method of mix design; ACI Method

TEXT BOOKS:

1. Building Materials by S. K Duggal New Age International Publishers.
2. Building construction by P C Varghese, Prentice hall of India (P) Ltd, New Delhi
3. Concrete Technology by A.M. Neville, Pearson Edition.

REFERENCES:

1. Civil engineering materials by Parbin Singh Prentice hall of India (P) Ltd, New Delhi
2. Building construction by B. C Punmia, Laxmi Publications, New Delhi
3. Concrete Technology by M.E. Grambhir, Tata Mc Graw- Hill Publishing Company Ltd.
4. Concrete technology by M.S Shetty, S. Chand & Company (Pvt) Ltd., New Delhi.

LIST OF EXPERIMENTS

1. Draw the Sign Conventions for Engineering Materials, Water supply & Sanitary fixtures and Electrical Installations etc. using Auto cad.
2. Draw the English bond & Flemish bond for one, one and half brick walls using Auto cad.
3. Draw the Doors, Windows and Ventilators using Auto cad.
4. Draw the Residential Building and School Building line diagrams using Auto cad.
5. Draw the Commercial Building and Hospital Building line diagrams using Auto cad.
6. Draw the Sloped roof building with Load Bearing walls using Auto cad.
7. Draw the Flat Roof Building with Framed construction using Auto cad.
8. Draw the Stair Case Plan, Sectional elevations including T- Beam, Landing Beam & landing slab using Auto cad.
9. Draw the Plan, section & elevation for given line plans of Single storied building using Auto cad
10. Draw the Plan, section & elevation for given line plans of Double storied building using Auto cad

Construction Materials and Concrete Technology

Course code : 13CE301 **L – T – P: 3-0-2**

Pre Requisit : NIL **Credits: 4**

Stones – bricks – concrete blocks: Stone as building material; Criteria for selection;Tests on stones; Deterioration and Preservation of stone work; Bricks; Classification – Manufacturing of clay bricks – Tests on bricks – Compressive Strength – Water Absorption – Efflorescence – Bricks for special use – Refractory bricks – Cement, Concrete blocks – Light weight concrete blocks.

Lime – cement – aggregates – mortar: Lime – Preparation of lime mortar – Cement – Ingredients – Manufacturing process – Types and Grades – Properties of cement and Cement mortar – Hydration – Compressive strength – Tensile strength – Fineness– Soundness and consistency – Setting time – Industrial byproducts – Fly ash – Aggregates – Natural stone aggregates – Crushing strength – Impact strength – Flakiness Index – Elongation Index – Abrasion Resistance – Grading – Sand Bulking.

Concrete: Concrete – Ingredients – Manufacturing Process – Batching plants – RMC – Properties of fresh concrete – Slump – Flow and compaction Factor – Properties of hardened concrete – Compressive, Tensile and shear strength – Modulus of rupture – Tests – Mix specification – Mix proportioning – BIS method – High Strength Concrete and HPC – Self compacting Concrete – Other types of Concrete – Durability of Concrete.

Timber and other materials: Timber – Market forms – Industrial timber– Plywood – Veneer – Thermacole – Panels of laminates – Steel – Aluminum and Other Metallic Materials – Composition – Aluminium composite panel – Uses – Market forms – Mechanical treatment – Paints – Varnishes – Distempers – Bitumens.

Modern materials: Glass – Ceramics – Sealants for joints – Fibre glass reinforced plastic – Clay products – Refractories – Composite materials – Types – Applications of laminar composites – Fibre textiles – Geomembranes andGeotextiles for earth reinforcement.

Text Books:

1. Varghese.P.C, “Building Materials”, PHI Learning Pvt. Ltd, New Delhi, 2012.

2. Shetty.M.S., “Concrete Technology (Theory and Practice)”, S. Chand and Company Ltd.,2008.

Reference Books:

1. Jagadish.K.S, “Alternative Building Materials Technology”, New Age International, 2007.
2. IS456 – 2000: Indian Standard specification for plain and reinforced concrete, 2011
3. IS4926–2003 : Indian Standard specification for ready–mixed concrete, 2012
4. IS383–1970: Indian Standard specification for coarse and fine aggregate from natural Sources for concrete, 2011
5. IS1542–1992: Indian standard specification for sand for plaster, 2009
6. Duggal.S.K., “Building Materials”, 4th Edition, New Age International , 2008.
7. Gambhir. M.L., & Neha Jamwal., “Building Materials, products, properties and systems”, Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2012.
8. Gambhir.M.L., “Concrete Technology”, 3rd Edition, Tata McGraw Hill Education, 2004

LIST OF EXPERIMENTS

1. To Determine the initial and final setting time of cement with vicat’s apparatus
2. To Determine the Normal Consistency of cement with vicat’s apparatus
3. To Determine the fineness modulus of fine aggregates
4. To Determine the fineness modulus of coarse aggregates
5. To find bulk density specific gravity void ratio and porosity of fine aggregates
6. To find bulk density specific gravity void ratio and porosity of Coarse aggregates
7. Workability of concrete by slump cone apparatus
8. Workability of concrete by Compaction factor apparatus
9. To find the compressive strength of concrete cubes and cylinders
10. To determine the tensile strength of concrete by split cylinder test
11. To determine the flexural strength of concrete beam specimen
12. To determine the flakiness index and elongation index of the given aggregate

ENGINEERING GEOLOGY

Course Code 13CE 302 **L –T – P: 3-0-2**
Prerequisite: NIL **Credits: 4**

Importance of geology from Civil engineering point of view, Weathering Process of rocks and its importance in civil engineering; Geological action of Rivers.

Mineralogy: Definition of mineral; Significance of different physical properties of minerals. Study of common rock forming minerals - Quartz, feldspar, Muscovite, calcite, Talc, Haematite.

Petrology: Igneous Rocks: Formation and types of Igneous rocks; Structures of Igneous rocks. Study of Granite - Basalt – Dolerite

Sedimentary Rocks: Formation and types of Sedimentary rocks; Structures of Sedimentary Rocks. Study of Sand Stone – Lime Stone – Shale

Metamorphic Rocks: agents of metamorphism, formation and types of metamorphic rocks, Structures of Metamorphic rocks, Study of Granite gneiss – schist – Marble -khondalite – Charnockite. distinguisition of igneous, sedimentary and metamorphic rocks in field, Different Engineering properties of rocks.

Structural Geology: Strike and Dip; Outcrop. Types of Folds; Faults; Joints; and their importance in Civil Engineering constructions.

Earthquakes and Seismic Hazards: Causes and effects of earthquakes; Seismic belts, seismic hazards in India ; Civil Engineering considerations in seismic areas.

Land Slides: Classification; Causes and effects of Landslides; Preventive measures of Landslides.

Site Investigation Techniques for Civil Engineering Projects: toposheets/topographic maps; Geological maps and their interpretation in site investigation; Electrical resistivity methods and seismic methods for sub-surface investigations; Remote sensing, Geographical information systems, application of RS & GIS in Civil Engineering Projects ;

exploration of ground water. **guidelines for major dam and reservoir investigations. Tunnels**: Purpose of tunneling; tunnels and underground excavations – methods of site selection, tunnel excavation in various rock types, Geology of some tunnel sites;

Stones: Qualities of a good building stone; Stone quarrying; Dressing of stones; **Bricks:** Composition of good brick earth; Harmful ingredients in brick earth; Manufacture of bricks; Comparison between clamp burning and kiln burning; Qualities of good bricks; Classification of bricks; Size and weight of bricks; Fire – clays. AAC(aerated auto clave blocks) blocks, light weight concrete blocks: cement blocks: solid and hallow.

Flooring and wall cladding materials; cement flooring,marble, granite, limestone and ceramic tiles. glass fiber reinforced concrete **Timber:** Defects in timber; Qualities of good timber; Preservation of timber; Seasoning of timber; distinguisition of different types of timber. Market forms of timber,

Alternative materials for wood; galvanized iron, fiber reinforced plastics, steel and aluminium.

Steel: Manufacture of steel; Uses of steel; Defects in steel; Market forms of steel; Properties of mild steel; Properties of hard steel; Corrosion of ferrous metals. **Paints:** Constituents of paints, types of paints, Painting of new and old substrate Painting; white washing, Varnishing; base coat for paints: cement based putties, various tests on base coat materials for painting.

Insulating Materials: thermal insulators, electrical insulators and sound (acoustic) insulators

Text Books:

1. Engineering Geology by D. Venkat Reddy; Vikas Publishing House Pvt. Ltd., Noida
2. Building Materials by S. K Duggal New Age International Publishers.
3. Concrete Technology by M.E. Grambhir, Tata Mc Graw- Hill Publishing Company Ltd

Reference Books:

1. Engineering and General Geology by Parbin Singh; S. K. Kataria & Sons, New Delhi.
2. Engineering Geology and Geo techniques by Krynine and Judd, Mc Graw – Hill Book Company.
3. Civil engineering materials by Parbin Singh Prentice hall of India (P) Ltd, New Delhi
4. A text Book of Engineering Geology by N. Chennakesavulu; Macmillan India Ltd., Delhi.
5. Text Book of Geology, by P. K. Mukherjee, World Press (P) Ltd., Kolkata

LIST OF EXPERIMENTS

1. Study of physical properties of minerals.
   a) Rock forming minerals
   b) Economic minerals
2. Megascopic identification, structure and textural study of Rocks
   a) Igneous rocks
   b) Sedimentary rocks
   c) Metamorphic rocks
3. Study of geological maps
4. Study of structural geology models.
5. Study of tunnel models.
6. Study of river features.
7. Map reading of topo sheets and Base map preparation.
8. Study of drainage density.
9. Watershed delineation for water resources development.
10. study of Slope analysis.
11. study of Land use land cover using satellite images
12. Electrical resistivity method for identification of ground water potential and thickness of strata – (demo).

TRANSPORTATION ENGINEERING

Course Code 13CE 303 **L –T – P: 3-0-2**
Prerequisite: NIL **Credits: 4**

Transportation Development and Planning: Importance of Transportation Engineering, Classification of Transportation Studies – Modal, Elemental & Functional Classification. Historical Development of Road Construction, Highway Development in India. **Highway Alignment -** Factors governing alignment; Engineering surveys. **Highway Geometric Design**: Introduction, Highway cross-section elements; Sight distance – SSD, ISD, OSD; Design of horizontal alignment; Design of vertical alignment – summit curves and valley curves. **Pavement Design Engineering**: Pavement types, components of flexible & rigid pavements, Pavement Design Factors, Flexible Pavement Design - Design strategies, CBR Method, Burmister's Layered Theory, IRC 37-2001 Guidelines, Rigid Pavement Design - General Design Considerations, Stresses in concrete pavements, Joints, Design of Rigid Pavements as per IRC:58-2002 Guidelines. Pavement Drainage - Necessity, Analysis and Design of Surface and sub surface drainage system. **Highway Construction**: Equipment, Stages of Pavement Construction, Earthwork, Stabilization of Soil, Bituminous Pavement Construction and Cement Concrete Pavement Construction. **Highway Maintenance**: Pavement Distress – causes and remedial measures. **Traffic Infrastructure Design:** Properties of Traffic Engineering Elements – Introduction, Vehicle Characteristics, Human Factors and Driver Characteristics, Road Characteristics, Control Mechanisms and Terminal Facilities. Traffic Studies, Traffic Operations –Traffic Regulations, Traffic Control Devices - Traffic Signs, Traffic signals, Road Markings and Islands. Traffic Stream Parameters and their Relations; Design of Traffic Signals, Design of Intersections – Intersection at Grade and grade separated Intersections.

TEXT BOOKS:

1. Principles of Transportation Engineering by Partha Chakroborty and Animesh Das. Prentice Hall of India, New Delhi
2. Highway Engineering by S.K.Khanna & C.J.Justo, Nemchand & Bros., Latest Edition.

REFERENCE BOOKS:

1. Principles of pavement design – Yoder & wit zorac – Jhonwilley & Sons
2. Principles and practices of highway Engineering by Dr. L. R. Kadiyali & Dr. N. B. Lal Khanna publishers, Latest Edition .
3. Transportation Engineering by C. Jotin Khisty, B.Kent Lall, Prentice Hall of India, New Delhi
4. Traffic Engineering and Transportation Planning by L.R.Kadiyali, Khanna Publishers

CODES:

1. IRC 37 – 2001: Guidelines for the design of flexible pavements, Indian Road Congress Publications, New Delhi.
2. IRC 58 – 2002: Guidelines for the design of plain jointed rigid pavements for highways, Indian Road Congress Publications, New Delhi.
3. MORTH - Specifications for Road and Bridge works, Indian Road Congress Publication, New Delhi, Latest Edition
4. IRC 67 – 2001: Code of Practice for Road Signs, Indian Road Congress Publication, New Delhi
5. IRC 35 – 1997: Code of Practice for Road Markings, Indian Road Congress Publication, New Delhi
6. IRC 35 – 1997: Code of Practice for Road Markings, Indian Road Congress Publication, New Delhi

LIST OF EXPERIMENTS

I. Tests on Road Aggregates
   a. Aggregate Crushing value Test
   b. Aggregate Impact value Test

c. Abrasion value Test a) Los Angeles b) Devel's
d. Shape Tests (a) Flakiness Index (b) Elongation Index (c) Angularity Number
e. Soundness Test
f. Specific Gravity and Water Absorption
g. Sieve Analysis a) Coarse Aggregate b) Fine Aggregate
h. Film Stripping Test

II. Tests on Bitumen
   a. Penetration test
   b. Softening point test
   c. Ductility test
   d. Flash & Fire point test
   e. Specific gravity test

III. Tests on Bituminous Mixes
   a. Marshal Method of Bituminous Mix Design
   b. Bitumen Extraction Test

IV. CBR Test on Soil

V. Benkelman Beam Deflection Test

VI. Merlin Road Roughness Test

FOUNDATION ENGINEERING

Course Code:13CE 304 **L –T – P: 3-0-2**
Prerequisite: 13CE206 **Credits: 4**

Bearing Capacity Of Shallow Foundations: Introduction, Basic definitions, Principal modes of soil failures, Terzaghi's bearing capacity theory/ equation and its modifications for square, rectangular and circular foundation, Skempton's bearing capacity analysis for clays, Meyerhof's analysis, Hansen's bearing capacity theory, Vesic's bearing capacity theory, IS code recommendations for bearing capacity, Bearing capacity of granular soils based on SPT value and Static cone resistance, Bearing capacity of footings on layered soils, Factors influencing bearing capacity, Allowable bearing pressure. General requirements of foundations, Factors affecting location and depth of foundation, Choice of type of foundations, Steps involved in the proportioning of footings. **Pile Foundations:** Use of piles, Types of piles, Construction, Selection of pile type, Types of foundations to suit subsoil conditions, Pile load capacity, Static formulae, Dynamic formulae, Load tests, on piles, Group action of piles, Load carrying capacity of pile groups, Negative skin friction, Piles subjected to uplift loads. **Well Foundations:** Types of wells and caissons, components of well foundation, shapes of wells, depth of a well foundation, forces acting on a well foundation, lateral stability of well foundation, construction and sinking of a well. **Settlement Analysis:** Consolidation settlement, Immediate settlement, Corrections to settlement due to consolidation, Settlement in different soil types/Settlement from field tests, Allowable settlement, Settlement of pile group. **Stability Of Slopes:** Infinite slopes and translational slides, Definitions of factor of safety, Finite slopes-Forms of slip surface, Limiting equilibrium method and Critical stages in stability, Total stress and effective stress methods of analysis, $ø_u = 0$ Analysis (total analysis), c – ø analysis - method of slices, Location of the most critical circle, Friction circle method, Taylor's stability number. **Earth Pressure And Retaining Walls:** Effect of wall movement on earth pressure, Earth pressure at rest, Rankine's theory of earth pressure, Coulomb's theory of earth pressure, Coulomb's equation for c = 0 back fills, Cullman's graphical method, Passive earth pressures-Friction circle method, Design considerations retaining walls.

TEXT BOOK:

Basic and Applied Soil Mechanics by Gopal Ranjan and ASR Rao, New Age International Publishers, Second Edition, 2007.

REFERENCE BOOKS:

1. Foundation Analysis and Design by J.E. Bowles, MacGraw Hill, 1996.
2. Soil Mechanics and Foundation Engineering by V. N. S. Murthy, CBS Publishers & Distributors, New Delhi.
3. Geotechnical Engineering Principles and Practices by Donald P. Coduto, Man-Chu Ronald Yeung and William A.Kitch, PHI Learning Pvt. Ltd., Second Edition.
4. Foundation Design by W. C. Teng, Prentice hall

LIST OF EXPERIMENTS

1. Determination of geotechnical physical properties using GEOTECH software.
2. Determination of vertical load capacity analysis of piles using GEOTECH software.
3. Determination of slope stability analysis, including reinforcement like soil nails,geogrids etc using GEOTECH software.
4. Analysis of embedded retaining walls like sheet pile, secant and diaphragm walls using GEOTECH software
5. Analysis of gravity retaining walls using GEOTECH software.

DESIGN OF REINFORCED CONCRETE STRUCTURES

Course code : 13CE305 **L –T – P: 3-0-2**
Pre Requisite: 13CE203 **Credits: 4**

Introduction to working stress method: Introduction, Design for bending, Analysis and design of singly reinforced and doubly reinforced beams.
Introduction to limit state design : Concepts of limit state design, Characteristic loads, Characteristic strength, Partial loads and Material Safety factors, Representative stress, Strain curves, Assumptions in limit state design, Stress block parameters, Limiting moment of resistance.
Singly and doubly reinforced beams: Limit state analysis and design of singly reinforced, doubly reinforced beams. **Flanged sections**: Limit state design of T and L beam sections.
Shear, torsion and bond: Limit state analysis and design of sections for shear and torsion, Concept of bond, anchorage and development length, I.S Code provisions. Design examples in simply supported beams.
Slabs: Design of one way slabs, Two way slabs, Continuous slabs using IS coefficients. **Columns**: Short and long columns Uni axial loads Uni - axial bending and bi-axial bending I.S code provisions.
Footings: Footings: Different types of footings–Design of isolated, square, rectangular and circular footings.

Text Books:

1. Pillai & Devdas Menon, “Reinforced concrete design”, 3rd Edition, Tata McGraw Hill, New Delhi, 2009.
2. A.K.Jain, “Reinforced Concrete Design”, 5th edition, Charotor Publications, 2010.
3. M.L.Gambhir, “Design of Reinforced Concrete Structures” 6th Edition, PHI, Delhi, 2013.

Reference Books:

1. N.C. Sinha and S.K Roy, “Fundamentals of Reinforced Concrete”, 4th Edition, S. Chand publishers, 2002
2. N. Krishna Raju and R.N. Pranesh, “Reinforced Concrete Design”, 8th Edition, New age International Publishers, New Delhi, 2004.

LIST OF EXPERIMENTS

NOTE: All the designs to be taught in Limit State Method. Following plates should be prepared by the students.

1. Reinforcement particulars of T-beams and L-beams.
2. Reinforcement detailing of continuous beams.
3. Reinforcement particulars of columns and footings.
4. Reinforcement particulars of footings
5. Detailing of One way slab
6. Detailing of two way slabs
7. Detailing of Continuous slabs

DESIGN OF STEEL STRUCTURES

Course Code:13CE 306 **L –T – P: 3-0-2**
Prerequisite: 13CE203 **Credits: 4**

Materials and Structural Fasteners: Rolled steel sections, Common steel structures, Advantages and Disadvantages, Types of steel, properties of structural steel, Special considerations in steel design, Loads and Load combinationsPrinciples of Limit state design, Types of riveted and welded joints, Advantages and disadvantages of riveted and welded joints, Design of Rivet, Design of welds. Tension Members: Types of sections –Net sectional area-Permissible stress-Design of axially loaded tension member-Design strength of a Tension member- Design procedure-Tension member splice-Lug angles. Compression Members: Buckling class of Cross section-Slenderness ratio-Design compressive Stress and Strength-Shapes of compression members-Design of compression members – Design of lacing and battening type columns – Design of column bases – Gusseted base. Beams: Design of laterally supported beam, Design of Laterally unsupported beam, Bending strength of laterally supported beam, Shear strength of laterally supported beam, Web buckling ,Web crippling and unsupported beams – Effective length for lateral torsional buckling, Built up beams – design of purlins -design of grillage beams. Design of Bolted and Welded Beam Connection: Types- framed connection- unstiffened seated-stiffened seated-small moment resistant-large moment resistant connections – For both Bolted and welded. Design of Beam Columns: Introduction-behaviour-second order moments-elastic torsional buckling-interaction-Eccentricity of load-Eccentrically loaded base plates. Roof Trusses: Roof trusses – Roof and side coverings – Design loads, design of purlin, Sheetings-Loads on trusses-Analysis of trusses and elements of truss-Grouping of members- end bearing

TEXT BOOKS:

1. Steel Structures (Design and Practice) by N Subramanian. Oxford University Press, New Delhi, 2010.

REFERENCE BOOKS:

1. Design of steel structures by limit state method by S.S. Bhavikatti. I.K International Publishing House Pvt. Ltd .New Delhi-110016
2. Limit state design of Steel Structures by S.K Duggal, Tata McGraw Hill publishing company Limited, New Delhi- 110008.
3. Limit State Design in Structural Steel by M R Shiyekar, PHI learning private limited, New Delhi, 2011

LIST OF EXPERIMENTS

Students are required to analyze the following structures using Software package (STRUDS and TEKLA)

1. Design of continuous beam with and without sinking of support.
2. Design of R.C.C portal frame.
3. Design of steel portal frame.
4. Design of steel Truss.
5. Design of space frame.
6. Design of a two storey R.C.C building

WATER RESOURCES ENGINEERING

Course Code:11CE307 **L –T – P: 3-1-0**
Prerequisite: Nil **Credits: 4**

Hydrology: Distribution of water over earth, characteristics of rainfall in India, major river basin of India, surface water and ground water potential. Hydrology: Definition, Hydrologic cycle; Precipitation; Measurement of precipitation, Raingauge network, Classification of storms, Detection of heterogeneity in rainfall records, Estimation of missing data, Mean rainfall over an area, frequency of point rainfall, Interception, Evaporation, Depression storage, Infiltration, Infiltration index, Runoff; Factors affecting runoff; Computation of run-off, Estimation of design peak rate of runoff. Hydrographs: Introduction, Effect of basin shape on hydrograph, components of hydrograph, Unit hydrograph; use and application of the unit hydrograph for flood hydrograph resulting from rainfall of unit duration and two or more periods of rainfall; Method of construction of unit hydrograph in different duration ; Method of super position, S-hydrograph. **Ground Water**

Hydrology: Forms of sub–surface water; Types of aquifers Aquifer; Aquitard, Aquicludes; Aquifuge; Specific yield; Specific retention; Darcy's Law, Well hydraulics; Steady radial flow to a well–Dupuit's theory for confined and unconfined aquifers; Tube wells; Open wells; Well shrouding and well development; Yield of an open well–Constant level pumping test, Recuperation test. **Soil-Water-Plant Relationship:** Composition of soil, soil texture and soil structure, Water holding capacity of soil, Soil types, Classification of soil water, Soil moisture tension, Soil moisture stress, Soil moisture Constants: Saturation capacity, Field capacity, Moisture equivalent, Permanent wilting point, temporary wilting, ultimate wilting, Available moisture, Readily available moisture; Salt problems in soil and water, reclamation of salt affected soils. **Water Requirement of Crops**: Limiting soil moisture conditions; gross command area; culturable command area; culturable cultivated and uncultivated area; kor depth and kor period; Crop period and Base period, Duty and Delta of crop, relation between duty and delta; factors affecting duty; methods of improving duty, Crop seasons and crops of India, consumptive use of water (evapo-transpiration); Consumptive irrigation requirement, Net irrigation requirement, Estimating depth and frequency of irrigation; irrigation efficiencies, Irrigation methods, types of irrigation system. **Irrigation Channels:** Classification of canal; Canal alignment; Intensity of irrigation, Net and Gross sown area, Net and Gross irrigated areas, Time factor, capacity factor, Inundation canals; Cross–section of an irrigation channel; Balancing depth; Borrow pit; Spoil bank; Land width; Maintenance of irrigation channels; Silt theories–Kennedy's theory, Lacey's regime theory. **Reservoir Planning:** Investigations for reservoir planning; Selection of site for a reservoir; Zones of storage in a reservoir; Storage capacity and yield; Mass inflow curve and demand curve; Calculation of reservoir capacity for a specified yield from the mass inflow curve; Determination of safe yield from a reservoir of a given capacity; Sediment flow in streams; Reservoir sedimentation; Life of reservoir; Reservoir sediment control; flood routing; Methods of flood routing-Graphical Method (Inflow – storage discharge curves method), Trial and error method. **Dams:** Classification; Gravity dams, Arch dams, Buttress dams, Steel dams, Timber dams, Earth dams and rock fill dams; Physical factors governing selection of type of dam and selection of site for a dam. **Earth Dams**: Types of earth dams; Causes of failure of earth dams; Criteria for safe design of earth dams; Section of an earth dam; Design to suit available materials; Seepage analysis, Seepage control measures; Slope protection.

Gravity Dams: Forces acting on a gravity dam; Combination of loading for design; Modes of failure and criteria for stability requirements; Stability analysis; Elementary profile of a gravity dam; Practical profile of a gravity dam; Limiting height of a gravity dam; High and low gravity dams; Design of gravity dams–single step method.

TEXT BOOK:

1. R.K. Linsley & J.L.H. Paulhus, 'Water Resource Engineering', McGraw Hill Book Co.
2. Engineering hydrology by K. Subramanyam, TataMcGrawHill, NewDelhi.
3. Irrigation Engineering and Hydraulic Structure by S.K.Garg; Khanna Publishers, Delhi.
4. Asawa, G.L. (2005). Irrigation and Water Resources Engineering, New Age International Ltd.

Reference Books

1. Irrigation Water Resources and Water Power Engineering by, P. N. Modi, Standard book house, New Delhi.
2. Elementary Hydrology by V. P. Singh , PHI Publishers, New Delhi.
3. Applied Hydrology by Ven Te Chow, McGraw-Hill Book Company.

Advanced Structural Analysis

Course code :13CE308 L – T – P: 3-0-2
Pre Requisite: 13CE203 **Credits**: 4

I.L.D for Determinate Structures: Influence line for reactions, simply supported, over hang, I L

D for shear force in cantilever, simply supported, I L D for B. M cantilever, over hang and simply supported beams, position and magnitude of maximum shear force and B.M for concentrated load and udl, series of concentrated loads, absolute maximum S.F and B.M.

Analysis of Structure by Flexibility Matrix Method: Concept of flexibility coefficients, analysis of truss, indeterminate beams and rigid frames by this method (up to 2 DOF)

Analysis of Structure by Stiffness Matrix Method Concept of degrees of freedom, degree of indeterminacy and stiffness coefficients, analysis of truss, indeterminate beams and rigid frames by this method (up to 2 DOF)

Analysis of Cable and Three Hinged Structures: Solution method for cable structure, analysis of three hinged arch,

Plastic Analysis Structures Idealized stress-strain diagram, Plastic Moment of resistance, plastic modulus, shape factors for different sections, load factor, Plastic hinge and mechanism, plastic analysis of indeterminate beams and frames

Text Books:

1. Basic Structural Analysis by C S Reddy, Tata McGraw Hill publishing Company ltd. Delhi. 2nd edition 2010

Reference Books:

1. Intermediate Structural Analysis by C. K. Wang, McGraw Hill Book Company, 2010
2. Structural analysis, A Matrix Approach by Pandit & Gupta, Tata McGraw Hill publishing Company ltd. New Delhi.2008
3. Structural Analysis by T.S Thandavamoorthy, Oxford University Press, New Delhi, First edition, 2011.
4. Fundamentals of Structural Mechanics and Analysis by M L Gambhir, PHI learning private limited, New Delhi, 2011.

LIST OF EXPERIMENTS

Students are required to analyze the following structures using Software package (STRUDS / SAP 2000)

1. Analysis of continuous beam without sinking of support.
2. Analysis of continuous beam with sinking of support.
3. Analysis of continuous beam with internal hinge.
4. Analysis of portal frame without sinking of support.
5. Analysis of portal frame with sinking of support.
6. Analysis of portal frame with internal hinge.
7. Analysis of Truss without sinking of support.
8. Analysis of truss with sinking of support.
9. Analysis of space frame without sinking of support
10. Analysis of space frame with sinking of support.
11. Analysis of space frame with internal hinge.

ADVANCED DESIGN OF REINFORCED CONCRETE STRUCTURES

Course code : 13CE309	L – T – P : 3-0-2
Pre Requisite: 13CE305	**Credits : 4**

Combined footings: Introduction, Design of combined rectangular footings, combined rectangular footings with central beam, MAT foundation, Reinforcement detailing and bar bending schedule.

STRUCTURAL DESIGN OF PILE FOUNDATIONS : Types of piles, Load carrying capacity of piles, Group action in piles, Structural design of RC piles, Design of pile cap for 2 or 3 piles, Reinforcement detailing and bar bending schedule.

RETAINING WALLS : Introduction – Types of retaining walls –Active and passive earth pressure- Design principles of cantilever retaining walls with horizontal back fill –With sloping back fill. Design principles of Counter fort retaining walls with horizontal back fill. Reinforcement detailing and bar bending schedule.

RECTANGULAR WATER TANKS: Introduction – General design requirements according to Indian standard code of practice – Design of on ground and underground water tanks- Design of over head water tanks- Reinforcement detailing and bar bending schedule.

CIRCULAR WATER TANKS : Introduction – General design requirements according to Indian standard code of practice – Joints in water tanks – Circular tank with flexible joint between floor and wall – Circular tank with rigid joint between floor and wall – Design of Over head tanks - IS code method for design of circular tanks- Reinforcement detailing and bar bending schedule need to be prepared.

INTRODUTION TO PRESTRESSED CONCRETE: Historic development – General principles of Pre-stressing – Pretensioning and Post tensioning – Advantages and Limitations of Prestressed concrete – Materials – High Strength Concrete and High Tensile Steel and their characteristics. Methods and Systems of Pre-stressing; Pretensioning and Post tensioning methods – Different systems of Pre-stressing like Hoyer system, Magnel Blaton System, Freyssinet's system and Gifford Udall System. Analysis of sections for flexure; Elastic analysis of concrete beams pre-stressed with straight, Concentric, Eccentric, Bent and Parabolic Tendons.

Text Books:

1. Punmia B.C., Ashok kumar Jain & Aurn Kumar Jain, *"Reinforced concrete structures"*, volume – I, 5th Edition,Laxmi publications Pvt. Ltd., New Delhi, 2008.
2. Varghese P.C., *"Limit State Design of Reinforced Concrete Structures"*, 3rd Edition, Prentice hall of India, New Delhi,2005.

Reference Books:

1. Varghese P.C., *"Advanced Reinforced Concrete Structures"*,4th edition, Prentice hall of India, 2005.
2. Pillai S.V. and Menon D, *"Reinforced Concrete Design"*,2nd edition, Tata Mc Graw Hill, 2006.
3. Krishna Raju N, *"Advanced Reinforced Concrete Design"*,4th edition, University Press, 2007.

Codes: Relevant IS codes

LIST OF EXPERIMENTS

1. Design and drawing of Combined footing
2. Design and drawing of Mat foundation
3. Design and drawing of Piles and Pile Caps
4. Design and drawing of Cantilever Retaining Wall
5. Design and drawing of Counterfort Retaining Wall
6. Design and drawing of Rectangular Tank resting on ground
7. Design and drawing of Under ground Tank
8. Design and drawing of overhead rectangular Tank
9. Design and drawing of Over head circular Tank
10. Design and drawing of Prestressed beams using MIDAS Software

QUANTITY SURVEYING AND ESTIMATION

Course Code:13CE310 **L –T – P: 3-0-2**
Prerequisite: 13CE203 **Credits: 4**

Procedure of Estimating: Methods of estimating; Main items of work; Deduction for openings; Degree of accuracy. **Methods of Building Estimates**: Individual wall method; Centre line method; Arch masonry calculation; **Estimate of RCC works**: Estimate of RCC slab; RCC beam and RCC column with foundation. **Road Estimating:** Estimate of earthwork; Estimate of pitching of slopes; Estimate of earthwork of road from longitudinal sections; Estimate of earthwork in hill roads. **Canal Estimate:** Earthwork in canals–different cases; Breached sections/Breach closures. **Specifications:** Purpose and method of writing specifications; Detailed Specifications for Brick work; R.C.C; Plastering; Mosaic Flooring; R. R. Stone Masonry. **Analysis of Rates**: Preparing analysis of rates for the following items of work: i) Concrete ii) RCC Works iii) Brick work in foundation and super structure iv) Plastering. preparing lead statements.

PWD accounts and procedure of works: Organization of Engineering department; Work charged establishment; Contract; Tender; Tender notice; Tender Schedule; Earnest money; Security money; Measurement book; Administrative approval; Technical sanction; Plinth area; Floor Area; Carpet

area; Approximate Estimate; Plinth area estimate; Revised Estimate; Supplementary estimate, cash flow allocations yearly.
Valuation: Cost; Price & value; Methods of valuation; Out goings; Depreciation; Methods for estimating cost depreciation; Valuation of building
Contracts: Contract: types of contracts, Contract Law, EMD, Tenders, Acceptance of Contract, Breach of Contract, Cancellation of Contract, arbitration ,Re-tendering – work order, running payment, Final Bill, Completion Certificate.

TEXT BOOKS:

1. Estimating & Costing in Civil Engineering by B.N. Dutta; U. B. S. Publishers & Distributors,New Delhi.
2. Valuation of Real properties by S. C. Rangwala; Charotar Publishing House, Anand.

REFERENCE BOOKS:

1. Estimating & Costing by M. Chakraborty, S Chand Publishing House.

LABORATORY:
Estimate the following

1. Building
2. Road works
3. Water head tank
4. Bridge
5. Culverts
6. underpass

DIGITAL LOGIC DESIGN & COMPUTER ORGANIZATION

Course Code:13CS201 **L –T – P: 3-0-2**
Prerequisite: NIL **Credits: 4**

Data Representation: Number Systems: Introduction to Binary, Octal, Decimal and Hexa Decimal Number Systems and conversions from one system to the other. Arithmetic operations like Addition and Subtraction using Complementary operations, floating point representations, a **Logic gates:** Introduction to Boolean Algebra and the application Boolean algebra in various Logic Gates: **Combinational switching circuits**: Realization of various Combinational Switching Circuits in terms of NAND-NAND and NAND-NOR Circuits , Full Adder ,Half Adder, Multiplexers, De- Multiplexers, Decoders **Sequential switching circuits**: Introduction to Latches & Flip-Flops, Construction of counters and shift registers and their applications in Digital Circuits **Basic Computer organization:** Memory and CPU organization, programming SMAC with instruction set, program execution and tracing, vector operations and indexing, stacks. **Central processing unit**: Operation code decoding and encoding, Instruction set and instruction formats , Addressing modes, Register sets, clocks and timing, CPU buses, data flow, data paths and microprogramming and control flow. **Memory Organization:** semiconductor memory, dynamic and static memory, writing and reading memory, organization of RAMs, Read only memory, Cache memory, virtual memory. **Input – Output Organization:** Device interface, I/O methods**,** programming control data transfer, interrupt structures, interrupt control data transfer, DMA based data transfer, I/O processors, Bus structure, Serial data communication.

Text Books:
1.M.Morris Mano,"Digital Design",Third Edition,Pearson Education/,4th edition PHI.

Reference Books

1. V.Rajaraman and T.Radha Krishnan, "Digital logic and Computer Organization", 2009, 2nd edition/PHI.
2. M. Morris Mano, "Computer Organization and Architecture" , 3rd edition/PHI,
3. Willaim Stallings, "Computer Organization and Architecture", 7th edition/PHI.
4. Ronald J. Tocci, Neal S. Widmer, Gregory. L. Moss , Digital Systems Principles and Applications- 10th Edition ,Pearson Publisher.
5. Brian Holdsworth, Cline Woods, Digital Logic Design- 4th Edition, Elsevier.

6. Sivarama P. Dandamudi , Computer Organization–Springer International Edition.
7. John P. Hayes – Computer Architecture and Organization, 2/e, Tata McGraw hill.
8. David Harris, Sarah Harris, "Digital Design and Computer Architecture", Elsevier Science & Technology, 2012.
9. Patterson & Hennessy, "Computer Organization and Design-The Hardware/Software Interface", 4/e, Morgan Kaufmann, 2011.

HUMAN COMPUTER INTERACTION

Course Code:13CS202 **L –T – P: 3-0-2**
Prerequisite: 13ES101 **Credits: 4**

History and Overview, The Human and The Computer, Input-Output Channels , Thinking, Reasoning and problem solving, Psychology and Design of Interactive Systems, Text entry devices, positioning, pointing and drawing and display devices, Physical controls, Sensors and Special Device, Interaction, Models of interaction, Frameworks and HCI, Ergonomics, interaction styles, Elements of WIMP, Interface, Interactivity, The context of interaction, paradigms for interaction, Interaction design basics, user focus, scenarios, Navigation design, Screen Design, and layout, iteration and prototyping. HCI in the software process, Software Life Cycle, Usability Engineering, Iterative design and prototyping, Design Rationale, Design Rules, Principles to support usability, Standards, Guidelines, Golden Rules HCI Patterns, Elements of windowing systems, Programming the application, Using toolkits, User Interface, Management System. Evaluation Techniques, Goals of Evaluation, Evaluation through experts, Evaluation through user participation, choosing an evaluation method, User Support, Requirements of User Support, approaches to User Support, Adaptive help systems, desigboration models, face to face communication, planning User Support systems. Socio – organizational issues and stakeholder requirements, Organizational issues, capturing Requirements, communication and collaboration models, face to face communication, conversation, group working Dialog notation and design, Dialog design notation, diagrammatic notation , textual Dialog notation , dialog semantics, Dialog analysis and design.

TEXT BOOK:

1. Alan Dix, Janet Finlay, Gregory d Abowd, Russel Bealel,"Human Computer Interaction", 3rd edition, Pearson education 2008.
2. Dan Olsen, "Human-Computer Interaction", 1/e, Cengage Learning, 2013.

Reference Books:

1. Dan R oslen jr., Cengaga Learning, 'Human Computer Interaction', 2009.
2. John M. Corroll,"Human Computer Interaction in the new millennium" – LPE, Addison-Wesley Professional; 1/e, 2001).
3. Shosrp, Rozers, Preece , "Interaction Design"- John Wiley & Sons, 3/e, 2011.

OPERATING SYSTEMS

Course Code:13CS203 **L –T – P: 3-0-2**
Prerequisite: NIL **Credits: 4**

Introduction to Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Distributed Systems, Special-Purpose Systems. **Operating-System Structures-** Operating-System Services , User Operating-System Interface, System Calls , Types of System Calls, System Programs , Operating-System Design and Implementation, Operating-System Structure, Virtual Machines, Operating-System Generation, System Boot. **Processes-Concept**, Process Scheduling, Operations on Processes, Interprocess Communication, Examples of IPC Systems, Communication in Client-Server Systems **Systems Programming:** System Calls and library functions, introduction, Error Handling: perror (), Regular File Management, Process Management, Signals, Interprocess Communications. **Multithreaded Programming-** Multithreading Models, Thread Libraries, Threading Issues. **Process Scheduling-** Scheduling Criteria, Scheduling Algorithms, Thread Scheduling, Multiple-Processor Scheduling. **Process Synchronization-**The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization Examples, and Atomic Transactions. **Deadlocks-** System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention. Deadlock Avoidance, Deadlock Detection. Recovery from Deadlock. **Memory Management Strategies-** Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation, Example: The Intel Pentium **Virtual Memory Management-** Demand Paging , Page Replacement , Allocation of Frames , Thrashing , Memory-Mapped Files , Allocating Kernel Memory. **File-System -** The Concept of a File, Access Methods, Directory and Disk Structure, File-System Mounting, File Sharing, Protection. **File system Implementation-** File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance, Recovery, NFS, Example: The WAFL File System.

Text Books:

1.Silberschatz & Galvin, 'Operating System Concepts', 9th edition, Wiley 2012.

Reference Books:

1. W.Richard stevans,pearson,"Advanced programming in the Unix environment", 2nd edition, Pearson 2009 .
2. William Stallings ,"Operating Systems: Internals and Design Principles" ,6th edition, pearson 2009 .
3. Albert S. Woodhull , Andrew S.Tanenbaum ,"Operating Systems: Design and Implementation",Pearson Education International, 2009.
4. Harvey M. Deitel , Paul J. Deitel , David R. Choffnes: "Operating Systems" ,3/E, Pearson/Prentice Hall, 2004.
5. Crowley, "Operating System : A Design-Oriented Approach", : 1/E, Tata Mcgraw Hill Education Private Limited (2009)
6. Gary Nutt:"Operating Systems",3/E Pearson (2004) .
7. Graham Glass, King Ables ,"Linux for Programmers and users", Prentice Hall(2006)

DATABASE MANAGEMENT SYSTEMS

Course Code:13CS204 **L –T – P: 3-0-2**
Prerequisite: 13ES204 **Credits: 4**

Introduction To Database Systems, The Entity -Relationship Model, The Relational model, Relational Queries, Relational Algebra And Calculus, SQL: Queries, Programming, Triggers, Query -By-Example (QBE), Data Storage And Indexing, Storing Data: Disks And Files, File Organizations And Indexes, Tree -Structured Indexing, Hash-Based Indexing, Query Evaluation, External Sorting, Evaluation Of Relational Operators, Introduction To Query Optimization, A Typical Relational Query Optimizer, Database Design, Schema Refinement And Normal Forms, Transaction Management Overview, Concurrency Control, Crash Recovery.

Text Book:
1.Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", 3/E, Tata Mcgraw Hill 2004.

Reference Book:
1.A Silberschatz , Henry F Korth, S. Sudarshan ,"Database System Concepts" , Fifth Edition, Tata Mcgraw-Hill, 2003 .
2.Elmasri & Navathe Fundamentals of Data base Systems, 6th edition, Pearson2008.
3.Thomas M. Connolly,"Database Systems: A Practical Approach to Design, Implementation and Management" 5th Edition, Pearson (2008).
4.Hector Garcia-Molina Jeffrey D. Ullman ,"Database Systems: The Complete Book", 2/e, pearson2008.
5.Jan L. Harrington, "Relational Database Design and Implementation: Clearly Explained", 3/e, Morgan Kaufmann Publishers, 2009.

COMPUTER NETWORKS

Course Code:13CS205 **L –T – P: 3-0-2**
Prerequisite: NIL **Credits: 4**

Use of Computer Networks, Network Hardware, Network software, Reference models, Example Networks Physical Layer: The theoretical basis for Data Communication, Guided Transmission media, Modems, ADSL, Trunks and Multiplexing, switching Data Link Layer: DLL design issues. Error Detection and Correction, Elementary data link protocols, sliding window protocols. Medium Access Control Sub layer: Channel allocation problem, multiple access protocols, Ethernet, Data link Layer switching Network Layer: Network layer design issues, Routing algorithms, congestion control algorithms, Quality of service, Internetworking, network layer in the Internet Transport Layer: Transport service, Elements of transport protocols, Internet transport protocols: TCP & UDP, Performance Issues Application Layer: Domain Name System, Electronic Mail, World Wide Web.

Text Books:

1. Andrew S.Tanenbaum, Computer Networks, PHI, Fourth Edition.2003

Reference Books:

1.William Stallings, Data and Computer Communications, 7/e, Pearson Edition, ,2007
2.Behrouz A. Fourouzan, TCP/IP Protocol Suite, Tata McGraw Hill, Third Edition, 2006.
3.Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Elsevier, 2012.
4.James F. Kurose, Keith W. Ross, “Computer Networking:A Top-Down Approach”, Pearson Education, 2012.

SOFTWARE ENGINEERING

Course Code: 13CS301 **L –T – P: 3-0-2**
Prerequisite: 13ES202 **Credits: 4**

Software and Software Engineering: Nature of software, software application domains, unique nature of web applications, software engineering, software process, software engineering practice, software myths. **Process Models:** Generic process model, prescriptive process models, specialized process models, unified process, personal and team process models, product and process. **Agile development:** Agility, agile process, extreme programming and other agile process models. **Modeling:** Core principles, principles that guide each frame work activity. **Understanding Requirements:** Identify stakeholders, recognizing multiple view points, Eliciting requirements, building requirement model, negotiating requirements, validating requirements. **Requirement Modeling. Design concepts:** Design process, Design concepts, design model. **Architecture Design:** Software architecture, architectural styles, architectural design, assessing alternative architectural designs, architectural mappings using data flow. **Component-level design:** Designing class based components, conducting component level design. **User interface design:** The golden rules, user interface analysis and design, interface analysis, interface design steps**. Quality concepts:** software quality, software quality dilemma, achieving software quality. **Review Techniques,** Software **quality assurance:** Elements of software quality assurance, sqa tasks, goals. Formal approaches. **Software testing strategies:** A strategic approach to software testing, strategic issues, test strategies for conventional software, validation testing, system testing, testing **conventional applications.**

Text Books:

1.Roger S.Pressman ,”Software Enginering – A Practitioner’s Approach 7th Edition, Mc Graw Hill(2010).

Reference Books:

1.Ian Sommerville,‘Software Engineering’, Sixth Edition,Pearson Education(2001).
2.Software Engineering: Modern Approaches by, Wiley; 2 edition (April 5, 2010).
3.Shari Lawrence Pfleeger , Joanne M. Atlee :“Software Engineering: Theory and Practice” ,4/e, Prentice Hall(2009).

4.Software Engineering Best Practices: Lessons from Successful Projects in the Top Companies by Capers Jones, McGraw-Hill Osborne Media; 1 edition (October 8, 2009).
5.James F. Peters, Witold Pedrycz:"Software Engineering An Engineering Approach", 2/e, John Wiley, 2000.
6.Stephen R. Schach:" Object-Oriented and Classical Software Engineering,8/e, McGraw-Hill Science/Engineering/Math (2010) .
7.Carlo Ghezzi, Dino Mandrioli, Mehdi Jazayeri:"Fundamentals of Software Engineering", 2/e, PHI Learning. 2003.
8.Richard Schmidt, "Software Engineering: Architecture-Driven Software Development", Elsevier Science & Technology Books, 2013.

DESIGN AND ANALYSIS OF ALGORITHMS

Course Code: 13CS302 **L –T – P: 3-0-2**
Prerequisite: 13ES204 **Credits: 4**

Definition And Properties Of An Algorithm- Structured Algorithm-Recurrence And Non Recurrence Algorithm - Analysis Of Algorithm. Divide And Conquer: Merge Sort-Quick Sort-Strassen's Matrix Multiplication. Greedy Method: The General Method- Optimal Storage On Tapes-Job Sequencing With Deadlines- Knapsack Problem- Minimum Cost Spanning Trees-Single Source Shortest Path Method. Dynamic Programming: The General Method- All Pairs Shortest Path- Optimal Binary Search Tree- Multistage Graphs-0/1 Knapsack- Single Source Shortest Path Method. Backtracking: The General Method- Solution Space And Tree Organization- The Eight Queens Problem - Sum Of Subset Problem - Graph Coloring - Knapsack Problem. Branch And Bound: The General Method- 0/I Knapsack Problem- Traveling Sales Person Problem- Efficiency Consideration. Np Hard And Np Complete Problems: Basic Concepts-Cook's Theorem-NP Hard Graph Problems. PRAM Algorithms: Merging-Sorting.

Textbooks:

1.Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", 2nd Edition, University Press, 2008.

References Books:

1.Jon Kleinberg and Eva Tardos, "Algorithm Design", Pearson Education, 2006.
2.Aho A V, Hopcroft J E and Ullman J D, "Design and Analysis of Algorithms", PHI, 2006.
3.Richard Johnsonbaugh, Marcus Schaefer, "Algorithms", Pearson, 2004.
4.Anny Levitin, "Introduction to Design and Analysis of Algorithms", 2rd Edition, Person Education Press. 2007.
5.Gilles Brassard & Paul Bratley, "Fundamental Algorithms", Prentice-Hall. 1998
6.Cormen, Leizerson & Rivest, "Introduction to algorithms", 3rd Edition, Prentice-Hall, 2002.

INFORMATION ASSURANCE AND SECURITY

Course Code: 13CS303 **L –T – P: 3-0-2**
Prerequisite: 13CS205 **Credits: 4**

A Model for Network Security. **Classical Encryption Techniques:** Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Rotor Machines, Steganography**. Block Ciphers and DES:** Block Cipher Principles, DES, DES Example, Strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles. **AES:** The Origins AES, AES Structure, AES Example, AES Implementation. **Block Cipher Operation:** Multiple Encryption and Triple DES, ECB Mode, CBC Mode, CFB Mode, OFB Mode, Counter Mode, XTS Mode for Block-Oriented Storage Devices**. Pseudorandom Number Generation and Stream Ciphers:** Principles of Pseudorandom Number Generation, Pseudorandom Number, Generators, Pseudorandom

Number Generation Using a Block Cipher, Stream, Ciphers, RC4 **Public-Key Cryptography and RSA:** Principles of Public-Key Cryptosystems, the RSA Algorithm. **Other Public-Key Cryptosystems:** Diffie-Hellman Key Exchange, ElGamal Cryptosystem, Elliptic Curve Arithmetic Elliptic Curve Cryptography. **Cryptographic Hash Functions:** Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Hash Functions Based on Cipher Block Chaining, SHA, SHA-3. **MAC:** Message Authentication Requirements, Message Authentication Functions, Message Authentication Codes, Security of MACs, MACs Based on Hash Functions: HMAC, MACs Based on Block Ciphers: DAA and CMAC, Authenticated Encryption: CCM and GCM. **Digital Signatures:** Digital Signatures, ElGamal Digital Signature Scheme, Schnorr Digital Signature Scheme, Digital Signature Standard (DSS). **KMD:** Symmetric Key Distribution Using, Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys, X.509 Certificates, Public Key Infrastructure, User Authentication Protocols, Remote User Authentication Principles, Remote User Authentication Using Symmetric Encryption, Kerberos, Remote User Authentication Using Asymmetric Encryption, Federated Identity Management. **TLS:** Web Security Issues, Secure Sockets Layer (SSL), Transport Layer Security (TLS), HTTPS, Secure Shell (SSH). **EM Security:** Pretty Good Privacy (PGP), S/MIME, Domain Keys Identified Mail (DKIM). **IP Security:** IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange, Cryptographic Suites.

Text books:

1. William Stallings, "Cryptography and Network Security", 5th Edition, Pearson Education, 2010.

References Books:

1. William Stallings, "Network Security and Essentials: Applications and Standards", 3rd Edition, Pearson Education.
2. Neal Koblitz, "A Course on Number Theory & Cryptography, 2nd Edition, Springer, 1994.
3. Wenbo Mao, "Modern Cryptography: Theory and Practice", 1st Edition, Pearson, 2003.
4. Forouzon B, "Cryptography and Network Security", Indian Edition, TMH, 2010.
5. Bruice Schneier, "Applied Cryptography", 2nd Edition, Wiley, 2007

ARTIFICIAL INTELLIGENCE

Course Code:13CS304 **L –T – P: 3-0-2**
Prerequisite: 13ES204 **Credits: 4**

Introduction to AI, Problems, Problem Spaces and Search: Defining the Problem as a State space Search, Production Systems, Problem Characteristics, Production system characteristics, Issues in the Design of Search Programs. **Heuristic Search Techniques:** Generate-and-test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis. **Knowledge Representation Using Predicate Logic:** Representing Simple Facts in logic, Representing Instance and Isa Relationships, Computable Functions and Predicates, Resolution. **Representing Knowledge Using Rules:** Procedural versus Declarative Knowledge, Logic Programming, Forward versus Backward Reasoning, Matching, Control Knowledge. **Weak slot-and-filler structures**: Semantic Nets, Frames, **Strong slot-and-filler structures**: Conceptual dependency, Scripts. **Connectionist models:** Hopfield Networks, Perceptrons, Back Propagation Networks, Applications of Neural networks. **PROLOG Language:** Facts, Objects and predicates, Variables, Rules, Input and Output, Arithmetic Operations, Cut, Fail, Recursion, String operations, Dynamic databases.

Text Books:

1.Elaine Rich & Kevin Knight, 'Artificial Intelligence', 3rd Edition, (Tata McGraw Hill Edition) Reprint 2008

2.Carl Townsend, 'Introduction to TURBO PROLOG', BPB Publications. 2011

Reference Books:

1.Patrick Henry Winston, 'Artificial Intelligence', Pearson Education, 2003

2.Russel and Norvig, 'Artificial Intelligence', Pearson Education, PHI, 2003

DISTRIBUTED COMPUTING

Course Code: 13CS305 **L –T – P: 3-0-2**
Prerequisite: 13CS205 **Credits: 4**

Fundamentals · Basic Algorithms in Message-Passing Systems · Leader Election in Rings · Mutual Exclusion in Shared Memory · Fault-Tolerant Consensus · Causality and Time Simulations · A Formal Model for Simulations · Broadcast and Multicast · Distributed Shared Memory · Fault-Tolerant Simulations of Read/Write Objects · Simulating Synchrony · Improving the Fault Tolerance of Algorithms · Fault-Tolerant Clock Synchronization Advanced Topics · Randomization · Wait-Free Simulations of Arbitrary Objects · Problems Solvable in Asynchronous Systems · Solving Consensus in Eventually Stable Systems References Index.

Textbooks:

1.Hagit Attiya and Jennifer Welch, Distributed computing: fundamentals, simulations, and advanced topics, second edition. Wiley.

Reference books:

1. Nancy A. Lynch, Distributed Algorithms, Morgan Kaufmann Publishers, 2000.
2. Introduction to Distributed Algorithms by Gerard Tel, Cambridge University Press; 2 edition (October 16, 2000).
3. Concurrent and Distributed Computing in Java, Vijay K. Garg, Wiley-IEEE Press; 1st edition, 2004.

AUTOMATA THEORY AND FORMAL LANGUAGES

Course Code: 13CS306 **L –T – P: 3-0-2**
Prerequisite: 13BS206 **Credits: 4**

Automata: The methods and the Madness, Finite Automata, Regular Expressions and Languages, Properties of Regular Expressions, Context-Free Grammars and Languages, Pushdown Automata, Properties of Context-Free Languages, Turing Machines.

Textbooks:

1.John E. Hopcroft, Rajeev Motwani and Jeffery D. Ullman, "Introduction to Automata theory, Languages and Computation", 3rd Edition, Pearson Education, 2008,

References Books:

1. Harry R Lewis, Christos H Papadimitriou, "Elements of the theory of computation", 2nd Edition, PHI/Pearson Education, 1997.
2. Michel Sipser, "Theory of Computation", 1st Edition, Cengage, 2008.
3. Elaine Rich, "Automata Computability and Complexity: Theory and Applications", 1st Edition Pearson, 2012.
4. Peter Linz, "An Introduction to Formal Languages and Automata", 3rd Edition, Narosa Publishers, 1998.

COMPILER DESIGN

Course Code: 13CS401 **L –T – P: 3-0-2**
Prerequisite: 13CS306 **Credits: 4**

Language processors, the structure of a compiler, the evaluation of programming languages, the science of building a compiler, Applications of compiler technology, programming language basics. **A Simple Syntax-Directed Translator:** Syntax Definition, Syntax Directed Translation, Parsing, A Translator for Simple Expressions, Lexical Analysis, Symbol Tables, Intermediate Code Generation. **Lexical Analysis:** The role of the lexical, analyzer input buffering, specification of tokens, recognition of tokens, the lexical-analyzer generator Lex, Finite automata, from regular expressions to automata, Design of a lexical-analyzer generator, optimization of DFA-based pattern matchers. **Syntax Analysis:** Context-free Grammars, Writing a Grammar, Top-down Parsing, Bottom-Up Parsing, and o LR Parsing: Simple LR, More Powerful LR Parsers, Using Ambiguous Grammars, and Parser Generators. **Syntax- Directed Translation:** syntax-directed definition, evaluation orders for SDD's, Applications of Syntax-Directed Translation, Syntax-Directed Translation Schemes, and Implementing L-Attributed SDD's. **Intermediate- Code**

Generation: variants of syntax trees, three-address code, types and declarations, translation of expressions, type checking, control flow, back patching, switch-statements, intermediate code for procedures. **Run-time Environments:** Storage Organization, Stack Allocation of Space, Access to Nonlocal Data on the Stack, Heap Management, garbage collection, trace-based collection, short-pause garbage collection, advanced topics in garbage collection. **Code Generation:** Issues in the design of a code generator, the target language, address in the target code, basic blocks and flow graphs, optimization of basic blocks, a simple code generator, peephole optimization, register allocation and assignment, instruction selection by tree rewriting, optimal code generation for expression, dynamic programming code-generation. **Machine-Independent optimization:** The principle source of optimizations, data-flow analysis, foundations of data-flow analysis, constant propagation, partial-redundancy elimination, loops in flow graphs, region-based analysis, and symbolic analysis.

Textbooks:

1. Alfred Aho, Monica S. Lam, Ravi Sethi, Jeffrey D Ullman, "Compilers Principles, Techniques and Tools", 2nd edition, Pearson Education, 2012.

References Books:

1. Allen I. Holub "Compiler Design in C", Prentice Hall of India, 2003.
2. C. N. Fischer and R. J. LeBlanc, "Crafting a compiler with C", Benjamin Cummings, 2003.
3. K D Cooper and Linda Jorczon, "Engineering a Complier", Morgan Kaufmann, 2004.
4. D Brown, J Levine, T Mason, "LEX and YACC", O'Reilly Media, 1992.
5. Henk Alblas and Albert Nymeyer, "Practice and Principles of Complier Building with C", PHI, 2001.
6. Parag Himanshu Dave, Himanshu Bhalchandra Dave, "Compilers: Principles and Practice", 1st Edition, Pearson.

SIMULATION AND MODELLING

Course Code:13CS402 **L –T – P: 3-0-2**
Prerequisite: 13BS206 **Credits: 4**

Introduction to Simulation, Simulation Examples, General Principles, Statistical Models in Simulation, Stochastic Processes, Discrete-Time Markov Chains, Continuous- Time Markov Chains, Networks of Queues, Input Modelling, Verification and Validation of Simulation Models, Output Analysis for a Single Model.

Text Books:

1. Jerry Banks, John S Carson, Barry L Nelson, David M Nicol, "Discrete- Event System Simulation", 4th Edition, Pearson, 2007.
2. Kishore S Trivedi, "Probability& Statics with Reliability, Queing and Computer Science Applications", 2nd Edition, Wiley India, 2009.

Reference Books:

1. Geoffrey Gordon, "System Simulation", 2E, Prentice Hall, India, 2002.
2. D.S. Hira, "System Simulation", S.Chand and company Ltd, New Delhi, 2001.
3. S.Ross,"Probability Models For Computer Science", 1st Edition,Elsevier, 2001.
4. D. Gross And C. M Harris, Fundamentals Of Queueing Theory, John Wiley And Sons, 1974.
5. L. Kleinrock, Queueing Systems Vol. I & Ii, John Wiley And Sons, 1975.

DESIGN OF ELECTRONIC SYSTEMS

Course Code: 13EC201 **L –T – P: 3-0-2**
Prerequisite: 13BS103 **Credits: 4**

Introduction to Electronics and Design: Introduction, History of Electronics, Electronic Systems, Electronic Signal and Notation, Classification of Electronic Systems, Specifications of Electronic Systems, Types of Amplifiers, Design of Electronic Systems, Design of Electronic Circuits, Electronic Devices, Emerging Electronics. **Introduction to Amplifiers and Frequency Response:** Introduction, Amplifier Characteristics, Amplifier Types, Cascaded Amplifiers, Frequency

Response of Amplifiers, Miller's Theory, Frequency Response Methods, Amplifiers Design. **Introduction to operational Amplifiers and Applications:** Introduction, Characteristics of Ideal Op-Amps, Analysis of Ideal Op-Amp Circuits, Op-Amp Applications- Integrator, Differentiator Op-Amp Circuit Design. **Semiconductor Diodes:** Introduction, Ideal Diodes, Transfer Characteristics of Diode Circuits, Practical Diodes, Analysis of Practical Diode Circuits, Modeling of Practical Diodes, Zener Diodes, Light-Emitting Diodes, Power Rating, Diode Data Sheets. **Applications of Diodes:** Introduction, Diode Rectifier, Output Filters for Rectifiers, Diode Peak Detectors and Demodulators, Diode Clippers, Diode Clamping Circuits, Diode Voltage multipliers, Diode Function Generators. **Semiconductor and PN Junction Characteristics:** Introduction, Semiconductor Materials, Zero-Biased PN Junction, Reverse-Biased PN Junction, Forward-Biased PN Junction, Junction current Density, Temperature Dependences, High-Frequency AC Model. **Field-Effect Transistors:** Introduction, Junction Field Effect Transistors, Metal Oxide Field-Effect Transistors, Enhancement MOSFETs, Depletion MOSFET's, MOSFET Models and Amplifier, A MOSFET Switch, DC Biasing of MOSFET's, Common-Source (CS) Amplifiers, Common-Drain Amplifiers, Common-Gate Amplifiers, Multistage Amplifiers, DC Level Shifting and Amplifier, Frequency Response of MOSFET Amplifiers, Design of MOSFET Amplifiers. **Bipolar Junction Transistors and Amplifiers:** Introduction, Bipolar Junction Transistors, Principles of BJT Operation, Input and Output Characteristics, BJT Circuit Models, The BJT Switch, DC Biasing of Bipolar Junction Transistors, Common Emitter Amplifiers, Emitter Followers, Common Base Amplifiers, Multistage Amplifiers, The Darlington Pair Transistor, DC Level Shifting and Amplifier, Frequency Model and Response of Bipolar Junction Transistors, Frequency Response of BJT Amplifiers, MOSFETs versus BJTs, Design of Amplifiers.

TEXT BOOKS

1.Muhammad H. Rashid "Microelectronics Circuits Analysis and Design" 2nd Edition, Cengage Learning.

REFERENCES

1. Sedra Smith " Micro-electronic circuits theory and applications", Oxford press
2. Donald A. Neamen, "Microelectronics: Circuit Analysis and Design", McGraw Hill.
3. J Millman," Microelectronics", McGraw Hill.
4. Richard C. Jaeger, Travis N. Blalock," Microelectronic Circuit Design", Mc Graw Hill
5. J J Cathey," Electronic Devices and circuits', Schaum's Outline.
6. R Loxton,"Problems and Solutions in Electronics', Chapman & Hall.

SIMULATION BOOKS

1. David Baez-Lopez ," Circuit Analysis with Multisim", Morgan & Claypool Publishers
2. Paul Tobin ,'PSpice for Circuit Theory and Electronic Devices", Morgan and Claypool Publishers
3. Steven T. Karris, "Electronic Devices and Amplifier Circuits with Matlab Applications" Orchrd Publications
4. John Okyere Attia , Electronics and Circuit Analysis Using Matlab", Second Edition, CRC Press

ELECTROMAGNETIC FIELD THEORY

Course Code: 13EC202 **L –T – P: 3-0-2**

Prerequisite: 13BS103 **Credits: 4**

Vector Analysis: Introduction to vector analysis, co-ordinate systems

Electrostatics: Types of charge distributions, Coulomb's Law, Electric field intensity, Electric-field intensity due to different charge distributions, electric flux, electric flux density, Gauss's Law and applications, Divergence, Divergence theorem , Potential and Potential difference, Potential field of a point charge and a system of charges, Potential gradient, electric dipole, Poisson's and Laplace's equations. Capacitance of different configurations. Boundary conditions on E and D , Energy density in Electrostatic field **Steady Magnetic Field:** Electric current, current densities, equation of continuity. Fundamentals of steady magnetic field, Faraday's Law of Induction, Magnetic flux density, Magnetic field strength, Biot-savart's Law and applications, Ampere's circuital law, differential form of Ampere's circuital law, Curl, Stoke's theorem, Lorentz force equation, force on a current element in magnetic field, Ampere's force law, Boundary conditions on H and B, scalar and vector magnetic potentials, energy density in magnetic field. **Maxwell's Equations**: Introduction, equation of continuity for time - varying fields, Faraday's law, Inconsistency of Ampere's Law, the concept of displacement current, modified Ampere's circuital Law, Maxwell's equations for static fields and time – varying fields both in differential form and integral form. Maxwell's equations in phasor form, Boundary conditions. **Electromagnetic Waves:** Introduction, wave equations for free space, Uniform plane wave-general solution and propagation. wave equations for conducting medium. wave equations in phasor form, wave propagation in loss less medium, conducting medium, good dielectrics and good conductors, skin effect, polarization. Poynting theorem and pointing vector, complex Poynting vector. **Guided Waves:** Introduction, Waves between parallel plates, Derivation of field equations between parallel plates and propagation parameters, field components for TE waves, field components of TM waves, Propagation parameters of TE and TM waves, Guided wavelength. Transverse electromagnetic wave (TEM wave), velocities of propagation. Attenuation in parallel plane guides, wave impedances **Wave Guides:** waves in rectangular wave guides, Derivation of field equations in rectangular wave guides, propagation parameters of TE and TM waves in rectangular wave guides.

TEXT BOOKS

1. W.H. Hayt Jr , "Engineering Electromagnetic", Mc-Graw Hill – New York, 7th Edition
2. EC.Jordan, "EM waves and Radiating Systems", Pearson Education, 1997
3. GSN Raju, "Electromagnetic Field Theory and Transmission Lines", Pearson Education Pvt. Ltd., New Delhi, 2005.

REFERENCE BOOKS

1. Mathew no Sadiku, "Elements of Electromagnetics ", Oxford University Press, 2003.
2. Joseph A Edminister, "Theory and problems of Electromagnetics", 2nd edition, Scham's Outline series, Mc-Graw Hill International.
3. Fawwaz T. Ulaby," Fundamentals of Applied Electromagnetics ", Pearson Education
4. Constantine A. Balanis," Advanced Engineering Electromagnetics" John Wiley

SIMULATION TEXT BOOK

1. Karl E. Lonngren,Sava V Savov," Fundamentals of Electromagnetic with Matlab", SciTech.

BASICS OF DIGITAL SYSTEMS

Course Code: 13EC203 **L –T – P: 3-0-2**
Prerequisite: 13BS101 **Credits: 4**

Number Systems & Codes: Review of Number systems, Classification of codes, Binary, BCD, Excess – 3, Gray, Error detection & Correction and Alphanumeric codes. **Boolean Algebra:** Boolean postulates, theorems, logic gates, implementation of logic gates using universal gates, Boolean functions – standard and canonical forms, simplification of Boolean functions using theorems, K – map simplification (up to 5 variables), Quine Mc-Cluskey method (up to 5 variables). **Combinational Logic systems** General design procedure for Combinational logic circuits, Design and applications of Binary Adders and Subtractors, Comparators, Encoders, Decoders, Multiplexers and De-multiplexers, Design of BCD to 7 Segment Decoder, Code converters, Parity Generator and Checker, BCD Adder / Subtractor, Carry look ahead adders. **Sequential Logic Functions:** Flip Flops**,** excitation Tables, State Table, conversion of flip flops, Analysis of sequential logic functions, state reduction and state assignment techniques, Mealy and Moore models, Design of sequential logic functions. **Sequential Logic Circuits:** Counters: Modulus of a counter, Asynchronous or ripple counters, synchronous counters, design of counters. **Shift registers:** Bi-directional Shift register, Universal shift register, Sequence Generator, Sequence Detector. **Algorithmic State Machine (ASM) Charts:** Salient features of ASM chart, Timing considerations, Control implementation, Design with multiplexers.

TEXT BOOKS

1. M. Morris Mano, "Digital Logic and Computer Design" Pearson
2. ZviKohavi, "Switching and Finite Automata Theory" 2nd Edition, Pearson

REFERENCE TEXT BOOKS

1. Khan & Khan, "Digital Logic Design", Scitech
2. RP Jain, "Modern Digital Electronics", 3rd Edition, PHI
3. A. Anand Kumar, "Fundamentals of Digital Circuits" PHI

SIMULATION TEXT BOOKS

1. Michael D. Ciletti, **"**Advanced Digital Design with the Verilog HDL (2nd Edition)"
2. David R Smith, Paul D Franzon, "Verilog Styles for Synthesis of Digital Systems "
3. J. Bhasker, "A Verilog HDL Primer", 3rd Edition, BS Publications
4. Peter J. Ashenden "Digital Design – An Embedded System Approach using Verilog"
5. Palnitkar S., "Verilog HDL: A Guide to Digital Design & Synthesis", PHI

ANALOG ELECTRONIC CIRCUITS

Course Code:13EC205 **L –T – P: 3-0-2**
Prerequisite: 13EC201 **Credits: 4**

Feedback Amplifiers: Introduction, Feedback, Characteristics of Feedback, feedback topologies, Analysis of Feedback Amplifiers, Series-Shunt feedback, Series-Series Feedback, Shunt-Shunt Feedback, Shunt-Series Feedback, Feedback Circuit Design, Stability Analysis, Compensation Techniques. **Operational Amplifiers:** Introduction, Internal Structure of Op-Amps, Parameters and Characteristics of Practical Op-Amps, BJT Op-Amps, Analysis of the LM741 Op-Amps, Design of Op-Amps Differential Amplifiers: Introduction, Internal Structure of Differential Amplifiers, MOSFET Current Sources, MOS Differential Amplifiers, Depletion MOS Differential Amplifiers, Frequency Response of Differential Amplifiers, Design of Differential Amplifiers. **Power Amplifiers:** Introduction, Classification of Power Amplifiers, Power Transistors, Class A Amplifiers, Class B push-pull Amplifiers, Complementary Class AB push-pull Amplifiers, Class C Amplifiers, Class D Amplifiers, Class E Amplifiers, Short-Circuit and Thermal Protection, Power Op-Amps, Thermal Considerations, Design of Power Amplifiers. **Oscillators:** Introduction, Principles of Oscillators, Audio Frequency Oscillators, Radio Frequency Oscillators, Crystal Oscillators, Active-Filter Tuned Oscillators, Design of Oscillators. **Active Filters:** Introduction, Active versus Passive Filters, Types of Active Filters, First-Order Filters, The Biquadratic Function, Butterworth Filters, Transfer Function Realizations, Low pass Filters, High-Pass Filters, Band-Pass Filters, Band-Reject Filters, All-Pass Filters, Switched Capacitor Filters, Filter Design Guide Lines. **Integrated Analog Circuits and Applications:** Introduction, Circuits with Op-Amps and Diodes, Comparators, Zero Crossing Detectors, Schmitt Triggers, Square-Wave Generators, Triangular-Wave Generators, Sawtooth-Wave Generators, Voltage Controlled Oscillators, The 555 Timer, Phase Lock Loops, Voltage-to-Frequency and Frequency-to-Voltage Converters, Sample-and-hold Circuits, Digital-to-Analog Converters, Analog-to-Digital Converters, Circuit Design Using Analog Integrated Circuits.

TEXT BOOK

1. Muhammad H. Rashid "Microelectronics Circuits Analysis and Design" 2nd Edition, Cengage Learning.

REFERENCES

1. Sedra Smith " Micro-electronic circuits theory and applications", Oxford press
2. Donald A. Neamen,"Microelectronics: Circuit Analysis and Design", McGraw Hill.
3. J Millman," Microelectronics", McGraw Hill.
4. Richard C. Jaeger, Travis N. Blalock," Microelectronic Circuit Design", Mc Graw Hill
5. J J Cathey," Electronic Devices and circuits', Schaum's Outline.
6. Loxton, "Problems and Solutions in Electronics', Chapman & Hall.

SIMULATION BOOKS

1. David Baez-Lopez," Circuit Analysis with Multisim", Morgan & Claypool Publishers
2. Paul Tobin, "PSpice for Circuit Theory and Electronic Devices", Morgan and Claypool Publishers

3. Steven T. Karris, "Electronic Devices and Amplifier Circuits with Matlab Applications" Orchrd Publications
4. John Okyere Attia, Electronics and Circuit Analysis Using Matlab, Second Edition, CRC Press

CMOS VLSI Design

Course Code: 13EC206 **L –T – P: 3-0-2**
Prerequisite: 13EC201 **Credits: 4**

Technology Introduction: Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS Technologies. VLSI Fabrication, Oxidation, Lithography, Diffusion, Ion Implantation, Metallization, Integrated Resistors and Capacitors. **MOS Theory Analysis:** Basic Electrical Properties of MOS Circuits: I_{ds}-V_{ds} Relationships, MOS Transistor Threshold Voltage V_{th}, g_m, g_{ds}, Figure of Merit ω_o, Short Channel and Narrow Channel Width Effects. Pass Transistor, Transmission Gate, NMOS Inverter, Various Pull-ups, CMOS Inverter Analysis and Design, Bi-CMOS Inverters, Latch up in CMOS Circuits. **CMOS Circuits and Logic Design Rules:** MOS Layers, Stick Diagrams, Design Rules and Layout, 2µm, 1.2 µm Design Rules, Rules for Vias and Contacts, Stick Diagrams and Simple Symbolic Encodings for NMOS, PMOS, CMOS and BiCMOS Logic Gates. Scaling of CMOS Circuits. **CMOS Circuit Charactersation and Performance Estimation:** Sheet Resistance R_S and its Concept to MOS, Area Capacitance Units, Calculations - Delays, Driving Large Capacitive Loads, Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation, Reliability. **CMOS Fault models:** need for testing, manufacturing test principles,

TEXT BOOKS

1. Kamran Ehraghian, Dauglas A. Pucknell and Sholeh Eshraghiam, “Essentials of VLSI Circuits and Systems” – PHI, EEE, 2005 Edition.
2. Neil H. E. Weste and David. Harris Ayan Banerjee„ “CMOS VLSI Design” - Pearson Education, 1999.

REFERENCES BOOKS:

1. Sung-Mo Kang, Yusuf Leblebici,”CMOS Digital Integrated Circuits” TMH 2003
2. Jan M. Rabaey, “Digital Integrated Circuits” Pearson Education, 2003
3. Wayne Wolf, “Modern VLSI Design ", 2nd Edition, Prentice Hall,1998.

SIMULATION TEXT BOOKS

1. Etienne Sicard, Sonia Delmas Bendhia, “Basics of CMOS Cell Design”, TMH, EEE, 2005.

ANALOG COMMUNICATIONS

Course Code: 13EC207 **L –T – P: 3-0-2**
Prerequisite: 13ES205 **Credits: 4**

Linear Modulation Systems: Need for Modulation, Frequency Translation methods, Amplitude Modulation, Modulation Index(single tone and multi-tone), Spectrum of AM Signal, Modulators and Demodulators(envelope detector),DSB-SC Signal and its Spectrum, Balanced Modulator, SSB Signal, SSB Generation Methods, VSB generation and detection, Synchronous Detectors, Power Calculations in AM Systems, Application of AM Systems **Angle Modulation Systems**: Angle Modulation, Phase and Frequency Modulation and their Relationship, Phase and Frequency Deviation, Spectrum envelope of FM Signal, Narrow Band FM and Wide Band FM, Carson s Rule, Transmission Bandwidth, Phasor Diagram for FM and Signals, Indirect and direct methods of Frequency Modulation, Linearized model of PLL, FM demodulation employing first order PLL, Practical Considerations, Foster seely discriminator, Pre emphasis and De-emphasis, Applications: Commercial radio broadcasting, **Radio Transmitters and receivers**: Classification of Radio Transmitters, AM and FM Transmitters, SSB Transmitters. Radio receiver Types, AM super heterodyne receivers, FM Receivers, specifications of AM and FM receivers, Applications: Single chip FM radio, software radio, **Noise performance of AM and FM**: Noise in AM Systems, Figure of merit for envelope and coherent detection methods, Noise in FM receiving systems, performance comparison of AM and FM. **Pulse Modulation Transmission and Reception**: Introduction, PAM generation and detection, Pulse Time Modulation (PTM),Pulse width modulation generation and detection, Pulse Position Modulation (PPM), Applications, PAM as sampler and Pulse Width Modulation (PWM), PPM applications in communications.

TEXT BOOKS

1. H Taub & D. Schilling, Gautam Sahe, "Principles of Communication Systems, TMH, 2007, 3rd Edition.
2. Simon Haykin ,"Principles of Communication Systems ",John Wiley, 2nd Ed.

REFERENCES TEXT BOOKS

1. John G. Proakis, Masond, Salehi ,"Fundamentals of Communication Systems ",PEA, 2006.
2.Shanmugam,"Digital And Analog Communication Systems, John Wiley & Sons, Inc
3. Lathi,"Modern Digital & Analog Communications Systems 2e,Oxford University Press
4. Leon W Couch II, Digital and Analog Communication Systems, Pearson Education, 2004
5. G. Kennedy and B Davis, Electronics & Communication Systems, TMH 2004.
6. Martin S. Roden,"Analog And Digital Communications System", Shroff Publishers & Distributors Pvt. Limited

SIMULATION TEXT BOOKS

1. Paul Tobin, ,"PSpice for Analog Communications Engineering" ,Morgan & Claypool
2. M F Mesiya, "Contemporary Communication Systems ",McGraw-Hill,
3. K C Raveendranathan,"Communication Systems Modeling and Simulation Using MATLAB and Simulink', Universities Press (India) Private Ltd,

DIGITAL COMMUNICATION

Course Code:13EC308 **L –T – P: 3-0-2**
Prerequisite: 13EC207 **Credits: 4**

Introduction: Elements of digital communication system; Advantages of digital communication systems; Shannon's Information Capacity Theorem. **Pulse Modulation:** Sampling process; Quantization Process; Quantization Noise; Pulse-Code Modulation; Noise Considerations in PCM Systems; Time-Division Multiplexing; Virtues, Limitations, and Modifications of PCM; Delta Modulation; Differential Pulse-Code Modulation; Adaptive Delta Modulation. **Baseband Pulse Transmission:** Matched filter; Error rate due to noise; Inter-symbol interference; Nyquist's criterion for distortionless baseband binary transmission; Ideal Nyquist channel; Raised cosine spectrum; Correlative-level coding; Duo-binary signaling; Modified Duo-binary signaling; Baseband M-ary PAM transmission. **Signal-Space Analysis**: Geometric representation of signals; Gram-schmidt orthogonalization procedure; Conversion of the continuous AWGN channel into a vector channel; Coherent detection of signals in noise: Maximum likelihood decoding; Correlation Receiver; Probability of error; Bit versus symbol error probabilities. **Passband Data Transmission**: Introduction; Passband transmission model; Coherent phase-shift keying; Binary phase-shift keying; Quadriphase-shift keying; Offset QPSK; π/4 – shifted QPSK; M-ary PSK; Carrier-less amplitude/phase modulation. Coherent frequency-shift keying; Binary FSK; Minimum shift keying; Gaussian-filtered MSK; M-ary FSK; Detection of signals with unknown phase; Non-coherent orthogonal modulation; Non-coherent binary frequency-shift keying; Differential phase-shift keying; Comparison of digital modulation schemes using a single carrier.

TEXT BOOKS

1.Simon Haykin, "Communication Systems'', John Wiley & Sons, 4th Edition,
2.John G. Proakis & Masoud Salehi, "Communications System Engineering", 2nd edition, Pearson education.

REFERENCE BOOKS

1.Leon W Couch II, "Digital and Analog Communication Systems", Pearson,
2.B.P Lathi, "Modern Analog and Digital Communication", 3rd edition, Oxford Press.
3.Andrew J. Viterbi & Jim K. O, "Principles of Digital Communication and Coding", McGraw-Hill Book Company
4. Bernard Sklar, "Digital Communications - Fundamentals and Applications", 2E, Prentice Hall

SIMULATION BOOKS

1.Paul Tobin, "Pspice for Digital Communications Engineering", Morgan & Clay Pool.
2.Cory L Clark," Labview Digital Signal Processing and Digital Communications", McGraw Hill.
3.Dayan Adionel Guimar, "Digital Transmission A Simulation-Aided Introduction with VisSim/Comm", Springer
4. Dennis Silage, "Digital Communication Systems Using MATLAB and Simulink", Bookstand Publishing,
5. Won Y. Yang,Yong S. Cho ,Jeong W. Lee,Won G. Jeon, Jong H. Paik MATLAB/Simulink for Digital Communication",A-Jin Publishing Co., Ltd.,

DESIGN WITH PLDS AND FPGAS

Course Code:13EC312 **L –T – P: 3-0-2**
Prerequisite: 13EC203 **Credits: 4**

Introduction: Full Custom Design; Semicustom Design; Programmable Logic Devices; Notations for Programmable Logic Devices; Design Methodology Using Programmable Logic Devices; Design Soft Ware; **Programmable Read Only Memory (PROM):** Mask programmed ROM; EPROM; EEPROM; Programmable Logic Element (PLE); Combinational Logic Design using PLEs; Sequential Circuit Realization using PLEs; **Programmable Logic Devices:** Programmable Logic Device (PLD); Sequential PLD; Complex PLD; Field Programmable Gate Array (FPGA); Xilinx SRAM-Based FPGA; Comparison between FPGA, ASIC and CPLD; FPGA based system design; **Field Programmable Gate Arrays:** Introduction; The Xilinx logic Cell Array; Advanced futures of the 4000 series; The Actel ACT; Technology Trends; **New generation Architectures of Programmable Logic Device:** Erasable Programmable Logic Devices; Reprogrammable Generic Logic Devices; Erasable Programmable Logic Array (EPLA); Generic Array Logic (GAL); Programmable Electrically Erasable Logic (PEEL);

TEXT BOOKS

1. Parag K. Lala, "Digital System Design Programmable Logic Devices", B S Publications
2. Debaprasad Das, "VLSI Design", Oxford.
3. Pak K. Chan, Samiha Mourad, "Digital Design Using Field Programmable Gate Array", Pearson Education.

REFERENCE TEXT BOOKS

1. Bob Zeidman, "Designing with PFGAs and CPLDs", CMP Books,
2. Stephen Brown Zvonko Vranesic "Fundamentals of Digital Logic with VHDL Design" McGraw-Hill, 2008

SIMULATION BOOK

1. Ian Grout,"Digital Systems Design with FPGAs and CPLDs",Newnes,
2. Scott Hauck,André Dehon,"Reconfigurable Computing: The Theory and Practice of FPGA-Based Computing", Elsevier Science.

ANTENNA AND WAVE PROPAGATION

Course Code:13EC313 **L –T – P: 3-0-2**
Prerequisite: 13EC202 **Credits: 4**

Radiation Fields Of Wire Antennas: Concept of Vector Potential, Radiation of Small Current Element. Radiation of Short Dipole, Radiation from Half-Wave Dipole and its radiation resistance & Quarter-Wave Monopole, Radiation Fields. **Antenna Fundamentals:** Radiation Patterns, Radiation Intensity, Radiation Power Density, Beam Width, Beam Area, Beam Efficiency, Directivity, Gain, Radiation Resistance, Main Lobe, Polarization, Reciprocity Principle, Antenna efficiency, Half Power Beam width, Effective Length and Effective Area, Relation between Gain, Effective Area and Radiation Resistance, relation between effective area and directivity, Effective area and effective height, Firiss Transmission Equation, Radar Range Equation, Related Problems. **Antenna Arrays:** Two Element Arrays, N- Element Linear Arrays – BSA, EFA, Directivity N-Element Linear Array with uniform spacing, Non Uniform Amplitudes, Binomial Arrays, Principal of pattern Multiplication Related Problems. **Antenna Types:** Travelling Wave Antenna, Half wave dipole, Quarter wave monopole, Folded Dipole, Yagi –Uda Antenna, Vee Antenna, Rhombic Antenna, Helical Antenna, Horn antenna, Slot antenna, Biconical antenna, Concept of frequency Independent antennas, Logperiodic **Reflector and Lens antennas** Focusing in Paraboloid Reflectors–Geometry, Types of feeds, Importance of F/D Ratio, Cassegrain Feed system, Focusing in a Lens Antenna – Dielectric Lenses & Metal Plane Lens Antenna. Corner Reflector(90^o only). **Antenna Measurements:** Introduction, Impedance/VSWR measurements, Scattering parameters Types of of Ranges: Anechoic Chamber, Elevated Ranges, Slant Range Ground Ranges, Near Field Ranges, CATR, Radiation Pattern measurements, Gain Measurements **Wave Propagation:** The Three basic types of Propagation; Ground wave, space wave & sky wave propagation. **Ground Wave propagation:** Attenuation characteristics for Ground wave Propagation, Summerfield analysis of Ground wave, Losses due to earth constants. **Space Wave propagation:** Effect of curvature of an Ideal earth, Atmospheric effects in Space-wave propagation, Duct Propagation, Maximum range of distance for LOS. **Sky Wave Propagation:** Structure of Ionosphere Propagation, Refraction and Reflection of sky waves by Ionosphere, Critical frequency, Skip distance, Maximum unable Frequency, Virtual Height.

TEXT BOOKS

1.C.A Balanis, "Antenna Theory", John Wiley & Sons, 2nd ed.

2.E.C. Jordan and K.G. Balamain, "Electromagnetic Waves and Radiating Systems". 2nd ed., Pearson

3. Evans, Gray E," Antenna Measurements Techniques", Artech House, Inc

REFERENCE BOOKS

1. John D Kraus, "Antennas". 2nd ed., Mc Graw-Hill
2. F.E.Terman , "Radio Engineering", MC Graw Hill
3. Warren L. Stutzman, Gary A. Thiele," Antenna Theory and Design, Second Edition , John Wiley & Sons, Inc
4. Yi Huang, Kevin Boyle ," Antennas From Theory to Practice, John Wiley and Sons
5. J S Hollis, T J Lyon, L Clayton," Microwave Antenna Measurements, Scientific Atlants, Inc
6. Vincent F. Fusco, "Foundations of Antenna Theory and Techniques, Pearson Education
7. SAMUEL Silver, Microwave Antenna Theory And Design, First Edition, Mc-Graw-Hi Hill
8. Henery Jasik, "Antenna Engineering Handbook, Third Edition, Mc-GRAW-HI Hill
9. Robert E Collin, "Antenna and Radio Wave Propagation, "Mc-GRAW-HI Hill

SIMULATION BOOK

1. Sophocles J. Orfanidis, " Electromagnetic Waves and Antenna"
2. Binboga Siddik Yarman,"Design of Ultra Wideband Antenna Matching Networks",Springer,
3. Leo Diaz,"Antenna Engineering Using Physical Optics: Practical CAD Techniques and Software", Artech House

MICROWAVE ENGINEERING

Course Code:13EC314 **L –T – P: 3-0-2**
Prerequisite: 13EC202 **Credits: 4**

Introduction: Limitations of Conventional tubes at Microwave frequencies, Klystron: Velocity – modulation process. Bunching process, output power and beam loading, Multicavity Klystron amplifiers: beam current density, output current and output power of two cavity Klystron, reflex Klystron, Velocity modulation, Power output and efficiency. **Microwave Tubes:** Traveling Wave tubes, Microwave crossed field tubes: Cylindrical Magnetron, CFA and BWO **(Qualitative analysis only)**.**Microwave Passive Components:** Microwave Probes, Wave guide bends and twists, wave guide Tees, Tee junction parameters, fields and currents in tee junctions, theorems on Tee junctions, Scattering Matrix–Significance, Formulation and Properties, S Matrix Calculations for – 2 port Junctions. Scattering parameters for shunt or H-plane tee, scattering parameters for series of E-plane Tee, Equivalent circuit of magic tee, scattering parameters of Magic Tee, and applications of magic tee. Directional couplers, coupler parameters, directional couplers in use, applications of directional couplers, Attenuators, microwave resonators, rectangular and cylindrical cavity resonators. **Microwave Solid-State Devices:** Microwave tunnel diode, Avalanche transit time diodes: Read diode, IMPATT diode, TRAPATT diode, Gunn Effect diodes and modes of operation, BARITT Diode, Graphine, Strip and Micro strip. Point Contact Diode. **Microwave Measurements:** Ferrite Devices, Faraday Rotation Isolator, Circulator, Gyrator (elementary principles only), scattering parameters for Circulator and Isolator. Microwave Power Measurement, Attenuation Measurement, Standing Wave ratio Measurements –Measurement of Low and High VSWR, Cavity Q, Impedance Measurements. Basic principle of operation of Network analyzer, Spectrum Analyzer &signal Analyzer.

TEXT BOOKS

1.Samuel Y Liao," Microwave Devices and Circuits" Pearson Education

2. RE Collin, "Foundations for Microwave Engineering", IEEE Press Series,

3. GSN Raju," Microwave Engineering", IK International Publications

REFERENCE BOOKS

1. ML Sisodia & GS Raghuvamshi, "Microwave Circuits and Passive Devices".
2. Mathew. R. Radmanesh, "RF & Microwave Engineering",PHI-2001
3. David M. Pozar, "Microwave and RF Design of Wireless systems" , John Willey & Sons, 2001.
4. Peter A. Rizzi," Microwave Engineering Passive Circuits," Pearson Education
5. Annapurna Das, Sisir K. Das," Microwave Engineering", Tata McGraw-Hill Education

DSP PROCESSORS & ARCHITECTURE

Course Code:13EC415 **L –T – P: 3-0-2**

Prerequisite: 13EC205 **Credits: 4**

Introduction to Digital Signal Processing: Review of a digital signal-processing system, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time Invariant Systems, Digital filters IIR and FIR, Decimation and interpolation. Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic range and precision, Sources of error in DSP implementations, ADC and DAC conversion errors, DSP computational errors, Compensating filter. Architectures for Programmable DSP Devices: Basic Architectural features, DSP computational building blocks, Bus architecture and memory, Data addressing capabilities, Address generation unit, Programmability and program execution, Speed issues, Features for external interfacing. Execution Control and Pipelining: Hardware looping, Interrupts, Stacks, Relative Branch support Pipelining and Performance, Pipeline Depth, Interlocking, Branching effects, Interrupt effects, Pipeline Programming models. Programmable Digital Signal Processors: Commercial DSP Devices, Data Addressing modes of TMS320C54XX, DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline operation of TMS320C54XX Processors. Implementations of Basic DSP Algorithms: The Q-notation, FIR Filters, IIR Filters, Interpolation Filters, Decimation Filters, PID Controller, Adaptive Filters, 2-D Signal Processing, An FFT Algorithm for DFT Computation, A Butterfly Computation, Overflow and scaling, Bit-Reversed index generation, An 8-Point FFT implementation on the TMS320C54XX, Computation of the signal spectrum. Interfacing Memory and I/O Peripherals to Programmable DSP Devices: Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA), A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC-DSP interface example.

TEXT BOOKS

1. Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004..
2. DSP Processor Fundamentals, Architectures & Features - Lapsley et al. S. Chand & Co, 2000.

REFERENCE BOOKS

1.Digital Signal Processors, Architecture, Programming and Applications – B. Venkata Ramani and M. Bhaskar, TMH, 2004.

2. Digital Signal Processing –Principles, Algorithms Applications by J.G. Proakis & D.G. Manolokis, PHI, 2005.

3. Texas Instruments tutorials and notes.

MICRO-PROCESSORS & MICRO-CONTROLLERS

Course Code: 13EC311 **L –T – P: 3-0-2**
Prerequisite: 13EC203 OR 13CS201 **Credits: 4**

8086 Microprocessor: Introduction to Microprocessor, Intel Microprocessor families ,8086 Microprocessor architecture, Register Organization, Pin Description, Physical Memory Organization, Modes of operation. **8086 Instruction set & Assembly Language programming:** Addressing modes, Instruction set, Assembler directives, simple Programs, Procedures and Macros, 8086 Interrupts. **8051 Microcontroller:** Microcontroller families, 8051 Architecture, Signal Description, Register organization, Internal RAM, Special Function Registers, Interrupt control flow, Timer/Counter Operation, Serial Data Communication, and RS-232C Standard.**8051 Programming & Interfacing:** Addressing modes, Instruction set, Simple Programs involving Arithmetic and Logical Instructions, Timers/Counters, Serial Communication & Interrupts. **Interfacing:** Matrix Key Board, Stepper Motor, LCD's, DAC & ADC. **Introduction to ARM Processor:** Architecture, Registers, Pipe Line, Interrupts, Architecture revisions, ARM Instructions, LPC 2148 Architecture, GPIO.

TEXT BOOKS

1.D.V.Hall "Microprocessor and Interfacing", 2nd Edition Tata McGraw Hill Publishing Company.
2.Mazidi & Mc Kinley "The 8051 Micro controller and Embedded systems: using assembles and C, 2nd edition.
3. Andrew N Sloss, Dominic symes," ARM System developers Guide", Elesiver

REFERENCE BOOKS

1. A.K. Ray & K. M Bhurchandi, "Advanced Microprocessors & peripherals", Tata Mc Graw Hill Publishing Company 2002.
2.Walter A Tiebel Avtar Singh", The 8088 and 8086 Microprocessor", Pearson Education
3. Rajkamal, "Microcontrollers - Architecture, Programming, Interfacing & System Design", 2nd edition, Pearson Education.
4. The 8051 Microcontroller 3E by Kenneth Ayala, Thomson Delmar Learning Edition
5. Steve Furber, "ARM system-on-chip architecture", 2e Pearson Education
6. Walter A Tiebel Avtar Singh", The 8088 and 8086 Microprocessor", Pearson Education

DC MACHINES & TRANSFORMERS

Course Code: 13EE201 **L –T – P: 3-0-2**
Prerequisite: NIL **Credits: 4**

Electromechanical Energy Conversion: Basic principle Energy, Force and Torque in singly and multiply excited systems. **DC Machines:** Working principle, construction and methods of excitation. Armature Winding- Detailed study of simple lap and wave windings. D.C. Generators emf equation. Circuit models, Armature reaction, Effect of brush shift. Compensating winding, Characteristics of various types of generators, applications. D.C. Motors: Torque equation, Circuit models Characteristics of d.c. shunt, series and compound motors, applications. Starting & Speed Control- Starting methods and speed control of d.c. shunt and series motors. Commutation- Causes of bad commutation, Methods of improvement. Testing- Direct and regenerative methods to test d.c. machines. **Transformers**: Principle, construction and operation of single phase transformers, phasor diagram, equivalent circuit, voltage regulation, losses and efficiency. Testing- Open & short circuit tests, Polarity test, Sumner's test, Separation of hysteresis and eddy current losses. Three phase Transformer: Construction, various types of connection and their comparative features. Parallel operation of single phase and three phase transformers. Autotransformers- Construction, Principle, Applications and Comparison with two winding transformer. Excitation phenomenon in transformers, Harmonics in single phase and three phase transformers, Suppression of harmonics. Phase conversion-Scott connections, Three phase to six phase conversion. Tap changing Transformers- No load and on load tap changing of transformers. Three winding Transformers. Cooling methods of transformers.

Text Books:

1. "Electrical Machines", P.S. Bimbra, 7th ed., Khanna Publishers., 2007.
2. "Electrical Machines", I.J Nagrath & D.P Kothari, 3rd ed., Tata Mc Graw-Hill, 2009.

Reference Books:

1. "Performance and Design of D.C Machines", by . A.E. Clayton & Hancock, 3rd ed., BPB Publishers, 2004.
2. "Performance and Design of A.C Machines", M.G Say, 3rd ed., BPB Publishers, 2002.
3. "Electric Machinery", by A.E.Fitzgerald, C Kingsley and S Umans, 7th ed., McGraw Hill, 2013.

FIELDS & NETWORKS

Course Code:13EE202 **L –T – P: 3-0-2**
Prerequisite: 13ES203 **Credits: 4**

Electrostatics: Co-ordinate systems, Del operator, Gradient of a scalar, Divergence of a vector, Curl of a vector.Coulomb's Law, Electric Field Intensity – Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Electric Potential, Relations Between E and V, Maxwell's Two Equations for Electrostatic Fields, Energy Density, Related Problems. Poisson's and Laplace's Equations; Capacitance – Parallel Plate, Coaxial, Spherical Capacitors, Related Problems. **Magneto Statics:** Biot-Savart Law, Ampere's Circuital Law and Applications, Magnetic Flux Density, Maxwell's Two Equations for Magnetostatic Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law, Inductances and Magnetic Energy. Related problems. **Maxwell's Equations (Time Varying Fields):**Faraday's Law and Transformer emf, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in Different Final Forms and Word Statements. Conditions at a Boundary Surface: Dielectric-Dielectric and Dielectric-Conductor Interfaces. Related Problems. **Network Synthesis:** Positive real functions – Properties and limitations of positive real functions – Synthesis of one port networks, R-L, R-C and L-C networks by Foster and Cauer forms - Numerical problems. **Filters:** Low pass, High Pass, Band Pass, Band Elimination, Prototype filters design - M-derived filters of Low Pass and High Pass-Numerical Problems.

Text Books:

1. Engineering circuit analysis by W.H.Hayt and J.E.Kimmerly, McGraw Hill, 5th Edition, 1993.
2. Mathew NO Sadiku, Elements of Electromagnetics, Oxford University Press,2011.

Reference Books:

1. William Hart Hayt, John A. Buck , Engineering Electromagnetics, McGraw-Hill Publication, 2012
2. Dr GSN Raju, Electromagnetic Field Theory and Transmission Lines, Pearson Education,2004, First edition.
3. Network analysis and synthesis by N.C.Jagan, C.Lakshmi Narayana., BS Publications,2004.
4. Network Analysis by Wadhwa, C.L., New Age International Publications, First Edition, Aug 2008.

AC MACHINES

Course Code:13EE203 **L –T – P: 3-0-2**
Prerequisite: 13EE201 **Credits: 4**

Basic concepts of AC Machines: Winding factors, generated e. m. f., m. m. f. of distributed a.c. winding, rotating magnetic field. **Induction Machines**: Constructional features, production of torque, phasor diagram, equivalent circuit, performance analysis, torque-slip characteristics.

Testing-Running light and blocked rotor test, load test. Effect of rotor resistance, deep bar and double cage induction motor. Generator Operation, Starting- Starting methods of squirrel cage and wound rotor induction motor.Speed Control- Various methods of speed control of squirrel cage and wound rotor induction motor. Effects of space harmonics. **Single phase induction motors**- Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split phase starting methods &applications. **Synchronous Machines**: Constructional features. Cylindrical rotor machine- Synchronous Generator- Generated e.m.f., circuit model and phasor diagram, armature reaction, synchronous impedance, voltage regulation and different methods for its estimation. Synchronous Motor- Operating principle, circuit model, phasor diagram, effect of load. Operating characteristics of synchronous machines, V-curves, starting methods of synchronous motors. Salient pole Machine- Two reaction theory, analysis of phasor diagram, power angle characteristics, determination of x dand xq. Parallel operation of Alternators-Synchronization and load division.

Text Books:

1. "Electrical Machines", P.S. Bimbra, 7th ed., Khanna Publishers., 2007.
2. "Electrical Machines", I.J Nagrath & D.P Kothari, 3rd ed., Tata Mc Graw-Hill, 2009.

Reference Books:

1. "Theory of Alternating Current Machinery" by Alexander S Langsdorf,2nd ed., Tata Mc Graw-Hill,2001.
2. "Performance and Design of A.C Machines", M.G Say, 3rd ed., BPB Publishers, 2002
3. "Electric Machinery", A.E. Fitzgerald, C.Kingsley and S.Umans, Mc Graw-Hill Companies, 7^{th} edition, 2013.

ELECTRICAL POWER GENERATION AND DISTRIBUTION

Course Code:11EE203 **L –T – P: 3-0-2**
Prerequisite: 13ES203 **Credits: 4**

The growth of electrical power generation, transmission and distribution systems in India. Typical layout of power system. **Hydro power stations:** Layout of Hydro power stations-Brief description of Hydro power station components: reservoir, dam, spillways, penstock, surge tank, draft tube, governors. Different types of Hydraulic turbines, power calculations.

Thermal Power Stations: Layout of Thermal power stations, Line diagram of thermal Power Station showing paths of coal, steam, water, air, ash and flue gasses.- Brief description of Thermal power station components: Economizers, Boilers, Super heaters, Turbines, Condensers, Chimney and Cooling towers. **Nuclear Power Stations:** Selection of site, nuclear Fission and chain reaction: Nuclear fuels.- Principle of operation of Nuclear reactor.-Reactor Components: Moderators, Control rods, Reflectors and Coolants.- Radiation hazards: Shielding and Safety precautions.- Types of Nuclear reactors and brief description of PWR, BWR and FBR. Principles of electric power generation using renewable energy resources– solar, wind, ocean wave energy (qualitative treatment only). **Economic Aspects of Power Generation:** Load curve, load duration and integrated load duration curves-load factor, demand factor, diversity factor, capacity factor, utilization factor and plant use factor, depreciation methods. **Tariff Methods:** Cost of Generation and their division into Fixed, Semi-fixed and Running Costs. Flat Rate, Block-Rate, two-part, three–part, and power factor tariff methods. **D.C. Distribution Systems:** Classification of Distribution Systems- Comparison of DC vs AC Distribution Systems- Requirements and Design features of Distribution Systems- Voltage Drop Calculations in D.C Distributors - Radial and Ring Main Distributor. **A.C. Distribution Systems:** Voltage Drop Calculations in A.C. Distributors - Power Factors referred to receiving end, Power Factors with respect to load points. **Substations:** Classification of substations, Indoor & Outdoor substations: Substation layout showing the location of all the substation equipment. Bus bar arrangements in the substations: Simple arrangements like single bus bar, sectionalized single bus bar, main and transfer bus bar system with relevant diagrams. Introduction to Gas Insulated Substations (GIS).

Text Books:

1. "Electrical Power Generation, Transmission and Distribution" by S.N.Singh., PHI, 2010.
2. "Generation Distribution and Utilization of Electrical power" by C.L. Wadhwa, Revised edition, New Age International (P) LIMITED, Publishers – 2006.

Reference Books:

1. "Elements of Power Station design and practice" by M.V. Deshpande, Wheeler Publishing,1999.
2. "Principles of Power Systems" by V K Mehta and Rohit Mehta, 1st edn., S.CHAND & COMPANY LTD., New Delhi 2009.
3. "Gas Insulated Substations" by M.S Naidu, International Publications Ltd., 2008.

ELECTRICAL POWER TRANSMISSION

Course Code:11EE205 **L –T – P: 3-0-2**

Prerequisite: 13EE203 **Credits: 4**

Transmission Line Parameters: Types of conductors - calculation of resistance for solid conductors, Skin and Proximity effects - Description and effect on Resistance of Solid Conductors. Calculation of inductance for single phase and three phase, single and double circuit lines, concept of GMR & GMD, symmetrical and asymmetrical conductor configuration with and without transposition. Calculation of capacitance for 2 wire and 3 wire systems, effect of ground on capacitance, capacitance calculations for symmetrical and asymmetrical single and three phase, single and double circuit lines, Numerical Problems.

Performance of Transmission Lines: Classification of Transmission Lines – Representation of short transmission lines using generalized parameters (A, B, C, D) and performance of short lines. Representation of medium lines - Nominal-T, Nominal- ∏ representations of medium lines. Representation of medium transmission lines using generalized parameters (A, B, C, D) Performance of medium transmission lines. Representation of Long Transmission Lines: Rigorous Solution. Interpretation of the Long Line Equations, Incident, Reflected and Refracted Waves - Surge Impedance and SIL of Long transmission Lines, Wave Length and Velocity of Propagation of Waves. Equivalent T and representation of long transmission lines. Representation of long transmission lines using generalized parameters (A,B,C,D).Performance of long transmission lines - Charging Current -Ferranti effect – Expressions for active and reactive powers in terms of A,B,C,D parameters with sending end and receiving end quantities.

Per Unit Representation: Representation of power system components, single line representation of power system in impedance and Reactance forms- Per-Unit System of Representation on single phase basis and on three phase basis - Per-Unit equivalent reactance representation of synchronous generator, two winding and three winding transformers - per unit representation of a three phase Power System. Advantages of per unit system- Solution of Numerical Problems

Mechanical Design of Transmission systems: Sag and Tension Calculations with equal and unequal heights of towers, Effect of Wind, temperature and Ice on weight of Conductor. **Overhead Line Insulators:** Types of Insulators, String efficiency and Methods for improvement, Numerical Problems - voltage distribution, calculation of string efficiency, Capacitance grading and Static Shielding. Corona - Description of the phenomenon, critical voltages, power loss, factors affecting corona, methods to reduce corona losses. Interference with nearby communication lines.

Underground Cables: Types of Cables, Construction, Insulating materials used in LV, HV, and EHV cables. Calculations of Insulation resistance and stress in insulation. Capacitance of Single and 3-Core belted cables. Grading of Cables - Capacitance grading, Description of Inter-sheath grading.

Text Books:

1. "Power system Analysis" by John J Grainger William D Stevenson, TMH Companies, 4th edition, 2005.
2. "Electrical power systems" - by C.L.Wadhwa, New Age International (P) Limited, Publishers, 2008.

Reference books:

1. "Modern Power System Analysis" by I.J.Nagarath and D.P.Kothari, Tata McGraw Hill, 3rd Edition.2008.
2. "Power system analysis and design' by B.R. Gupta, 3rd edition wheeler publishers 2003.

POWER SYSTEM ANALYSIS

Course Code:11EE302 **L –T – P: 3-0-2**
Prerequisite: 11EE205 **Credits: 4**

Power System Network Matrices: Review of graph theory, Bus Classification, development of system admittance matrix, Ybus, by inspection and through singular transformation, Zbus building up algorithm for systems without mutual coupling, Zbus modifications. Power Flow Methods: power flow problem formulation, Power flow solution by gauss-seidel method, Newton Raphson method in polar coordinates, flow chart. Power Flow Techniques Continued: derivation of Fast Decoupled Load flow, D C Load flow and applications. Symmetrical Fault Analysis: Short circuit of synchronous machine unloaded, Short circuit of loaded synchronous machine. Calculation of symmetrical short circuit currents for simple systems, short circuit current computation through Thevenin's theorem Symmetrical Components & Networks: Symmetrical components transformation, phase shift in Y/Δ transformers, sequence impedance of transmission lines, sequence impedance of synchronous machine, sequence impedance of transformers, construction of sequence networks, Unsymmetrical Faults: Single line-to-ground, line to line and double line to ground faults on an unloaded generator, unsymmetrical faults on power systems, single line to ground, line-to-line and double line-to-ground faults on a power system, interpretation of the interconnected sequence networks, analysis of unsymmetrical faults using bus impedance matrix, computation of circuit breaker capacities.

Text Books:

1. "Power System Analysis", John J Grainger, W D Stevenson Jr., T M H , 2003
2. "Electrical Power Systems" by C. L. Wadhwa, New Age Publications, Fourth Edition.

Reference Books:

1. "Modern Power Systems Analysis", Xi-Fan Wang, YonHua Song, Malcolm Irving, Springer International Edition, 2013.
2. "Electrical Power Transmission System Engineering Analysis and Design", Turan Gonen, CRC Press, 2009.
3. "Power system Analysis", PSR Murthy, BS Publications, Second edition, 2010.
4. "Power System Analysis", Hadi Saadat, Tata Mc Graw Hill, 2002.
5. "Modern Power System Analysis", D.P. Kothari, I.J. Nagrath, T M H New Delhi, 2003
6. "Power System Analysis, Operation and Control", Abhijit Chakraborty and Sunita Halder, (III Ed.), PHI Learning Pvt Ltd., New Delhi, 2010.
7. "Electric Energy Systems Theory: An Introduction", O.I. Elgerd, McGraw-Hill Inc.1971.

POWER ELECTRONICS

Course Code: 11EE303 **L –T – P: 3-0-2**
Prerequisite: 13ES203 **Credits: 4**

Power Semiconductor Devices: Ideal Switch Characteristics, Power Diodes, SCR, Theory of operation of SCR, Two transistor model of SCR, Characteristics and ratings, SCR turn on and turn off methods, generalized block diagram for SCR firing, R, RC, UJT and Ramp comparator, Protection of SCR, Series and parallel operation of SCRs, Brief overview of these devices with their Characteristics and applications: P-N-P-N devices, SCS, LASCR, DIAC, TRIAC, IGBT, MOSFET. **Line Frequency Phase Controlled Converters:** Rectifiers and Inverters, Introduction, Single - Phase – semi & fully controlled converters with R, RL & RLE loads, Three – Phase - semi & fully controlled converters with R, RL & RLE loads, power factor improvements, effect of load and source inductances, Single phase & Three Phase Dual Converters, Numerical Problems. **AC voltage controllers:** Introduction, Single Phase AC Voltage controllers with R, RL Loads, Three Phase AC Voltage Controllers with different loads, Applications: Induction Motor speed control, concept of SVC. **Cycloconverters:** Principle and operation of single-phase cycloconverters and applications, Three phase - cycloconverters. **Inverters:** Principle of inverter operation with various loads, single phase inverters - Performance analysis and Switch rating determination, three phase inverters (120,180 modes of operation), voltage source inverters, current source inverters, Numerical problems. **Choppers:** Principle of choppers, step up and step down choppers, different classes of chopper circuits and their analysis: Speed control of DC motors, Numerical problems.

Text Books:

1. Power Electronics Converters Applications and Design by Ned Mohan, Tore M. Undeland, Robbinds 3rd Edition, John Wiley and sons Publications
2. Power Electronics, circuits, devices and applications by M. H. Rashid, 3rdEdition, Prentice Hall (India) Publications.

Reference Books:

1. Power Electronics by Dr.P.S Bimbra Khanna Publishers-2012
2. Principles of power Electronics by John G.Kassakian, Marfin F Sehelchet, George C Verghese, First Edition ,Pearson Publications 2010
3. Power Electronics by Daniel W. Hart by TMH Edition-2011

CONTROL SYSTEMS

Course Code: 11EE304 | **L –T – P: 3-0-2**
Prerequisite: 13ES203 | **Credits: 4**

Control system terminology, examples of simple control systems, open loop and closed loop control systems, Types of control systems. **Mathematical models of physical systems:** Analogy with mechanical systems, Formulation of differential equations for electrical systems Transfer functions of open and closed loop systems, DC & AC servomotors, synchro pair as error detector, block diagram representation of control systems: block diagram algebra, signal flow graph, Mason's gain formula. **Time domain analysis:** Standard test signals – step, ramp, parabolic and impulse; impulse response, characteristic equation of feed back systems, transient response of first order and second order systems to standard test signals, time domain specifications, steady state error and error constants, Introduction to P, PI, PID controllers. **Stability analysis:** Concept of stability and conditions for stability, Routh – Hurwitz criterion, dominant poles of transfer function **Root Locus Technique:** The root locus concept, basic properties, magnitude and angle conditions, properties and construction of the complex root loci, effects of adding poles and zeros to G(s) H(s) on the root loci.

Frequency response Analysis & Design: Introduction, frequency response specifications, correlation between time and frequency response, specifications, polar (Nyquist) plot, Bode plot, phase margin and gain margin; stability analysis from Nyquist plot effect of adding poles & zeros to G(s) H(s) on the shape of polar plots. Preliminary design considerations – Introduction to lead, lag, lead - lag compensation techniques in frequency domain. **State space analysis:** Concepts of state, state variables, state vector, input vector, output vector; development of state models for simple systems, solution of state equation, the state transition matrix and its properties; characteristic equation and transfer function from state models, eigen values and eigen vectors. Diagonalization; transformation to phase variable canonical form, diagonal canonical form, Jordan canonical form. Concepts of controllability and observability.

Text Books:

1. J Nagrath & M Gopal, "Control System Engineering", 5th Edition New Age International Publication, New Delhi 2011.
2. B.C. Kuo," Automatic ontrol Systems", Prentice Hall India Publications, NewDelhi , Eighth Edition,2010.

Reference Books

1. K Ogata, "Modern Control Engineering", Prentice Hall India Publication, New Delhi , Fifth Edition,2010.
2. M.Gopal, " Control Systems Principles and Design" Tata Mc-Graw Hill Publications, Fourth Edition,2012.
3. Dhanesh N. Manik, "Control Systems", Cengage Learning Pvt. Ltd., First edition, 2012

POWER SYSTEM PROTECTION

Course Code:11EE305 **L –T – P: 3-0-2**
Prerequisite: 11EE302 **Credits: 4**

Power System Protection: Introduction, need for protective systems, nature and causes of faults, essential qualities of protection, zones of protection, primary and backup protection **Protective Relays:** Classification of protective relays & Schemes, electromagnetic relays Over current protection, IDMT relay **Distance relays:** Impedance relay, reactance, mho and off set mho relay, effect of power swings & surges, negative sequence relay Transmission Line and Feeder Protection**:** Protection of radial and ring main systems using over current relays. Tr.Line protection using distance relays(impedance relay, Reactance relay, MHO relay), 3- zone protection, under reach and over reach of distance relays. Generator Protection**:** Protection against stator and rotor faults and abnormal operating conditions such as unbalanced loading, loss of excitation, Over speeding. Transformer Protection**:** Types of faults, Over current protection, Differential protection, Differential relay with harmonic restraint, Protection against high resistance ground faults, Interturn faults, Bucholz relay. **Static, Microprocessor relays-** phase comparator, amplitude comparator, protection of lines using static relays, microprocessor based over current relay, distance relay, directional relays. Carrier Current protection scheme- phase comparison scheme. **Circuit Breakers:** arc phenomena – maintenance of the arc – losses – arc interruption theories – circuit breaker rating – characteristics of restriking voltage (RRRV)– current chopping – Classification of C.Bs: AC & DC Circuit breakers, air break CB, Air blast CB, Oil CB, Vacuum CB,SF6 CB- and their constructional features. Testing and ratings of circuit breakers. **Over Voltage Protection:** Causes of over voltages: lightning, switching, insulation failure and arching grounds, methods of *PROTECTION*-ground wire, Peterson coils, surge absorbers and diverters , location of protective apparatus – insulation coordination- neutral earthing.

Text Books:

1. Badri Ram, D N Vishwakarma, "Power System Protection and Switchgear", Tata Mc-Graw Hill Publications, 2nd Edition, 2011.
2. T S Madhava Rao, "Power System Protection – Static Relays with Microprocessor Applications", TMC, 2nd Edition, 2008.

Reference Books:

1. "Art and Science of Protective Relaying" by C.L. Mason.
2. "Power System Stability", by E.W .Kimbark, vol-II John Wiley & Sons.
3. "Power System Engineering", by Nagarath and Kothari, TMH publishing company Ltd.
4. "Electrical power systems", by C. L. Wadhawa, Wiley Eastern Ltd.
5. "A Text Book on Power System Engineering", by A. Chakrabarthi, M.L. Soni, P.V. Gupta and U.S. Bhatnagar, Dhanpat Rai & Co.
6. "Switch Gear Protection and Power Systems", by Sunil S Rao, Khanna Publications.

ELECTRICAL DRIVES

Course Code11EE307 **L –T – P: 3-0-2**
Prerequisite: 11EE303 **Credits: 4**

Introduction to drives and Characteristics: Concept and classification of Electric drives, advantages of electric drive, components of electric drives, Choice & Status of dc and ac drives

Control of Electric Drives. Fundamental torque equations, Modes of operation, Speed torque conventions and multi quadrant operation, Equivalent values of drive parameters, Components of load torques, Nature and classification of load torques, Speed control and drive classification. **DC motor Drives:** DC motors and their performance, Starting, methods of braking, speed control, Methods of armature voltage control, Transformer and uncontrolled rectifier control Controlled Rectifier fed DC Drives: Single phase fully and half controlled rectifier control of separately excited dc motor. Three phase fully and half controlled rectifier control of separately excited dc motor Dual converter control of separately excited dc motor, Rectifier control of dc series motor. **Chopper fed DC Drives:** Control of separately excited dc motors, Chopper control of series motor. Converter ratings and closed loop control. **Induction motor drives:** Three phase induction motors, Operation with unbalanced source voltages and single phasing, Operation with unbalanced rotor impedances, Starting, braking, Speed control, pole amplitude modulation, stator voltage control, Variable frequency control from voltage and current sources, rotor resistance control, slip power recovery, Variable speed constant frequency generation. **Synchronous motor drives:** Synchronous motors, Operation and fixed frequency supply, Synchronous motor variable speed drives, braking of synchronous motor. Variable frequency control of multiple synchronous motors, self-control synchronous motor drive employing load commutated thyristor inverter, starting large synchronous machines, self-control synchronous motor drive employing a cyclo converter.

Text Books:

1. G. K. Dubey, "Fundamentals of Electrical Drives" 2nd Edition, Narosa publications, 2001.
2. S.B.Dewan, G.R.Selmon & A.Straughen,(2009)" Power semiconductor drives"Wiley India Pvt.Ltd.Publishers.

Reference Books:

1. P.C Sen (1981),"Thyristor dc drives", Wiley Interscience publications
2. S.K Pillai (2005),"A First course in Electrical Drives"New Age International Publishers.
3. G. K. Dubey ,"Power Semiconductor controlled drives", Prentice Hall Inc., New Jersey 1989.
4. Vedam Subrahmanyam," Electrical Drives concepts and applications" ,Taya McGraw Hills publishers, 2008.

POWER SYSTEM OPERATION AND CONTROL

Course Code:11EE402 **L –T – P: 3-0-2**

Prerequisite: 11EE302 **Credits: 4**

Economic Operation: Review of non-linear optimization techniques with equality and inequality constraints, operating costs of thermal plants, economic operation with and without transmission losses, derivation of loss formulae, B_{mn} coefficients, penalty factors from transposed jacobian, unit commitment, Hydro-thermal optimal dispatch. **Automatic Generation Control (AGC):** Generator, load, prime-mover and governor models, steady state performance of speed governing system, Primary load-frequency loop, steady state and dynamic response, with and without integral control loop, modeling and performance of secondary load-frequency loop, extension to two-area system, tie-line power flow model, Comparison of angle stability with voltage stability, reactive power flow and voltage collapse, V-Q sensitivity analysis, Voltage stability problem and mathematical analysis, history of voltage collapse events, introduction to continuation power flow to obtain P-V curve, prevention of voltage collapse. **Rotor Angle Stability:** Dynamics of synchronous machine, power angle equation, steady state stability, transient stability, equal area criterion for SMIB system, determination of CCA & CCT for SMIB using EAC, numerical solution of swing equation using step-by-step method, introduction to multi-machine stability, factors affecting transient stability.

Text Books:

1. "Power Generation, operation and Control", by A.J. Wood and B.F. Wollenberg, John Wiley & sons, 1984.

2. “Power system Stability and Control”, by Prabha Kundur, T M H Edition, 2006.

Reference Books:

1. “Modern Power System Analysis”, by D.P. Kothari, I.J. Nagrath, T M H New Delhi, 2003.
2. “Power System Analysis”, by John J Grainger, W D Stevenson Jr., T M H , 2003
3. “Electric Energy Systems Theory: An Introduction”, by O.I. Elgerd, McGraw-Hill Inc.,1971
4. “Computer Techniques in Power System Analysis” by M.A. Pai, TMH.

COMPUTER ORGANIZATION

Course Code:13EM201 **L –T – P: 3-0-2**
Prerequisite: 13EC203 **Credits: 4**

REGISTER TRANSFER & MICRO-OPERATIONS: Register Transfer Language, Register Transfer, Bus & memory Transfers, Arithmetic Micro-operations, Logic Micro Operations, Shift Micro-operation, and Arithmetic Logic Shift Unit. **BASIC COMPUTER ORGANISATION AND DESIGN**: introduction codes, Computer Registers, Computer instructions, Timing and Control, Instruction Cycle, Memory-Reference Instruction, Input-Output and interrupt, Design of Basic Computer, Design of accumulator Logic**, MICRO PROGRAMMED CONTROL:** Control Memory, Address Sequencing, Micro-Program example, Design of Control Unit. **CENTRAL PROCESSING UNIT:** General registers Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced instruction Set Computer (RISC). **COMPUTER ARITHMETIC:** Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating-point Arithmetic Operations. **MEMORY ORGANIZATION:** Memory Hierarchy, Main Memory, Associative Memory, Cache Memory, Virtual Memory. **INPUT-OUTPUT ORGANIZATION:** Peripheral Devices, input-Output interface, Asynchronous Data Transfer, Modes of Transfer, Priority interrupt, Direct Memory Access (DMA), input –output Processor.

Text Books:

1.Morris M.Mano,” Computer Systems Arichitecture”,3rd Edition.

Reference Books:

1. John P Hayes,” Computer Arichitecture and Organization”2nd Edition
2.V.CarlHamacheret.al,” Computer Organization” 2nd Edition
3 Computer architecture and organization by Raja Raman and Radha Krishna-PHI

COMMUNICATION SYSTEMS

Course Code: 13EM202 **L –T – P: 3-0-2**
Prerequisite: 13EC205 **Credits: 4**

Amplitude Modulation techniques: Introduction to Modulation, Continuous wave AM Generation and Demodulation of AM: DSB, DSB-SC, SSB and VSB, phase and frequency modulation, narrow band and wide band F.M, Direct and indirect methods of generation of F.M, demodulation of F.M wave. **Transmitters and Receivers**: AM Transmitter and FM Transmiter, Armstrong method receiver, AM Superhetrodyne, receivers FM Superhetrodyne receivers. **Pulse modulation techniques:** Sampling Process, Types of Sampling, FDM, TDM, Modulation and Demodulation of PAM, PPM & PWM. S/N ratio of PAM, PWM, PWM & PPM, Quantization process, Quantization Noise, PCM, and DPCM **Digital Modulation Techniques**: ASK, FSK, BPSK, DPSK, QPSK, QAM, Bandwidth Efficiency, Carrier recovery, Clock recovery. **Information Theory**: Uncertainty, Information, Entropy, Source coding theorem: Shannon-Fanon coding, Huffman coding. **Codes:** Liner block codes, Cyclic codes, Convolution codes.

Text Books:

1. “Introduction to Analog and Digital Communication System” – By Simon Haykin, 2nd Edition.

2. “Communication Systems” by Singh R.P. and Sapre S.D - TMH
3. “Advanced Electronic Communication Systems” – By Wayne Tomasi, 6th Edition, PHI.

Reference Books:

1. “Analog and Digital Communications” – By Sam K.Shanmugam, Wiley
2. “Modern Digital & Analog Communication Systems” – By B.P. Lathi, 3rd Edition,

INTERNET PROGRAMMING

Course Code: 11EM301 **L –T – P: 3-0-2**
Prerequisite: 13ES202 **Credits: 4**

HTML, DHTML, Cascading Style Sheets, XML, A Closer Look at Methods and Classes, Inheritance, Packages and Inheritance, Exception Handling. Multithreaded Programming, I/O, Applets, and Other Topics, the Applet Class, Event Handling. Servlets and Java Server Pages, Database Access through the Web: Architecture for Database Access, the MySQL Database System, Database Access with JDBC and MySQL.

TEXTBOOKS:

1. Deitel & Deitel & Nieto, “Internet & World Wide Web – How to Program”, PEA, Third Edition.
2. Herbert Schildt, “Java the Complete Reference”, 7th Edition, Tata McGraw Hill, 2007. (Chapters 7,8,9,10,11,13,21,22,23,29,30)
3. Robert W. Sebesta, “Programming the World Wide Web”, 4th Edition, Pearson Education, 2008 (Chapters 1,2,3,4,5,6,7,10,11,13.3, 13.4, 13.7).

REFERENCES:

1. M. Deitel, P.J. Deitel, A.B. Goldberg, “Internet & World Wide Web, How to Program”, 4th Edition, Pearson Education, 2004.
2. Chris Bates, “Web Programming Building Internet Applications”, 3rd Edition, Wilet India, 2006.
3. Y. Daniel Liang, “Introduction to JAVA Programming”, 7th Edition, Pearson Education, 2007.
4. Xue Bai,”The Web Warrior to Web Programming”, Cengage Learning, 2003.
5. Anders Moller, Michael Schwartzbach, “An Introduction to XML and Web Technologies”, 1st Edition, Pearson Education, 2006.
6. Ivan BayRoss, “Web Enabled Commercial Application Development using HTML, DHTML, JavaScript, Perl”, BPB Publication, 3rd Edition, 2005.
7. Cay S. Horstmann, Gary Cornell, “Core Java, Volume I- Fundamentals”, 8th Edition, PrenticeHall, Sun Microsystems Press, 2008.
8. Uttam K Roy, “Web Technologies”, OXFORD University Press, 2012.
9. Jeffrey C Jackson, “Web Technologies: A Computer Science Perspective”, Pearson Education, 2009.

EMBEDDED SYSTEMS

Course Code: 11EM401 **L –T – P: 3-0-2**
Prerequisite: NIL **Credits: 4**

ES Basics: Introduction to Embedded Systems: Definition, Comparison with Loaded Systems, Challenges of Embedded systems, Application of Embedded Systems. Hardware fundamentals and devices: CHIPS, GATES, PCB, Power and decoupling, Timing Diagrams, Signal loading related issues, Clocks, Flip Flops, Memories, Micro Processors, PINS, ports, Address Resolution, Address Decoding within Micro Processors, Micro Processors VS Micro Controllers, Busses and Bus Handling, DMA, UART and RS232, PAL, FPGA, Timers, Counters, Pulse width Modulators for speed control, LCD Controllers, Key Pad Controllers, Stepper motor controllers, A/D Converters, Introduction to Temp Sensors, Flow Control devices, Humidity Control devices, Speed Control devices. Interfacing: Communication basics, Basic Terminology, Basic Protocol concepts, I/O

Addressing: Port Based Addressing, Bus Based addressing, Memory mapped I/O, Standard I/O, Interfacing Micro Processors through Interrupts and DMA, Arbitration Techniques, Multi Bus Architecture Serial Communication and Protocols: I2C, CAN, Fire-wire, USB, Parallel Communication and protocols: PCI Bus, ARM Bus, Wireless Communication and Protocols: IrDA, Blue Tooth, 802.11g. ES Software Processing Platform: Micro Processor Architecture both CISC and RISC, Interrupt Processing, Shared data problem, Interrupt Latency, Software Architectures: Round Robin, Round Robin with Interrupts, Function Queue Scheduling, RTOS, and selecting architecture. Real Time Operating Systems: Tasks and Task data, Scheduler, Reentrancy, Semaphores, Semaphore Problems, Message Queues, Mail Boxes, Pipes, Timer Functions, Event Handling, Memory Management, Interrupt Processing, and Power saving Functions. Introduction to µcos and VxWorks. Analysis, Design and Software Development: Analysis and designing Embedded Systems using RTOS: Overview, General Design Principles, Hardware and software CO design in Embedded Systems, Encapsulating Semaphores and Queues, Real Time Scheduling Considerations, Software development process and tools Testing and Debugging Techniques, Testing and Debugging Tools.

Text Books:

1. An Embedded Software Premier - David E- Siman, PEARSON Education
2. Embedded System Design - Frank Vahid / Tony Givargis, WILEY India

Reference Books:

1. Embedded / real - time systems - DR.K.V.K.K.Prasad, dreamtech
2. Embedded Systems - Raj – Kamal, Second Edition TMH

FLUID MECHANICS & HYDRAULIC MACHINES

Course Code:13ME201 **L –T – P: 3-0-2**
Prerequisite: 13ES106 **Credits: 4**

Fluid Properties: Definition of fluid, properties of fluid -density, specific weight, specific gravity, viscosity, classification of fluids, surface tension and capillarity vapour pressure.

Fluid Statics: Introduction, pressure, Pascal's law, hydrostatic law, measurement of pressure-simple and differential manometers, Total pressure and centre of pressure on vertical, horizontal, inclined and curved surfaces.

Fluid kinematics: Introduction, types of fluid flow, Discharge, Continuity equation, Continuity equation in three dimensional flow, velocity potential function and stream function.

Fluid dynamics: Introduction, Euler's equation of motion, Bernoulli's equation and applications, Dimensional analysis and model similitude

Flow through pipes: Introduction, major and minor energy losses, friction coefficient in laminar and turbulent flow, Hagen-Poiseuille law, Hydraulic gradient and total energy line, pipes in series and parallel, transmission of power through pipe, Reynold's experiment, water hammer.

Boundary layer theory: Introduction, laminar, turbulent boundary layer, boundary layer thickness, displacement thickness, momentum thickness, energy thickness, separation of boundary layer, methods of preventing separation.

Impact of jets: Introduction to impulse-Momentum equation and its applications, Force exerted by jet on fixed Target, moving target, series of curved vanes

Hydraulic Machines-Turbines: Introduction, types and classification Pelton wheel, Francis turbine, Kaplan turbine-theory, equations for work done and efficiency, design parameters, problems

Hydraulic Machines-Centrifugal pumps: Definition of pump, classification, description & general principle of working, priming & methods, work done & efficiencies of a centrifugal pump, Minimum starting speed, cavitation in centrifugal pumps, Multistage pumps, problems on centrifugal pumps.

TEXT BOOKS:

1. Fluid Mechanicsby john F Douglas,Tata McGraw-Hill publications.
2. Fluid mechanics by SK Som G Biswas,Tata McGraw-Hill publications.
3. Turbine,Compressors and Fans by S.M. Yahya,TMH

REFERENCE BOOKS:

1. Fluid Mechanics by Frank M White
2. Fluid Mechanics&Hydraulics,KR Arora,Standard Book house,New Delhi
3. Fluid Mechanics &Hydraulics,Modi&sath,standard Book House,New Delhi

APPLIED THERMODYNAMICS

Course Code:13ME202 **L –T – P: 3-0-2**
Prerequisite: 13ES201 **Credits: 4**

Pure Substances: Pure substance vapor-liquid-solid phase equilibrium in a pure substance, Independent properties of a pure substance, Tables of thermodynamic properties, Mollier Chart.

Vapor Power Cycles: Rankine cycle, methods to improve performance of the Rankine cycle, Ideal regenerative cycle, practical regenerative system, Binary vapor power cycle.

Steam Generators: Function, classification, Mountings and accessories, Modern high pressure boilers , critical and super-critical boilers, Draught- natural& forced, calculation of boiler efficiency equivalent rate of evaporation.

Steam Nozzles:, Types of nozzles, isentropic flow through nozzles, effect of friction, nozzle efficiency, critical pressure ratio and maximum discharge, calculation of throat and exit areas using Mollier diagram, supersaturated flow.

Steam Turbines: Types of steam turbines, impulse turbines, pressure and velocity compounding, velocity diagrams, work output, power, blade efficiency and stage efficiency, Reaction turbines, velocity diagrams, degree of reaction, work output, power, blade efficiency and stage efficiency, Governing of turbines, overall efficiency and reheat factor.

Steam Condensers: Jet and surface condensers, condenser vacuum and vacuum efficiency, condenser efficiency, thermodynamic analysis, air pumps, capacity of air extraction pumps.

Refrigeration: Need for refrigeration, definitions, Methods of refrigeration, vapor compression refrigeration system, vapor absorption refrigeration cycle air refrigeration system.

Psychrometry: Psychrometric properties, psychrometric chart and air-conditioning process.

TEXT BOOKS:

1. Applied Thermodynamics- T.D.Eastop-6E- Longman scientific & Technical & John Wiley, New York.

REFERENCE BOOKS:

1.	Engineering Thermodynamics	-	Cengel & Boles
2.	Engineering Thermodynamics	-	P.K.Nag, TMH, New Delhi
3.	Applied Thermodynamics	-	R.Yadav-CBH, Allahabad
4.	Power Plant Engineering (Steam & Nuclear)	-	P.K.Nag, TMH.
5.	Steam Turbines Theory & Practice	-	Kearton, ELBS

Note: use of steam tables and R&AC tables is permitted in university examinations

METALLURGY

Course Code:13ME203 **L –T – P: 3-0-2**
Prerequisite: 13ES107, 13ES103 **Credits: 4**

Introduction to Engineering materials, Crystallography, Properties of Metals and Alloys, Structure Property Relationship, Ferrous and Non Ferrous Materials, Ceramics , Composites, Nano materials, Bio materials, Smart Materials, Introduction to Methods of Studying Metal Structure, Constitution of Alloys, Phase Diagrams, Iron Carbon equilibrium phase diagram, Strengthening mechanisms, Heat Treatment of steels, cast iron, alloy steels, non ferrous metals and alloys, material testing methods, Destructive and Non Destructive, Powder Metallurgy.

Text Books:

1) Introduction to Physical Metallurgy-Sidney.H.Avner-TMH publications, Second Edition
2) Material science & Metallurgy-C.Daniel Yesudian, D G Harris Samuel-Scitech Publications, 2006 Edition

Reference Books:

1) Material science and Engineering by William D Callister,John Wiley publishers, 6th Edition.
2) Material science and Metallurgy for Engineers by Dr.V.D.Kodgire. EPH, 25th Edition 2009.
3) Material science and Engineering by V.Raghavan, PHI, Fourth Edition.

MANUFACTURING PROCESSES

Course Code: 13ME204 **L –T – P: 3-0-2**
Prerequisite: 13ES103 **Credits: 4**

Brief introduction of manufacturing, Overview on Materials of industrial interest, Classification, General Trends in Manufacturing, Environment Issues. Fundamentals of Metal Casting, Metal Casting Processes, Moulding casting Processes, Multiple use moulding casting Processes, casting defects, Inspection, Advanced Casting Techniques, Forging: Fundamentals of Forming, Bulk forming processes, defects, sheet metal working processes, Fundamentals of Joining, Classification, Design of joints, Fusion Welding, Gas Flame Processes, Arc Processes, Resistance Welding Processes, Solid State Welding Processes, Defects and Inspection, Brazing, Soldering, Adhesive Joining.

Text Book

1. Manufacturing Engineering & Technology by Serope Kalpakjian & Steven R schmid, Fourth edition, Pearson Education.
2. Manufacturing science by Amitab Ghosh & Ashok Kumar Mallik , East-west Press Pvt Ltd
3. Fundamentals of Modern Manufacturing by M.P.Grover, John Wiley and sons.

Reference Books

1. Manufacturing Technology by P.N.Rao, Vol -1, Tata McGraw-Hill Education, 2001.
2. Processes & Materials of Manufacture by Roy A Lindberg, 2nd Edition, Allyn and Bacon

STRENGTH OF MATERIALS

Course Code: 13ME205 **L –T – P: 3-0-2**
Prerequisite: 13ES106 **Credits: 4**

Simple Stresses and Strains: Introduction, Types of stress, stress strain diagram, Hooke's law, types of strains. **Axially loaded members:** Deflection of an axially loaded member, statically indeterminate structures (Stiffness method), Temperature effects. **Analysis of Stress and Strain:** Introduction, plane stress and strains, principle stress and maximum shear stress, Mohr's circle for plane stress. **Torsion: Introduction,** Torsion of a circular bar, Non uniform torsion, Transmission of power by circular shafts, Strain energy in pure shear and torsion. **Shearing Forces and Bending Moments**: Types of Beams, shear force and bending moment, relationship between load, shear force and bending moment, Shear force and bending moment diagrams.

Stresses in Beams: Introduction, Normal strains in beams, normal stresses in beams, cross section shapes of beams, shear stresses in rectangular beams, shear stresses in the webs of beams with flanges. **Deflection of beams:** Introduction, Deferential equations of the deflection curve, deflections by integration of the bending moment equation, Moment area method, Macaulay's Method. **Columns :** Buckling and Stability, Columns with Pinned ends, Columns with other support conditions, Limitations of Euler's Formula, Rankine's Formula, Columns with eccentric Axial Loads, Secant formula. **Thin pressure vessels**: Concepts of hoop and longitudinal stresses, Simple problems for cylinders and shells.

Text Books:

1. "Mechanics of Materials" by Gere & Timoshenko, CBS publishers
2. "Mechanics of Materials", SI Version by Beer P F and Johston (Jr) E R, McGraw Hill, NY.

Reference books:

1. "Strength of Materials" by Pytel A H and Singer F L, Harper Collins, New Delhi.
2. "Engineering Mechanics of Solids" SI Version, by Popov E P, Prentice Hall, New Delhi.
3. "Elements of Strength of Materials" by Timoshenko S P and Young D H, East West Press,New Delhi.
4. "Introduction to Solid Mechanics" by Shames, I. H., Pitarresi, J. M., Prentice-Hall, NJ.
5. "Strength of Materials" by S.S.Rattan. Tata McGraw Hill,

MECHANISMS AND MACHINE THEORY

Course Code: 13ME206 **L –T – P: 3-0-2**
Prerequisite: 13ES106 **Credits: 4**

Mechanisms and Machines: Kinematics and Dynamics, Mechanisms and Machines, Introduction to Plane and Space Mechanisms, Kinematic Pairs, Kinematic Chains, Kinematic Diagrams, Kinematic Inversion, Four Link Planar Mechanisms and their Inversions, Mobility and range of movement - Kutzbach and Grubler's criterion, Grashof's criterion. **Velocity analysis:** Instantaneous Centre (IC) of Velocity, Velocity analysis using IC and relative velocity method- four link mechanisms, slider crank mechanism and crank and slotted lever mechanism, rubbing velocity. **Acceleration analysis:** Acceleration Diagrams, four link mechanism, slider crank mechanism Corioli's component of acceleration and crank and slotted lever mechanism. **Cams: C**lassification of cams and followers, nomenclature, Motion of follower, cam profiles of knife edge, roller and offset followers of reciprocating motion. **Gears and Gear trains:** Gears – terminology, fundamental law of gearing, involute profile. Interference and undercutting. **Gear Trains** – simple, compound and epicyclic gear trains. **Balancing:** Introduction, Static balancing, Dynamic balancing, Transferring of a Force from one plane to another, Balancing of Several Masses in Different planes, Balancing of Reciprocating Mass, Secondary Balancing. **Dynamic force analysis**: Force analysis of Slider crank mechanism. **Gyroscopes :** Angular Velocity, Angular Acceleration, Gyroscopic Torque, Gyroscopic Effect on Naval Ships, Stability of an Automobile, Stability of a Two-Wheel vehicle.

Text Book:

1. Machines and Mechanisms-Applied Kinematic Analysis by David H. Myszka, 4th Edition, Prentice Hall
2. Kinematics and Dynamics of Machinery by Robert Norton 1st Edition, Tata McGraw - Hill Education, 2009
3. Theory of Machines and Mechanisms by Shigley J.E., and Uicker J.J., McGraw Hill, 1995.

Reference books:

1. Theory of Machine by Thomas Bevan, CBS Publications.
2. The Theory of Machines through Solved Problems, Rao, J. S., New Age International.
3. Machanisms and Machine Theory by A.Ghosh and A.K.Mallik, 3rd edition, EWP Pvt.Ltd.

4. Theory of Machine by S.S.Rattan Mc.Graw Hill
5. NPTEL lectures : [http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-Delhi/Kinematics of Machine/index.htm](http://nptel.iitm.ac.in/courses/Webcourse-contents/IIT-Delhi/Kinematics%20of%20Machine/index.htm)

I C ENGINES & GAS TURBINES

Course Code: 13ME301 **L –T – P: 3-0-2**
Prerequisite: 13ES201 **Credits: 4**

IC ENGINES: Basic engine nomenclature, Review and classification of I.C. Engines, working principles of S.I. and C.I. Engines (both 4 stroke and 2-stroke) - valve and port timing diagrams - Differences between SI & CI and 2 stroke & 4 stroke engines.

FUEL-AIR CYCLES AND THEIR ANALYSIS: Fuel-Air cycles significance, composition of cylinder gases, arable specific speeds, dissociation, comparison of air standard and fuel-air cycles, effect of operating variables.

ACTUAL CYCLES AND THEIR ANALYSIS: Comparison of air standard and actual cycles, Time loss factor, Heat loss factor, Exhaust blow down, loss due to rubbing friction.

FUEL SUPPLY SYSTEMS in S.I: Engines- Carburetion, injection system, chemically correct air-fuel ratio, Air-fuel mixture requirements, Simple float type carburetor.

FUEL SUPPLY SYSTEMS in CI Engines- Fuel supply and injection systems, Bosch fuel pump.

COMBUSTION IN SI ENGINE: Normal Combustion and abnormal combustion, importance of flame speed and effect of engine variables, pre-ignition and detonation. Knock Rating of Fuels-Octane number

COMBUSTION IN CI ENGINE: Phenomenon of Combustion, delay period and its importance, effect of engine variables, Diesel knock, Knock Rating of Fuels-Cetane number, antiknock additives

TESTING OF I.C.ENGINES: Indicator diagram, evaluation of Indicated Power, Brake power, Frictional Power, Fuel consumption, SFC, Mechanical & thermal efficiencies, mean effective pressure, air-fuel ratio, Heat balance, Engine performance curves, Variables affecting engine performance for both S.I. & C.I. Engines

GAS TURBINES: Closed and open Brayton cycle gas turbines, Analysis of closed cycle gas turbine, Compressor and turbine Efficiencies, Gas turbine cycle with inter cooling, reheat and regeneration.

JET & ROCKET PROPULSION: Basic principles of Jet propulsion - specific thrust, propulsive efficiency and overall thermal efficiency of a jet engine, Principles of Rocket propulsion, Types of rocket propulsion.

TEXT BOOKS:

1. Internal Combustion Engines Fundamentals- John B. Heywood, Pub.-McGraw Hill, New York
2. Engineering fundamental of the I.C.Engine – Willard W. Pulkrabek Pub.-PHI,India

REFERENCE BOOKS:

1. Fundamentals of I.C. Engines - P.W. Gill, J.H. Smith & Ziurys- IBH & Oxford pub.
2. Internal Combustion Engines –V. Ganesan, Pub.-Tata McGraw-Hill.
3. Gas Turbines – V. Ganesan, Pub.- Tata McGraw Hill.
4. Internal Combustion Engines & Air pollution- Obert E.F, Pub.-Hopper & Row Pub., New York

MACHINE TOOL ENGINEERING

Course Code: 13ME302 **L –T – P: 3-0-2**
Prerequisite: 13ES105 **Credits: 4**

Elementary Treatment Of Metal Cutting Processes, Mechanics Of Cutting Processes, Mechancial Drives, Vibration of machine tools and dynamic rigidity, Engine Lathe, Turret and Capstan Lathes, Automatic Lathes. Shaping, Planning, Slotting, Drilling, Boring, Grinding, Milling Machines. CNC Machine tools, Jigs & Fixtures.

Text Books:

1. Manufacturing Engineering & Technology by Serope Kalpakjian & Steven R schmid
2. Manufacturing science by Amitabh Ghosh & Ashok Kumar Mallik
3. Principles of Machine Tools by SEn and Bhattacharya

Reference Books:

1. Manufacturing Technology by P.N.Rao
2. Processes & Materials of Manufacture by Roy A Lindberg
3. Introduction to Manufacturing Process by John A Schey
4. Manufacturing science by Sen & Bhattacharya
5. CAD/CAM by Mikell. P. Grover

OPERATIONS RESEARCH

Course Code: 13ME303 **L –T – P: 3-0-2**
Prerequisite: NIL **Credits: 4**

Introduction to Operation Research: Introduction, Modeling in Operations Research, Phases of OR study, Scope and application of OR. **Linear Programming and its Applications**: Linear Programming Problem – Graphical solution of LP Problem. Simplex method, Big M method, two phase method, multiple solutions, infeasible solution, unbounded solution, degeneracy, Dual Simplex method. **Transportation:** Introduction – Methods of basic feasible solution, Optimality test, Degeneracy in transportation problem, unbalanced transportation Problem, **Assignment Problems**: Hungarian method for assignment problem, Traveling salesman problem. **Theory of Games:** Introduction, to solve the rectangular two person zero sum games, solution of rectangular games in terms of mixed strategies, solution of 2x2 games without saddle point, solution of a two person zero sum 2Xn game, Graphical method for 2Xn and nX2 games. **Inventory Control:** Introduction – EOQ with uniform rate of demand, Economic lot size with finite rate of replenishment, Quantity discounts, Deterministic model with Shortages, ABC analysis of inventory. **Dynamic Programming**: Introduction, Bellman's principle of optimality, application to shortest route problem, linear programming, tabular method. **Queuing Theory:** Introduction, single channel, Poisson arrival, exponential service time with finite population and infinite population, **Simulation:** Introduction, Monte-Carlo Simulation, Application to Inventory Control. **Project Management by PERT/CPM**: Introduction, simple network techniques, construction rules of drawing, Fulkerson's rule, Critical path method (CPM)- floats, critical path, project duration, PERT: Introduction, different Time estimates, expected time, variance, expected project duration and probability of completion. Crashing: Introduction, crashing of network, problem

Text Books:

1. Operations Research - Hamdy Taha
2. Operations Research – Hiller & Liberman.

Reference Books:

1. Quantitative Techniques – A.P. Natarajan
2. Operations Research – S.D. Sarma

METROLOGY AND INSTRUMENTATION

Course Code:13ME304 **L –T – P: 3-0-2**
Prerequisite: 13ES102 **Credits: 4**

Basic Concepts- Measurement system elements, Experimental Test Plan- Random Tests, Replication & repetition, Calibration - Sensitivity, Range, Accuracy, Standards, Traceability. Signals - Types of waveforms, Signal analysis, Signal amplitude & frequency, Fourier transform, Frequency spectrum. Measurement Systems Modelling- General model, First order systems, Second order systems, Transfer functions.

Statistical Measurement theory- Confidence intervals for means and standard deviations, Regression analysis, Data outlier detection. Uncertainty analysis- Type A and Type B, Determining combined standard uncertainty- Uncorrelated and correlated input quantities, reporting. Sampling concepts, Digital devices, D/A & A/D conversion, Data acquisition systems.
Metrology: Interferometry-, Slip gauges, Comparators, Abbe's principle, Pneumatic transducer, Electronic transducers, Angle measurement- Sine bar, angle gauges Optical instruments- Profile projectors, Autocollimators. Surface finish- Parameters, Stylus instruments. Limits and fits, Tolerancing of gauges, Evaluation of geometric tolerances, Screw thread measurements, Gear measurements. Coordinate Measuring Machines- Construction, Operation & Programming, Software, Applications. Machine Vision.
Instrumentation: Temperature measurement- Expansion thermometers, Resistance Temperature Detectors, Thermistors, Thermocouples, radiative measurements. Pressure measurements- Manometers, Elastic transducers. Strain measurements- Resistance & semiconductor strain gauges, circuits and arrangements. Force & Torque measurements.
Text Books:

1. Figliola, Richard S, & Beasley, Donald E, "Theory and Design for Mechanical Measurements", Third edition, John Wiley & Sons Inc,
2. Collett, CV, & Hope, AD, "Engineering Measurements", Second edition, ELBS/Longman.

References:

1. Chapman, W. A. J., "Workshop Technology - Part 3" Oxford & IBH Publishing Co Pvt Ltd, New Delhi.
2. Doebelin, Ernest O., "Measurement Systems", 4th edition, McGraw-Hill International.
3. Montgomery, Douglas C., "Design and Analysis of Experiments", Fifth ed, John Wiley & Sons Inc. New Delhi.
4. Taylor, B. N., and Kuyatt, C. E.,"NIST Technical Note 1297: Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results", National Institute of Standards and Technology, USA.

FINITE ELEMENT METHODS

Course Code: 13ME305 **L –T – P: 3-0-2**
Prerequisite: 13ME205 **Credits: 4**

FUNDAMENTAL CONCEPTS: Introduction, historical background, Analysis of 3-D stresses & strains, stress-strain relations, stress cubic, principal stress calculations, potential energy and equilibrium, the Rayleigh-Ritz method, Galerkin method, Saint venant’s principle, Von Mises stress. **BASIC CONCEPTS OF F.E.M. AND ONE DIMENSIONAL PROBLEMS :** Fundamental concepts, Finite Element Modeling, Coordinates and Shape functions, The Potential Energy Approach, The Galerkin Approach, Assembly of the Global Stiffness Matrix and Load Vector, Properties of Global Stiffness Matrix, The Finite Element equations; Treatment of boundary conditions, Examples of Axially Loaded Members. **ANALYSIS OF PLANE TRUSSES:** Introduction, **Plane Trusses:** Local and Global Coordinate systems, Element Stiffness Matrix, Stress Calculations, Example of plane Truss with three members. **TWO-DIMENSIONAL PROBLEMS USING CONSTANT STRAIN TRIANGLES**: Introduction, Finite Element Modeling, Constant-Strain Triangle (CST), Isoparametric Representation, Potential-Energy Approach, Element Stiffness, Force Terms Stress Calculations, Problem Modeling and Boundary Conditions. **AXISYMMETRIC SOLIDS SUBJECTED TO AXISYMMETRIC LOADING**: Introduction, Axisymmetric Formulation, Finite Element Modeling: Triangular Element, Potential-Energy Approach, Body force Term, Stress Calculations; Problem modeling and Boundary Conditions .**Scalar Field Problems**: Introduction, steady-state heat transfer, one-dimensional heat conduction, governing equation, boundary conditions, the one dimensional element. **DYNAMIC CONSIDERATIONS**: Introduction, Formulation, Element Mass Matrices, Evaluation of Eigen values and Eigen vectors; properties of Eigen vectors, Eigen value-Eigenvector Evaluation for line only.

TEXT BOOKS:

1. Tirupathi R.Chandrupatla, Introduction to Finite Elements in Engineering by Prentice hall of India Pvt. Ltd, 3rd Edition

REFERENCE BOOKS:

1. Finite Element Method by S.S.Rao, ELSEVIER Ltd, 4st Edition
2. Finite Element Method by C.Krishna Murthy, TMH, 2nd Edition.

3. David V Hutton, Fundamentals of Finite Element Analysis McGraw-Hill Int. Ed.
4. Logan D.L., A First course in the Finite Element Method, Third Edition, Thomson Learning,
5. Robert D.Cook., David.S, Malkucs Michael E Plesha , Concepts and Applications of Finite Element Analysis.
6. Reddy J.N, An Introduction to Finite Element Method, McGraw-Hill International Student Edition
7. O.C.Zienkiewicz and R.L.Taylor, The Finite Element Methods, Vol.1. The basic formulation and linear problems, Vol.1, Butterworth Heinemann.

MECHANICAL ENGINEERING DESIGN

Course Code:13ME306 **L –T – P: 3-0-2**
Prerequisite: 13ME205 **Credits: 4**

BASICS: Phases of design, General considerations and procedure in machine design, standardization, preferred numbers, Mechanical properties of materials. **DESIGN FOR STATIC STRENGTH:** Simple Stresses - Combined stresses - Torsional and Bending stresses - Factor of safety and theories of failure. **DESIGN FOR FATIGUE STRENGTH**: Stress concentration – Methods of reducing stress concentration factor, Design for fluctuating stresses, Fatigue strength and Endurance limit, Goodman diagram and Soderberg methods for combination of stresses, applications of soderberg's equation. **DESIGN OF SHAFTS AND COUPLINGS**: Shaft and its design based on strength, Design of shaft for variable load and based on stiffness. Introduction, types, uses, Design procedures for rigid and flexible rubber-bushed couplings. **POWER SCREWS**: Types - Mechanics of power screws, efficiency, **Design of Bolted joints (along with eccentric loading), WELDED JOINTS:** Design of Welded joints, Strength of welded joints, Welded joint with eccentric loading. **DESIGN OF SPRINGS:** Types, Design of Helical spring against static and fluctuating loads, Torsion springs, Spiral springs, Leaf springs. **FLYWHEEL:** Torque analysis, Solid disc flywheel, rimmed flywheel, stresses in rimmed flywheel.

TEXT BOOKS:

1. Shigley J.E, "Mechanical Engineering Design", McGraw-Hill, 1996.
2. Black P.H. and O. Eugene Adams, "Machine Design", McGraw Hill Book Co. Ltd

REFERENCE BOOKS:

1. Budynas, R. G., & Nisbett, J. K. Shigley's mechanical engineering design: McGraw-Hill.
2. Norton, R. L. Machine design: an integrated approach: Prentice Hall
3. Spotts, M. F., Shoup, T. E., & Hornberger, L. E. Design of machine elements: Pearson /Prentice Hall
4. Hamrock,B.J. et.al., Fundamentals of Machine Elements, McGraw Hill
5. Design of machine elements by Bhandari, Tata McGraw Hill book Co.
6. Machine Design by Dr.N.C.Pandya & Dr. C.S.Shah, Charotar Publishing House

"Usage of: "Design Data", P.S.G. College of Technology, Coimbatore is recommended".

HEAT TRANSFER

Course Code:13ME401 **L –T – P: 3-0-2**
Prerequisite: 13ES201 **Credits: 4**

Introduction: Modes and laws of Heat transfer, thermal conductivity, Fourier rate equation, Steady state Heat conduction, General conduction equation in Cartesian, Cylindrical and Spherical coordinates; **One-Dimensional Heat Conduction:** Heat flow through plane wall, cylinder and sphere with constant thermal conductivity, Heat flow through composite slab and cylinders, Thermal resistance, Electrical analogy, Thermal contact resistance, problems on variable thermal conductivity, critical insulation thickness for cylinders and spheres; **Conduction With Internal Heat Generation:** Simple systems with uniform heat generation in slabs, cylinders; **Extended Surfaces:** Types, Applications, Heat transfer from fins with uniform cross section, Fin efficiency and Effectiveness; **Transient Conduction:** Lumped system analysis, time constant, semi infinite body, Heisler Charts; **Principles Of Convection:** Principles of convection, Continuity, Momentum & Energy equations; **Forced Convection**: **End Flows:** Hydrodynamic and thermal boundary layers, boundary layer thickness, use of empirical relations for convective heat transfer over flat plates and cylinders, **Internal Flows:** Fully developed laminar flow, hydrodynamic and thermal entry lengths, Prandtl analogy, Turbulent flow inside tubes, Empirical relations for horizontal pipe flow, Duct flow & annulus flow; **Natural Convection:** Analysis of laminar flow on a vertical plate, Correlations for vertical plates, horizontal plates, vertical and horizontal cylinders; **Heat Exchangers:** Classification and type of heat exchangers, Flow arrangement, Overall heat transfer coefficient, Fouling factor, LMTD method of Heat exchanger analysis, correction, Effectiveness - NTU method; **Radiation:** Introduction, Radiative Properties, concept of black, white and grey body, Laws of radiation, Stefan Boltzman's law; Lamberts cosine law, Kirchhoff's law, Planck's law, Wein's law, **Radiation Heat Exchange Between Two Bodies: Shape factor,** shape factor algebra, Heat Exchange by radiation between two finite parallel surfaces, Electrical analogy, solid angle and Radiation intensity, Heat exchange by radiation between two finite black and gray surfaces, Radiation shields, Error in temperature measurement.

TEXT BOOKS:

1. Heat transfer - Cengel ,Mc Graw Hill
2. Heat Transfer – R.C.Sachdeva, New Age International Publishers Ltd.

REFERENCE BOOKS

1. Heat Transfer - A Basic Approach-- N.Ozisik , Mc Graw Hill

Introduction Heat and Mass Transfer – K Ramakrishna & P K Sarma –John Wiley

MACHINE DESIGN

Course Code:13ME402 **L –T – P: 3-0-2**
Prerequisite: 13ME205 **Credits: 4**

Bearings: Classification, modes of Lubrication, Sliding contact bearing design, bearing materials, selection of lubricant.

Rolling contact bearings- types, selection of ball, roller bearings- under static load, dynamic load.

Brakes and Clutches: Introduction to Brakes, Types, Analysis and Design of Block brakes, internal shoe Brakes, End shoe Brakes, Pivoted shoe Brakes, Band Brakes, Temperature rise, Friction materials.

Introduction to Clutches, Analysis and Design of simple and multiple disc Clutches, Cone Clutches and Centrifugal Clutch, friction materials, comparison of Brakes and Clutches.

Spur Gears :Introduction, force analysis, Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Estimation of module based on beam and wear strength, Methods of lubrication.

Helical Gears: Transverse and normal module, Virtual number of teeth, Force analysis, Beam and wear strengths, Effective load on gear tooth, Estimation of dynamic load by velocity factor and Buckingham's equation, Design of helical gears.

Bevel Gears: Straight tooth bevel gear terminology and geometric relationship, Formative number of teeth, Force analysis, Design criteria of bevel gears, Beam and wear strengths, Dynamic tooth load by velocity factor and Buckingham's equation, Effective load, Design of straight tooth bevel gears, Selection of materials for bevel gears, comparison of spiral bevel gears and hypoid gears and straight tooth bevel gears.

Design and analysis of worm gear drive

Belt Drives :Materials and construction of flat and V-belts, Geometric relationships for length of belt, Power rating of belts, Maximum power condition, Selection of flat and V-belts from manufacturer's catalogue, Belt tensioning methods, Relative advantages and limitations of flat and V-belts, Construction and applications of timing belts.

Chain Drives: Construction and materials of roller chain, Length of chain and number of links, Polygonal effect, Power rating of roller chains, Construction of sprocket wheels, Silent chains, Relative advantages and limitations-of chain drives.

I.C.Engine Components: Introduction, Design of piston, connecting rod and Crank shaft.

Text Books:

1. Shigley J.E, "Mechanical Engineering Design", McGraw-Hill, 1996.

Reference books:

1. Budynas, R. G., & Nisbett, J. K.. Shigley's mechanical engineering design: McGraw-Hill.
2. Norton, R. L. Machine design: an integrated approach: Prentice Hall
3. Spotts, M. F., Shoup, T. E., & Hornberger, L. E. Design of machine elements: Pearson /Prentice Hall
4. Black P.H. and O. Eugene Adams, “Machine Design”, McGraw Hill Book Co. Ltd.
5. Bhandari V.B., “Design of machine elements”, Tata McGraw Hill Public Co. Ltd.

“Usage of: “Design Data”, P.S.G. College of Technology, Coimbatore is recommended”.

INDUSTRIAL ENGINEERING TECHNIQUES

Course Code:13ME403 **L –T – P: 3-0-2**

Prerequisite: NIL **Credits: 4**

Work study: Techniques of work study, basic procedure of work study. **Method study**: Tools for recording techniques – Flow process chart, flow diagram, string diagram, multiple activity chart, Man-machine chart. **Micro motion study**: Therbligs, motion economy principles, SIMO chart. **Work measurement**: Stopwatch time study procedure - breaking the job into elements, timing methods, number of cycles to be timed, rating, allowances, setting standard time. **Work sampling**: Confidence levels, number of observations, use of random number table. **Inspection & Quality Control:** Concept and Types of Inspection, Quality Control Charts – SQC, Charts for variables and charts for attributes, application and construction of charts and problems. Acceptance sampling, Single and double sampling, OC curve, **Production Management:** Types of production systems, Mass production, Batch production, Job order production. Productivity and factors influencing productivity, Facility layout – definition, types – product layout, process layout, fixed position layout, cellular layout, introduction to computerized layout. **Scheduling :** Introduction, concept of assembly line balancing, scheduling of batch production, scheduling of job order, loading, sequencing,- definition, sequencing of n jobs through oe machine, n jobs through 2 machines, (Johnsons’ algorithm), sequencing of n jobs through 3 machines, n jobs through m machines. **Forecasting:** Definition, approach, types, Methods – Qualitative methods – Judgmental methods, Quantitative methods – times series, regression, Introduction to aggregate planning, Production planning & control: Introduction, definition, functions of PPC. Brief introduction to: JIT, Lean manufacturing, Six sigma, Supply chain management

Text Books:

1. Introduction to work-study -- ILO.
2. Production & Operations Management -- Adam & Ebert.

Reference Books :

1. Production & operations Management – S.N. Chari.
2. Production & operations Management -- Panner selvam.

MATERIAL & ENERGY FLOW COMPUTATION

Course Code:14PE 201 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Stoichiometry: Units and Dimensions, Conversion of Units, expressions and equations, dimensional groups and constants, Ideal and real gas laws, Behavior of ideal gases and mixtures, calculations of pressure, volume and temperature using ideal gas law, Gas mixtures, Use of partial pressure and pure component volume in gas calculations, Raoult’s law - vapor pressure, Clausius-Clapeyron equation, Cox Chart, Duhring’s Plot.

Material Balance – non-reactive systems: Material balance problems on single and multi-unit systems without involving chemical reactions - Degrees of freedom - Recycle - Bypass and Purge calculations.

Material Balance – reactive systems: Processes involving chemical reactions for single and multiple unit systems

Energy Balance: Energy balances with and without chemical reactions: Enthalpy - Heat capacity - Thermo-chemistry; Hess's law of heat summation - Heats of formation - reaction and combustion - Theoretical flame Temperature.

Combustion of coal - fuel gases and sulfur - Degree of conversion - Excess reactant - Limiting reactant.

Humidity and saturation: Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity – Dew point – Use of humidity in condensation and drying – Wet and dry bulb temperatures, Humidity chart, solving problems using humidity chart.

Combined material and Energy balance: Integrated material and energy balance equation – solving processes involving both material and energy balance equations.

Text Books:

1. Richard M. Felder and Ronald W. Rousseau, "Elementary Principles of Chemical Processes", 3rd Ed, John Wiley & Sons, INC. (2000).
2. B. I. Bhatt and S. M. Vora, "Stoichiometry", 4th Ed., Tata McGraw Hill Publishers Ltd., New Delhi, (2004).

Reference Books:

1. O. A. Hougen, K. M. Watson and R. A. Ragatz, "Chemical Process Principles", Vol- I, CBS Publishers and Distributors, New Delhi, (1995).
2. David M. Himmelblau, "Basic Principles and Calculations in Chemical Engineering", 8th Ed., Prentice Hall of India Private Limited, (2012).
3. Ernest J. Henley and Edward M. Rosen, "Material and Energy Balance Computations", John Wiley & Sons, (1969).

CHEMICAL REACTION ENGINEERING

Course Code:14PE 202 **L –T – P: 2-2-2**
Prerequisite: NIL **Credits: 4**

Basics of Kinetics: Introduction - kinetics of homogeneous reactions: concentration dependent & temperature dependent term of rate equation – searching for a mechanism - predictability of reaction rate from theory - molecularity and order of the reaction - elementary & non-elementary reactions - feasibility of a chemical reaction; Arrhenius - Collision, Transition State Theories; Interpretation of batch reactor data.

Kinetics of homogeneous reactions: Rate and equilibrium constant of 1st, 2nd, 3rd order irreversible Reactions. - 1st Order Reversible Reaction; Determination of the Rate Equation, Effect of Temperature on Reaction Rate. Displacement of Equilibrium: Le Chateller's Principle

Introduction to reactor design – ideal reactors

Design for single reactions- Introduction to reactor design- general discussion, symbols and relationship between C_A and X_A. Ideal reactors for a single reaction- Ideal batch reactor, Steady-state mixed flow reactor, Steady-state plug reactors Size comparison of single reactors, Multiple-reactor systems, Recycle reactor, Autocatalytic reactions.

Design of reactor for multiple reactions: Design for single and multiple reactions - size comparison of single reactors for single reactions - Multiple Reactor system for single reactions; parallel - series and series - parallel reactions of first order

Heat effects: Temperature and pressure effects on single and multiple reactions.

Flow behavior of Reactors: Non - ideal flow: Residence time distribution studies: C, E, F and I curves, conversion calculations directly from tracer studies. Models for non-ideal flow - dispersion and tanks in series multi-parameter models

Modes of contacting different phases: Self mixing of single fluids, mixing of two miscible fluids, Introduction. Design for heterogeneous reacting systems.

Kinetics of heterogeneous chemical reaction: Kinetics and mechanism of heterogeneous catalytic reactions - models - evaluation and elimination of internal and external diffusional resistances - effectiveness factor; solid catalyzed reactions - heat effects - controlling resistances - rates of chemisorption - adsorption isotherms - rates of adsorption and desorption.

Text Books:

1. Octave Levenspiel, "Chemical Reaction Engineering", 3rd Ed., John Wiley & Sons, (1999).
2. H. Scott Fogler, "Elements of Chemical Reaction Engineering", 4th Ed., Prentice-Hall, (2005)
3. J .M. Smith, "Chemical Kinetics", 3rd Ed., McGraw Hill, New York, (1981).

Reference Books:

1. Ronald W. Missen, Charles A. Minas, Bradley A. Saville, "Introduction to Chemical Reaction Engineering and Kinetics", John Wiley & Sons.
2. Gilbert F. Froment and Kenneth B. Bischoff, "Chemical Reactor Analysis and Design" by John Wiley & Sons.

INTRODUCTION TO PETROLEUM ENGINEERING

Course Code:14PE203 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Introduction: Overview, history and scenario of petroleum industry – Indian and Worldwide perspective, Physical and chemical properties of oil, gas and formation water. **Geology and Exploration:** Formation of petroleum, formation of petroleum reservoirs, types of rocks, parameters controlling petroleum occurrence, migration, entrapment, methods of oil exploration.

Reservoir Engineering: Reservoir rock characteristics, porosity, permeability, rock and fluid interaction, types of reservoir, recovery methods

Drilling operations: History, types of drilling – cable tool, rotary, drilling rigs and components. Types of wells – exploratory, delineation, development wells. Vertical, deviated, inclined, horizontal and ERD wells. Drilling fluids, casing and cementation. Planning – GTO, fracture, pore pressures. Role of drillers.

Well completion: Types, factors influencing well completion, perforation techniques

Introduction to surface production operations, heat transfer theory, distillation unit.

REFERENCE BOOKS:

1. Geology of Petroleum – Leverson, A.L
2. Formation Evaluation – Lynch
3. Drilling Manual – ONGC
4. Principles of oil Production – T.E.W. Wind
5. Introduction to Petroleum Engineering - Geltin
6. Petroleum Refining: Technology and Economics, Fifth Edition by James H. Gary, Glenn E. Handwerk and Mark J. Kaiser, CRC Press, 2007

SURVEYING

Course Code: 13CE205 **L –T – P: 3-0-2**

Prerequisite: NIL **Credits: 4**

Surveying, Overview of plane surveying (chain, compass and plane table), Objectives, Principles and classifications. Distances and Direction - Distance measurement conventions and methods; use of chain and tape, Electronic distance measurements, Meridians, Azimuths and Bearings, declination, computation of angle. Leveling and Contouring - Concept and Terminology, Temporary and permanent adjustments- method of leveling. Characteristics and Uses of contours- methods of conducting contour surveys and their plotting. Computation of Areas and Volumes - Area from field notes, computation of areas along irregular boundaries and area consisting of regular boundaries. Embankments and cutting for a level section and two level sections with and without transverse slopes, determination of the capacity of reservoir, volume of barrow pits. Theodolite - Theodolite, description, uses and adjustments - temporary and permanent, measurement of horizontal and vertical angles. Principles of Electronic Theodolite, Trigonometrical leveling, Traversing. Tachometric Surveying - Stadia and tangential methods of Tacheometry. Distance and Elevation formulae for Staff vertical position. Curves - Types of curves, design and setting out – simple and compound curves. Introduction to geodetic surveying, Total Station: Introduction – Accessories with description - Features of total station – Onboard software electronic data reading - Summary of total stations characteristics - Field procedure of total stations in topographic survey, Global positioning system, Introduction to Geographic information system (GIS).

TEXT BOOKS:

1. Surveying and Levelling by R.Subramanian, Oxford University Press, 2^{nd} edition, 2012.
2. Surveying Vol - I, II, III - Dr. B.C . Punmia Laxmi publications, Delhi-6

REFERENCE BOOKS:

1. Surveying and levelling part I & II by Kanetkar.T.P. & S.V.Kulkarni, Puna vidyarthi girha, Prakashan,23rd edition,1993.
2. Arora K. R, "Surveying Vol-I", Rajsons Publications Pvt. Ltd, 10th Edition, 2008

MOMENTUM TRANSFER

Course Code:14PE204 **L –T – P: 2-2-2**

Prerequisite: NIL **Credits: 4**

Introduction and Fluid statics: Properties of fluids and concept of pressure: Introduction - Nature of fluids - physical properties of fluids - types of fluids.

Fluid statics: Pressure - density - height relationships, Pressure measurement.

Units and Dimensions - Dimensional analysis; Similarity - forces arising out of physical similarity - dimensionless numbers.

Momentum Balance and applications: Kinematics of fluid flow: Stream line - stream tube - velocity potential. Newtonian and non-Newtonian fluids - Time dependent fluids - Reynolds number - experiment and significance - Momentum balance - Forces acting on stream tubes - Potential flow - Bernoulli's equation - Correction for fluid friction - Correction for pump work.

Flow of Incompressible Fluids Through Ducts: Flow of incompressible fluids in pipes - laminar and turbulent flow through closed conduits - velocity profile & friction factor for smooth and rough pipes - Head loss due to friction in pipes, fitting etc.

Introduction to compressible flow: Isentropic flow through convergent and divergent nozzles and sonic velocity.

Flow past immersed bodies: Form drag - skin drag - Drag co-efficient. Flow around solids and packed beds. Friction factor for packed beds - Ergun's Equation - Motion of particles through fluids - Motion under gravitational and centrifugal fields - Terminal settling velocity; Fluidization - Mechanism, types, general properties - applications.

Transportation and Metering: Measurement of fluid flow: Orifice meter - Venturi meter, Pitot tube – Rotameter - Weirs and Notches - wet gas meter and dry gas meter - Hot wire and hot film anemometers.

Transportation of fluids: Fluid moving machinery performance. Selection and specification- Air lift and diaphragm pump. Positive displacement pumps: Rotary and Reciprocating pumps - Centrifugal pumps and characteristics.

Text Books:

1. W.L. McCabe, J. C. Smith & Peter Harriot, "Unit Operations of Chemical Engineering", 6^{th} ed., McGraw-Hill, (2001).
2. P. Chattopadhyay, "Unit Operations of Chemical Engineering", Vol -1, Khanna Publishers, (2003).
3. J.M. Coulson, J.F. Richardson, "Chemical Engineering", Vol-I, Oxford, Pergamon Press, (1968).

Reference Books:

1. Christie J Geankoplis, "Transport Processes and Unit Operations", 3rd ed., PHI Pvt Ltd, (1993).
2. Foust, Alan S., "Principles of Unit Operations", 2nd ed., John Wiley and Sons, (1980).
3. Neol de Nevers, "Fluid Mechanics for Chemical Engineers." II Edition, Mc.Graw Hill (1991).

4. James O. Wilkes and Stacy G. Bikes, "Fluid Mechanics for Chemical Engineers" Prentice Hall PTR (International Series in Chemical Engineering) – (1999).

GEOLOGY FOR PETROLEUM ENGINEERS

Course Code:14PE204 **L –T – P: 3-0-2**
Prerequisite: NIL **Credits: 4**

THE EARTH - Origin, Exterior and Interior of the Earth
MINERAL AND ROCKS - Introduction to Minerals, Introduction to Igneous, Sedimentary and Metamorphic Rocks
SEDIMENTARY STRUCTURES - Flume Experiment; Laminar and Turbulent Flow, Bedload, Traction and Suspension Sedimentation - Erosional Structures, Depositional and Post Depositional Structures
SEDIMENTARY ROCK TEXTURES AND ITS SIGNIFICANCE - Shape, Size, Sorting, Maturity
LITHIFICATION AND DIAGENESIS - Early and Late Diagenesis- Compaction – Cementation - Porosity and Permeability Evolution
CLASSIFICATION AND DESCRIPTION OF SEDIMENTARY ROCKS - Rudaceous Rocks: Polymictic, Oligomictic, Infraformational - Extraformation, Othoconglomerate, Paracongiomerate - Arenaceous Rocks: Arenite, Arkose, Lithic arenite, Greywack - Argillaneous Rocks: Limestone and Dolomite - Evaporite Rocks: Gypsum, Anhydrite, Halite
CONCEPT OF FACIES AND SEDIMENTARY ENVIRONMENTS - Facies Concept - Lacustrine Environment
Fluvial Environment - Deltaic Environment - Linear Clastic Shore Line/Barrier Island System - Carbonate Platform - Deep Sea Basin
SEQUENCE STRATIGRAPHY - Eustasy, Sea Level, Subsidence and Tectonics - System Tract and Sequence Boundary - Seismic Facies and Sequence Analysis
PETROLEUM GEOLOGY - Composition of Petroleum and Natural gas - Oil filed waters
Origin and Occurrence of Petroleum - Theory of Origin: Organic and inorganic - Type of Organic Matter - Production, Accumulation and reservation of Organic Mater - Source Rock Analysis
RESERVOIR ROCKS - Physical Properties of Rocks - Clastic Reservoir Rocks - Carbonate Reservoir Rocks
MIGRATION AND ACCUMULATION - Primary and Secondary Migration - Factors Controlling Accumulation -
Concept of Petroleum Province, System and Plays
TRAPING MECHANISM - Fundamentals of Trapping Mechanism - Structural Traps - Folded Trap - Faulted Traps - Fractured Traps - Stratigraphic Traps - Unconformity Traps - Palaeogeomophic Trap - Salt Domes - Combination Traps - Migration Vs. Trapping Time - Types of Petroliferous Basins - Global Geologic History and Distribution of Hydrocarbon Resources - Sedimentary Basin of India - Hydrocarbon Resources and Reserves

TEXT BOOKS:

1. Geology of petroleum by A.I. Levorsen, hardback edition, 1967
2. Developments in Petroleum Geology by G. D. Hobson, Vol. 1&2, Elsevier Science Ltd, 1977

REFERENCE BOOKS:

1. Origin of sedimentary rocks (Second edn.) by H. Blatt, G. Middleton, and R. Murray, Prentice-Hall, Inc., 1980
2. Principles of Sedimentology and Stratigraphy by Boggs, S.Jr., Merill Publ. Co., 1987
3. Principles of Sedimentary Basin Analysis by Miall, A.D., Springer Verlag, 1990
5. Sedimentary Environments and Facies by Reading, H.G. (Ed.), Blackwell Science, 1996

DRILLING AND WELL COMPLETION TECHNIQUES

Course Code: 14PE206 **L –T – P: 2-2-2**
Prerequisite: NIL **Credits: 4**

Well Planning, Rotary Drilling Method, Drilling Operations & Practices, Rig design, Geo-mechanics in drilling, Casing Design, Drill String design, Drill Bits, Drilling Fluids and hydraulics design, Well Problems and Solutions, Well control system, Oil Well Fishing, Cementing equipment and operations, Well Equipment, and Well Completion Design.

Text books:

1. Applied Drilling Engineering, Adam T. Bourgoyne Jr., Keith K. Millheim, Martine E. Chenevert and F. S. Young Jr., Society of Petroleum Engineers, (1991)
2. Well Engineering and Construction, Hussain Rabia, Entrac Consulting, (2002).
3. Fundamentals of Drilling Engineering, Robert F. Mitchell, Stefan Z. Miska, SPE TEXTBOOK SERIES VOL. 12, (2011)

Reference Books:

1. Neal Adams and Tommie Charrier, "Drilling Engineering: A Complete Well Planning Approach" PennWell Pub. Co., (1985)
2. Economides, M. J., "Petroleum Well Construction" John Wiley & Sons, (1998).
3. Formulas and Calculation for Drilling, Production and workover, Norton J. Lapeyrouse, 2nd Edition, Gulf Publishing, (2002).
4. Heriot Watt, "Drilling Engineering Handbook".
5. Drilling Engineering, by A. A. Azar and G. Robello Samuel, Penn Well Publisher, 2007

PETROLEUM REFINING PROCESS AND TESTING

Course Code:14PE207 **L –T – P: 2-2-2**
Prerequisite: NIL **Credits: 4**

Introduction: Origin, Formation, Composition of Petroleum and Thermal properties of Petroleum fractions.

Primary Processing of Crude Oil: Classification of crude oil, Dehydration and Desalting of crudes, Heating of crudes (Pipe still heaters). Distillation- Atmospheric distillation unit, Vacuum distillation unit. Products – Specifications, Properties and Petrochemicals.

Treatment Techniques : Removal of objectionable gases, odours, Fractions – Impurities, Gasoline treatment, wax and purification, Olefins and recovery operations from petroleum products.

Secondary processing of Crude Oil: Thermal and Catalytic Cracking, Reforming, Alkylation, Isomerization, Hydro-Processing. Visbreaking, Coking, Bitumen Production, Lube oil base stock production, Propane Deasphalting, Dewaxing, Polymerization. Environmental Issues and New trends in petroleum refinery operations.

Oil movement and storage: Various types of storage facilities in refinery, Storage stability, Storage safety, Transportation and storage of crude oil, transportation and storage of petroleum fractions.

Testing methods: Petroleum fractions testing's. (Flash point, fire point, cloud point, smoke point)

Text books:

1. "Modern Petroleum Refining Processes", B. K. BhaskaraRao, 5th edition, Oxford and IBH Publishing Company, New Delhi.
2. "A text on Petrochemicals" , B. K. BhaskaraRao, Khanna Publishers, Kolkata.

Reference Books:

1. **"**Fundamentals of Petroleum Engineering" 1st edition, Fahim, Al-Sehhaf and Elkilani, Elsevier Publishers.

PETROLEUM EXPLORATION METHODS

Course Code:14PE301 **L –T – P: 3-0-0**
Prerequisite: 14 PE 205 **Credits: 3**

Geological Methods: Surface indications of subsurface oil and gas accumulations. Oil accumulation parameters. Regional structural plan and local structures. Time of accumulation vis-avis time of oil generation.

Geochemical methods of prospecting: Soil geochemical surveys; Source rock characterization and Hydro geochemistry as a tool for oil exploration. Development Geology. Theoretical principles of prognostication of hydrocarbon reserve. Role of plane tectonics in Hydrocarbon accumulation onshore and offshore. Sequence of geological methods of oil exploration.

Geophysical Methods

Magnetic Method: The geomagnetic field, Magnetic anomalies. Magnetic survey instrument, Field method of magnetic surveys. Reduction of magnetic data, diurnal and geomagnetic correction. Interpretation of magnetic anomalies. Magnetic response of simple geometric shapes. Application of magnetic survey.

Gravity Method: Units of gravity, gravity measuring instruments, gravity survey, gravity anomalies, Gravity data reduction, Drift, Latitude, Elevation, and Free-air correction. Free-air and Bouguer anomalies. Gravity response of simple geometric shapes. Interpretation of gravity anomalies and application of gravity methods.

Seismic Methods: Geometry of refracted ray path, planar interface. Two layer case with horizontal interface. Methodology of refraction profiling. Field surveys arrangements. Recording instruments and energy source. Corrections applied to refraction data. Interpretation of refraction data. Application of seismic refraction method, Passive seismic

Advanced methods: Geometry of reflected ray path, planar interface, and single horizontal reflector. Importance of seismic reflection survey over seismic refraction survey technique. Common depth point (CDP) profiling and stacking. 2-D data processing and interpretation of reflection data. Introduction to 3-D data acquisition, processing and interpretation. Applications of seismic method in oil exploration, Concept of 4-D seismic and its application.

Text Books:

1. Philip Kearey, et.al., “An Introduction to Geophysical Exploration”, Wiley publications, (2002)
2. Applied geophysics, WM W. M. Telford, L.P Geldart, R.E sherief, Cambridge university press, (1990)

Reference Books:

1. Milton B. Dobrin, and Carl H. Savit, “Introduction to Geophysical Prospecting”, 4th Ed., McGraw Hill, (1988)
2. M.B. Ramachandra Rao, “Outlines of Geophysical Prospecting: A Manual for Geologists”, EBD Educational Pvt Ltd., (1993)
3. John Milsom and Asger Eriksen, “Field Geophysics” 4th Ed., John Wiley, 2011.
4. J. Guillemot, “Elements of Geology: Oil and Gas Exploration Techniques”, Technip, (1991)

RESERVOIR ENGINEERING

Course Code:14PE302 **L –T – P: 2-2-2**
Prerequisite: 14 PE 205 **Credits: 4**

Introduction to reservoir engineering

Reservoir fluid properties: Characteristics of crude oil and natural gas, classification of crude and its physicochemical properties.

Reservoir Rock Properties : Porosity and permeability determination, combination of permeability in parallel & series beds, porosity permeability relationship, fluid saturation determination and significance, effective and relative permeability, wettability, capillary pressure characteristics, measurements and uses. Coring and Core Analysis

PVT analysis: Phase behavior of hydrocarbon system, ideal & non ideal system, equilibrium ratios, reservoir fluid sampling, PVT properties determination, different correlations and laboratory measurements, data reduction, evaluation and application.

Driving mechanisms: Reservoir drive mechanics and recovery factors
Flow of Fluids through Porous Media: Darcy's law, single and multiphase flow, linear, radial & spherical flow, steady state & unsteady state flow, GOR, WOR equations
Special type of flow: Flow through fractures, Water and gas coning.
Reserve estimation: Resource & Reserve concept, Different reserve estimation techniques: Volumetric, MBE, decline curve analysis. Performance prediction of depletion drive, gas cap drive, water drive and combination drive.
Water influx calculations: steady and unsteady state models
Introduction to oil & gas field development: Rational development plan, Rate and order of drilling well, well spacing & pattern, selection of development scheme, economic aspect of development of oil and gas fields.
Immiscible Displacement processes: Theory & practices- fractional flow of water, Buckley Leverette treatment of fractional flow and frontal advance equations, water flood performance.
Reservoir Management: Concepts, Components and Applications.

Text Books:
1.Tarek Ahmed, "Reservoir Engineering Handbook", Gulf Professional Publishing, 4^{th} ed, (2010).
2.Nnaemeka Ezekwe, "Petroleum Reservoir Engineering Practice", Pearson Education, Inc, (2010).

Reference Books:
1. Benjamin Cole Craft, Murray Free Hawkins, and Ronald E. Terry, "Applied Petroleum Reservoir Engineering" by Prentice Hall, (1991).
2. LP Dake, "Fundamentals of Reservoir Engineering" shell learning and development, (1998).
3. Tarek Ahmed, Paul D. McKinney, "Advanced Reservoir Engineering" Gulf Professional Publishing , 4^{th} ed, (2005).
4. BF Towler, "Fundamental Principles of Reservoir Engineering", SPE, (2002).
5. Heriot Watt, "Reservoir Engineering Handbook"
6. Abhijit Y. Dandekar, "Petroleum Reservoir Rock and Fluid Properties", CRC Press, (2013).

PROCESS HEAT TRANSFER

Course Code:14PE303 **L –T – P: 2-2-2**
Prerequisite: 13 ES 201 **Credits: 4**

Introduction: Modes and laws of Heat transfer- Nature of heat flow, conduction, convection, natural and forced convection, radiation., thermal conductivity, Fourier rate equation, Steady state Heat conduction, steady state conduction in plane wall & composite walls, compound resistances in series, heat flow through a cylinder, conduction in spheres, thermal contact resistance, plane wall: variable conductivity.
Unsteady state heat conduction Equation for one-dimensional conduction, Semi-infinite solid, finite solid. Lumped systems, heat transfer through fins.
Principles of heat flow in fluids: Typical heat exchange equipment, countercurrent and parallel current flows, energy balances, rate of heat transfer, overall heat transfer coefficient, electrical analogy, critical radius of insulation, logarithmic mean temperature difference, variable overall coefficient, multi-pass exchangers, individual heat transfer coefficients, resistance form of overall coefficient, fouling factors, classification of individual heat transfer coefficients, magnitudes of heat transfer coefficients, effective coefficients for unsteady-state heat transfer.
Heat transfer to fluids with phase change: Heat transfer from condensing vapors-Heat transfer to boiling liquids.
Heat Exchangers: Classification and type of heat exchangers, General design of heat exchange equipment-Heat exchangers-Condensers, boilers; extended surface equipment, Heat transfer in agitated vessels-Scraped surface, Heat transfer in packed beds. Flow arrangement, overall heat transfer coefficient, Fouling factor, LMTD method of Heat exchanger analysis, correction, Heat exchanger Effectiveness - NTU method;
Evaporation: Principles, application and Equipment

Radiation: Introduction, Radiative Properties, concept of black, white and grey body, Laws of radiation, Stefan-Boltzmann's law; Lamberts cosine law, Kirchhoff's law, Planck's law, Wein's law, **Radiation Heat Exchange Between Two Bodies: Shape factor,** shape factor algebra, Heat Exchange by radiation between two finite parallel surfaces, Electrical analogy, solid angle and Radiation intensity, Heat exchange by radiation between two finite black and gray surfaces, Radiation shields, Error in temperature measurement.

Text Books:

1. W.L. McCabe, J.C Smith and Peter Harriott, "Unit Operations of Chemical Engineering", 7th Ed, McGraw-Hill, (2005).
2. Yunus A. Cengel and Afshin J. Ghajar "Heat and Mass transfer – Fundamentals and Applications" , 5th Ed., Mc Graw Hill, (2010).
3. R.C.Sachdeva, "Fundamentals of Engineering Heat and Mass Transfer", 4th Ed., New Age International Publishers Ltd. (2009).

Reference Books:

1. D.Q. Kern, "Process Heat Transfer", Tata- McGraw-Hill, (1997).
2. J.P. Holman, "Heat Transfer", 9th Ed, Tata McGraw-Hill, (2008).
3. N.Ozisik, "Heat Transfer - A Basic Approach" Mc Graw Hill.
4. K Ramakrishna & P K Sarma, "Introduction Heat and Mass Transfer" John Wiley.

NATURAL GAS ENGINEERING AND PROCESSING

Course Code: 14PE304 **L –T – P: 3-0-0**
Prerequisite: Nil **Credits: 3**

Introduction: Composition of Natural Gas, Utilization of Natural Gas, Natural Gas Industry, Natural Gas Reserves, Types of Natural Gas Resources, Future of the Natural Gas Industry.

Properties of Natural Gas: Physical properties of natural gas and hydrocarbon liquids associated with natural gas.

Unconventional gas: Coal Bed Methane, Natural Gas Hydrate, Basin Centered Gas, Tight Gas Sands, Shale Gas; Current Technology for Shale Gas and Tight Gas Exploration and Production.

Gas Compression: Types of Compressors, Selection, Thermodynamics of Compressors, Compression calculations. Heat and Mass Transfer Principles and Applications in Natural Gas Engineering, Use of Mollier Diagrams.

Gas Flow Measurement: Process control and instrumentation in natural gas processing plants.

Gas Gathering, Transport and Storage: Gas Gathering System. Steady Flow in Simple Pipeline System, Steady State and unsteady State Flow in Pipelines, Solution for Transient Flow. Transmission of Natural Gas, Specifications. Underground Storage and Conservation of Natural Gas.

Natural Gas Processing: Field separation and oil absorption process, Refrigeration and low temperature processing, Liquefaction Process, Dehydration of Natural Gas, Sweetening of Natural gas and Sulphur recovery.

Processing principle of LPG, CNG systems, Conversion of gas to liquid - LNG: Production and Utilization; Issue and Challenges to Enhance Supply of Natural Gas.

Text Books:

1. Arthur J. Kidnay, William R. Parrish, Taylor and Francis, "Fundamental of Natural Gas Processing", (2006).
2. James G. Speight, "Natural Gas: A Basic Handbook", Gulf Publishing Company, (2007).

Reference Books:

1. Saeid Mokhatab, William A. Poe, James G. Speight, "Handbook of Natural Gas Transmission and Processing", Gulf Professional Publishing, (2006).

2. Ken Arnold, Maurice Stewart, “Surface Production Operations”, Volume 2, 2nd Ed, Elsevier Science, (1989).
3. J. Leecraft, “Field Handling of Natural Gas”, 4th Edition, PETEX, (2007).
4. Doug Elliot, J.C. Kuo, Pervouz Nasir, “Plant Processing of Natural Gas”, 2nd Ed, PETEX, (2012).

PETROLEUM FORMATION EVALUATION

Course Code: 14PE305 **L –T – P: 3-0-0**
Prerequisite: 14 PE 301 **Credits: 3**

Introduction to well logging: Major components of well logging unit and logging setup; Classification of well logging methods.

Open-hole logging:

SP Log: Origen of SP, uses of SP log-Calculation of salinity of formation water, Shalyness-Factors influence SP log

Caliper log: Principle and application of caliper tool.

Gamma ray log: Principle of radioactivity - Uses of Gamma ray log - Determination of shalyness of formation. API counts - calibration of Gamma ray tool - statistical fluctuation - Time constant.

Natural Spectral Gamma ray log: Principle and application.

Resistivity log: Single point resistance log (SPR), Conventional Resistivity logs, Response of potential and gradient logs over thin and thick conductive and resistive formations, Limitations of conventional Resistivity tools,

Focused resistivity log - Advantages of focused resistivity tools over conventional resistivity tools.

Micro Resistivity log: Conventional and focused micro Resistivity logs and their application.

Induction log: Principle of induction tool and the advantages, Criteria for selection of induction and lateral logging tool, Determination of true Resistivity of the formation, Resistivity index, Archie’s equation.

Density log: Principle of density tool. Environmental corrections - Porosity determination, Tool calibration - Litho density log - Synthetic seismograms.

Neutron log: Principle and application of Neutron tool - Porosity determination.

Sonic log: Principle and application of Sonic log - Bore-hole compensation - Determination of primary and secondary porosity.

Cased-hole logging: Gamma ray spectral log. Neutron decay time log. Determination of fluid saturation behind casing; Cement bond log, Casing collar log, Depth control, Perforation technique; Free point locater and Plug setting, Casing inspection logs.

Advances in Well logging: Dip meter log, Image logs, Nuclear Magnetic resonance log.

Production logging: Solving production problems with the help of Fluid Density log, Temperature log, and Flow meter logs.

Direct Methods: Mud logging, coring – conventional and Sidewall coring, Core analysis

Interpretation: Quick look interpretation. Cross plots. Neutron- Density, Sonic- Density, Sonic-Neutron cross plots. Hingle plot, Mid plot, Correlation, Hydrocarbon reserve estimate

Text Books:

1. Edward J. Lynch, Harper & Row, “Formation evaluation”, (1962).
2. Toby Darling, “Well logging and formation evaluation”, Elsevier, New York, (2005).

Reference Book:

1. Hydrocarbon well logging recommended practice, Society of professional well log analysts, (1983).
2. Oberto Serra, Editions Technip, “Well Logging & Reservoir Evaluation”, (2007).
3. Richard M. Batemons, “Open - Hole log analysis and formation evaluation”, International Human Resources Development Corporation, Bostan, (1985).
4. Darwin V. Ellis, Julian M. Singer, “Well Logging for Earth Scientists”, Springer, (2007).

5. Oberto Serra, "Fundamentals of Well Log Interpretation: The Acquisition of Data", Elsevier, (1984).
6. Oberto Serra, "Well Logging Handbook", Editions Technip, (2008).

PIPELINE ENGINEERING & TRANSPORTATION OF OIL AND GAS

Course Code: 14PE306 **L –T – P: 3-0-0**
Prerequisite: Nil **Credits: 3**

Mode of Transportation of petroleum products

Objective and scope: Objective and scope of pipeline as a means of fluid transportation with special reference to crude oil/gas/refined products, Economics of Pipeline transportation.

Design of Pipeline: Factors influencing oil, gas and refined products as pipeline design; Hydraulic surge and water hammer, specific heat of liquids, river crossing, pipe size and station spacing etc. Theory and different formulae of the flow of fluids in oil/gas pipelines, basic equations for the flow of fluids through pipes, different flow equations for laminar and turbulent flow of compressible and incompressible fluids (Newtonian); Introduction to the flow of Non-Newtonian fluids through pipes; multiphase flow and loop pipelines.

Pipeline mechanical design: Codes and standards, Location classification, Pipeline design formula, Expansion and flexibility, Joint design for pipes of unequal wall thickness.

Construction and Maintenance of pipelines, Route location survey, materials, project specifications, general equipment specifications (Pipes, valves and fittings), Installation of expansion loops and thermodymetric tapping plant.

Pigging, Pigging Technology: Pig launcher and receiver, intelligent pigging, types of pigs.

Corrosion protection and control: Design of cathodic protection system, Pipeline automation.

Hydrates, Wax & Scale - Formation and prevention - Crude conditioning and use of additives to improve flow conditions.

Offshore Pipeline: Design and control of Sag and Over bend; Description of stinger; and Riser, articulated stinger, construction of offshore pipeline, Method of underwater welding.

Text Books:

1. M. Mahitpour, H. Golshan and M.A. Murray, "Pipeline Design and Construction: A Practical Approach", 2nd Ed, ASME Press, 2007.
2. Henry Liu, "Pipeline Engineering", Lewis Publishers (CRC Press), 2003.

Reference Books:

1. George A. Antaki, "Piping and Pipeline Engineering: Design, Construction, Maintenance Integrity and Repair", CRC Press, 2003.
2. E. Shashi Menon, "Pipeline Planning and Construction Field Manual", Gulf Professional Publishing, 2011.
3. E. W. McAllister, "Pipeline Rules of Thumb Handbook", 7th Ed, 2009.
4. E. Shashi Menon, "Liquid Pipeline Hydraulics", Mareel Dekker Inc., 2004.
5. Tian Ran Lin, Boyun Guo, Shanhong Song, Ali Ghalambor, Jacob Chacko, "Offshore Pipelines: Design, Installation, and Maintenance", Gulf publishers. 1st Ed, 2005.

ENVIRONMENTAL HAZARDOUS AND SAFETY MANAGEMENT

Course Code: 14PE307 **L –T – P: 3-0-0**
Prerequisite: Nil **Credits: 3**

Health hazards in Petroleum Industry: Toxicity, Physiological, Asphyxiation, respiratory and skin effect of petroleum hydrocarbons, sour gases. Safety System: Manual & automatic shutdown system, blow down systems. Gas detection system. Fire detection and suppression systems. Personal protection system & measures. HSE Policies. Disaster & crisis management in Petroleum Industry. Environment: Environment concepts, impact on eco-system, air, water and soil. The impact of drilling & production operations on environment, Environmental transport of petroleum wastes. Offshore environmental studies. Offshore oil spill and oil spill control. Waste treatment methods.

Text Books:

1. John C. Reis, "Environmental Control in Petroleum Engineering", Gulf Publishing Company, (1996).
2. Oil Industry Safety Directorate (OISD) Guidelines, Ministry of Petroleum & Natural Gas, Government of India and Oil Mines Regulations-1984, Directorate General of Mines Safety, Ministry of Labor and Employment, Government of India.

Reference Books:

1. Guidelines for Process Safety Fundamentals in General Plant Operations Centre for Chemical Process Safety, American Institute of Chemical Engineers, (1995).
2. Dennis P. Nolan, "Application of HAZOP and What if Reviews to the Petroleum, Petrochemical and Chemical Process Industries", Noyes Publications, (1994).
3. Guideline for Process Safety Fundamentals in General Plant Operations, Centre for Chemical Process Safety, AIChE, (1995).

PETROLEUM PRODUCTION ENGINEERING

Course Code: 14PE401 **L –T – P: 3-0-0**
Prerequisite: 14PE302 **Credits: 3**

Introduction to Petroleum production system

Reservoir deliverability: Flow Regimes, Inflow Performance Relationship, Construction of IPR Curves Using Test Points, Composite IPR of Stratified Reservoirs, Future IPR

Well bore performance: Introduction, Single-Phase Liquid Flow, Multiphase Flow in Oil Wells, Single-Phase Gas Flow, Mist Flow in Gas Wells, TPR curves

Choke performance: Sonic and Subsonic Flow, Single-Phase Liquid Flow, Single-Phase Gas Flow, and Multiphase Flow.

Well deliverability: Nodal Analysis, Deliverability of Multilateral Well

Artificial Lift Techniques: Working principles, design and maintenance

Sucker rod pumping, Electrical Submersible Pump, plunger lift, Gas lift design, hydraulic piston pumping, progressive cavity pumping.

Text Books:

1. Boyun Guo, William C. Lyons, Ali Ghalambor, "Petroleum production engineering: A computer assisted approach", Elsevier Science & Technology books, (2007).
2. Brown, K.,E. "The Technology of Artificial Lift Method", Volume 1,2,3,4,5, PennWell Books, Tulsa, Oklahoma, (1982).

Reference Books:

1. M. J. Economides, A. Daniel Hill & C. E. Economides, "Petroleum production systems", Prentice- Hall, N. J – 07488, (1994).
2. "Production Technology I-II", Institute of Petroleum Engineering, Herriot Watt University

OIL AND GAS WELL TESTING

Course Code: 14PE402 **L –T – P: 3-2-0**
Prerequisite: 14PE302 **Credits: 4**

Principles of Fluid Flow for steady state, semi steady state & non steady state conditions.

Diffusivity Equation Derivation & Solutions, Radius of investigation, Principle of superposition, Horner's approximation.

Pressure Transient Tests: Drawdown and buildup-test analysis, determination of permeability and skin factor, Analysis of pressure-buildup tests distorted by phase redistribution, Well-test interpretation in hydraulically fractured wells, Interpretation of well-test data in naturally fractured reservoirs. Wellbore effects, Multilayer reservoirs, Injection well testing, Multiple well testing, Wireline formation testing, Wireline while drilling formation testing, Interference testing, Pulse testing.

Drill Stem Testing: Equipment, DST chart observation and preliminary interpretation. Well preparation for testing, Multiple well testing. Effect of reservoir heterogeneities & Well bore conditions, fractured reservoir application

Well-test analysis by use of type curves: Fundamentals of type curves, Ramey's type curve, McKinley's and Gringarten et al type curves.

Gas well testing: Basic theory of gas flow in reservoir, Flow-after-flow test, Isochronal test, etc.

Applications of well testing: Well testing in horizontal wells, Extended Reach wells & multi-laterals wells, tests with and without flow measurement.

Computer–aided well test analysis: Derivative plot, diagonostic plot evaluation, data preparation, nonlinear regression, Introduction to well testing softwares.

Text Books:

1. John Lee, "Well Testing", SPE series, (1982).
2. Tarek Ahmed, Paul D. McKinney, "Advanced Reservoir Engineering". Gulf Professional Publishing, Elsevier, (2005).

Reference Books:

1. Earlougher R.C, "Advances in Well Test Analysis", SPE series (1997)
2. John Lee and Wattenbarger, R.A, "Gas Reservoir Engineering", SPE series, (1996)
3. Dominique Bourdet, "Well test analysis: The use of advanced interpretation models", Elsevier, (2002).

PROFESSIONAL ELECTIVES

SPECIALIZATION STREAM: GENETIC ENGINEERING

MOLECULAR GENETICS AND DNA FORENSICS

Course Code: 13BT 331 **L –T – P: 3-0-0**

Prerequisite: Nil **Credits:3**

Genome Organization & Types of Sequences; Nomenclature of chromosome, C-value paradox, dosage compensation. Chromosome structure, Genome organization, Chromatin, Euchromatin, Hetero- chromatin, Organization and evolution of nuclear and organelle genomes, Split genes, Essential & Non-essential genes, VNTR, SNP, SINES, LINES, SSR, STR, Mini and Micro Satellites. **Recombination;** Types of recombination: homologous, reciprocal and nonreciprocal, site-specific and illegitimate. Different models of homologous recombination. Molecular mechanisms of recombination: Base pairing, Nick initiation, Homologous recombination, Cross strand exchange, Site specific recombination, Transpositional recombination. **Gene Expression Regulation** An Overview of Gene Control, DNA-binding Motifs in Gene, Regulatory Proteins, Genetic Switches, Chromatin Structure and the Control of Gene Expression. The Molecular Genetic Mechanisms that create specialized Cell Types, Posttranscriptional Controls. **X chromosome in Forensics ;** History of forensic utilization of the X chromosome, X-chromosomal STR's and markers in trace analysis and kinship analysis. Mapping and haplotype analysis, Population haplotype distribution, Ethical considerations in X Chromosomal marker testing. **Y Chromosome & Mt DNA analysis in Forensics ;** Y-Chromosomal Markers in Forensic: Introduction, Identification of the male sex and lineage, Identification of a male's paternity and geographical origin. Mitochondrial DNA (mtDNA) biology, Identification of individuals (mtDNA typing).

Textbooks:

1. Molecular Biology of the Cell by Alberts, 5th Ed, Garland Science / Taylor & Francis Group (2008)
2. Molecular Forensics by Ralph Rapley, John Wiley & Sons, Ltd. 2007.

References:

1. Advanced Molecular Biology by R.M Twyman, Springer-verlag (1998)
2. Genetics by Eberhard Passarge, 27/sep/2006, (67.00).

TRANSGENIC TECHNOLOGY

Course Code: 13BT 332 **L –T – P: 3-0-0**

Prerequisite: Nil **Credits:3**

Vehicles for Transgenic Technology Plasmids, Phagemids, Cosmids, viruses, artificial chromosomes and shuttle vectors. Gene constructs. Principle and applications. Basic strategies of construction and screening of genomic and cDNA libraries. **Transgenic Plants** Gene transfer methods in plants, Transgenic plants with beneficial traits, Transgenic plant as bioreactor, Diagnostics in agriculture, Molecular breeding, Molecular markers, Edible vaccines, Bioethics. Case studies on Bt-Cotton and Bt-brinjal. **Transgenic Animals ;** Gene transfer methods in animals, Embryonic Stem Cell Method, Pronucleus Method, Random vs. Targeted Gene Insertion, Super ovulation, Transgenic animals, Case studies on Dolly. **Silencing Technology;** RNA silencing, SiRNAs and anti-sense RNAs – their design and applications, ShRNA, micro RNAs, and siRNA libraries. Epigenetic gene silencing, RNA silencing in plants, Case studies on Drosphilla, Mammalian Oocytes and Yeast cells. **Gene Therapy & Knock outs ;** Cationic liposomes, Lentiviral vectors, Retroviral vectors, HSV vectors, SCID therapy, Gene Therapy for Cystic Fibrosis: Gene Therapy Approaches, Gene

Therapy Approaches to Duchenne Muscular Dystrophy. Knockout Mice, Tissue-Specific Knockout Mice, Knock-in Mice. Ethics of Gene therapy.

Textbooks:

1. Principles of Gene Manipulation by Old and Primrose, Wiley-blackwell (1994-09-27)
2. RNAi by Patrick J. Paddison, Springer-verlag (Feb 2008)

References:

1. Gene therapy Technologies by Anthony Meager, John Wiley & Sons (1999).

GENOMICS AND PROTEOMICS

Course Code: 13BT431 **L –T – P: 3-0-0**

Prerequisite: Nil **Credits: 3**

Genomes and Genome analysis; Organization and structure of genomes, Genome Mapping: Construction of genomic libraries, mapping strategies and techniques. Human Genome Project, Genomes of other organisms. Principles of gene expression; Global analysis of gene expression, Peptide nucleic acid technology. **Comparitive and Functional genomics;** Comparative genomics: protein evolution from exon shuffling, Protein structural genomics, Genefunction by sequence comparison. Functional Genomics, Pharmacogenomics, Genomics in relation to molecular Diagnosis, Role of genomics in Drug discovery and development. **Microarrays;** Whole genome analysis of mRNA and protein expression, microarray analysis, types of micro arrays and applications in cancer diagnosis. Protein Biochips, Protein arrays. **Proteomics;** Principles of separation of Bio-molecules, 2D-Gel Electrophoresis, MALDI-TOF, Protein-protein interaction networks: Topology, Network motifs, Protein Expression profiling and applications. **Protein Networks and mapping; Y**east two hybrid, Co-Precipitation, Phage Display, Phylogenetic Profile, Domain fusion, Gene Neighborhood, Gene Cluster, Mirror Tree, Analysis of genome wide Protein-Protein Interactions in yeast, Genome wide yeast two hybrid analysis of other organisms, Protein fragment complementation assays.

Texts Books:

1. S.Sahai, Genomics and Proteomics, " Functional and Computational Aspects ", Pienum Publications, 1999.
2. Moody P C E and A J Wilkinson. Protein Engineering. IRL Press.

Reference Books:

1. Creighton T E, Proteins. Freeman W H. Second edition 1993.

MOLECULAR EXPRESSION TECHNOLOGY

Course Code: 13BT 432 **L –T – P: 3-0-0**

Prerequisite: Nil **Credits: 4**

Gene Expression; Transient VS stable expression, RT-PCR and the Standardized Expression Measurement, Monitoring Eukaryotic Gene Expression, Suppression Subtractive Hybridization, Gene Expression Informatics. **Prokaryotic system; Expression** in E. Coli: lac promoter, T7 expression system, pET, pMAL vectors. Induction methods, Case study on Insulin production. **Eukaryotic system; Saccharomyces** cerevisiae: GAL system, CUP1 system, Pichia pastoris: AOX system, Expression in insect cells, Baculovirus expression, Polyhedrin promoter, Expression in higher-Eukaryotic cells, Tet-on/Tet-off system. Advantages and disadvantages of yeast and insect expression systems. Case study of Interferons & Interleukins production in Pichia and SF9 cells. **Mammalian system;** CHO cell expression system, Vectors and markers for screening, Roller bottles, Fermentors used, Secretory proteins and Non-secretory proteins, Secretory pathway and signal peptides, Post translation modifications – Glycosylation. Case study of Erythropoietin production in CHO cells. **Protein purification system;** Purification of expressed proteins from E.coli, purification of soluble recombinant proteins, Purification of inclusion bodies, Invitro refolding of proteins, verifying protein integrity. Techniques for measuring protein stability. His-tag, GST-tag, MBP-tag. Factor X, Enterokinase signal cleavage.

Textbooks:

1. Gene Expression Profiling and Methods by Shimkets, Humana Press (Feb 2004)
2. Analysis of genes and genomes by Reece, John Wiley & Sons (January 2004)

References:

1. Protein purification applications by Simon Roe, Oxford University Press (2001)
2. Pichia Protocols by David R. Higgins Humana Press (1998-06-15)

MOLECULAR MARKERS & DIAGNOSTICS

Course Code: 13BT433 **L –T – P: 3-0-0**

Prerequisite: Nil **Credits: 3**

Molecular markers; Overview of genetics, History of molecular markers, Randomly amplified molecular markers, Sequence-based molecular markers, Fingerprinting, diversity studies, Successful examples – fingerprinting and diversity, **Marker assisted breeding ;**Marker-assisted breeding (MAB), Marker-assisted parent selection and backcrossing, Linkage mapping, Quantitative trait loci (QTL) analysis, Successful examples – putting QTL studies to use, Linkage disequilibrium, Pedigree-based analysis (PBA), Genomic selection, Successful examples – Association, PBA, Genomic selection. **Molecular breeding;** Molecular breeding for crop protection (biotic stress), Molecular breeding for abiotic stress tolerance, Molecular breeding for yield, Molecular breeding for crop quality traits, New molecular breeding tools: omics and arrays, Next generation sequencing analysis, Functional SNP Marker Development, High throughput SNP Genotyping Technology. **Molecular diagnosis – I ;**Introduction, molecular diagnostics, uses, Hybridization based methods, Reverse hybridization methods, Diagnostics based on DNA chips and Micro-arrays, Nucleic acid amplification-End-point PCR-Qualitative, Nucleic acid amplification - End-point PCR (Qualitative and Quantitative). Nucleic acid amplification - Real time PCR (Qualitative and Quantitative). **Molecular diagnosis – II ;** Ligation assay: SNP detection by probe ligation and amplification (e. g. MLPA), Other DNA based diagnosis (e. g. DNA sequencing), Principle of Immunological diagnosis,ELISA's, immunofluorescence, Western blots - Bioluminescence to monitor hygiene and contamination.

References:

1. Molecular Diagnostics: Fundamentals, Methods & Clinical applications (2007). Lele Buckingham and Maribeth L. Flaws.
2. Fundamentals of Molecular Diagnostics (2007). David E. Bruns, Edward R. Ashwood, Carl A. Burtis. Saunders Group.

SPECIALIZATION STREAM: BIOINFORMATICS

MOLECULAR MODELING AND DRUG DESIGN

Course Code: 13BT333 **L –T – P: 3-0-0**

Prerequisite: Nil **Credits: 3**

Introduction to Molecular Modeling; History of molecular modeling, physical and computer models, different representations of computer models, Generation of 3D coordinates–using x-ray crystallographic databases, compilation of fragment libraries with standard geometrics, drawing of 2D structures using sketch. **Basic concepts of Protein Modeling**; concepts of Force Fields, Quantum and Molecular mechanical force fields, Generation of potential energy surfaces, Geometry

Optimization, Energy-Minimizing Procedure, and Use of Charges. Salvation Effects, Methods, Ab initio Methods, Semi-empirical Molecular Orbital Methods, Conformational Analysis **Protein structure Determination** ; Comparative Modeling of Proteins, Ab initio modeling and fold recognition Transmembrane Protein Models Based on High-Throughput Molecular Dynamics Simulations with Experimental Constraints, Nuclear Magnetic Resonance-Based Modeling and Refinement of Protein Three-Dimensional Structures and Their Complexes. **Molecular Dynamics and Simulations**; Molecular Dynamics Simulations, Monte Carlo Simulations, Hybrid Quantum and Classical Methods for Computing, Kinetic Isotope Effects of Chemical Reactions in Solutions and in Enzymes, Normal Modes and Essential Dynamics **Molecular modeling applications in Drug designing**; Identifying Putative Drug Targets and Potential Drug Leads: Starting Points for Virtual Screening and Docking Receptor Flexibility for Large-Scale In Silico Ligand Screens: Chances and Challenges, Molecular Docking

Recommended textbooks:

1. Molecular modeling basic principles and applications-Hans-Dieter Holtje and Gerd Folkers, Wiley (2003).
2. Molecular modeling of Proteins-edited by Andreas Kukol, Humana Press. (Apr 2008)

Reference books:

1. Molecular Modeling Principles and Applications- AR Leach, Longman, 1996.

BIOPERL AND PERL PROGRAMMING

Course Code: 13BT334 **L –T – P: 3-0-0**

Prerequisite: Nil **Credits: 3**

An Introduction to Perl & Variables and Data Types; The Perl Interpreter - Perl Variables -Scalar Values-Variable Definition -Special Variables. **Arrays and Hashes;** Arrays-Array Manipulation -Push and Pop, Shift and Unshift –Splice-Other Useful Array Functions-List and Scalar Context -Hashes -Maintaining a Hash. **Control Structures & String Manipulation;**Comparisons Choices- If - Boolean Operators- Else-Loops-For Loops -For each Loops 52. Indeterminate Loops -While -Repeat Until -Loop Exits -Last - Next and Continue - Array-Based Character Manipulation -Regular Expressions –Match-Substitute – Translate. **Input and Output ;**Program Parameters -File I/O -File handles- Working with Files -Built-in File Handles -File Safety - The Input Operator –Binary- Interprocess Communications – Processes- Process Pipes-Creating Processes - Monitoring Processes. **Bioperl;** Sequences – Seq Feature – Annotation-Sequence - Example Bioperl Programs

Recommended text books:

1. Beginning Perl for Bioinformatics, James Tisdall, O'Reilly Publishers
2. Jamison D. ,Perl Programming for Biologists,Wiley publishers

Reference text books:

1. Introduction to computers, Peter Norton, Tata Mc Graw Hill publishers

BIOMEDICAL INFORMATICS

Course Code: 13BT434 **L –T – P: 3-0-0**

Prerequisite: Nil **Credits: 3**

MEDICAL INFORMATICS; Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, e-health services, Health Informatics – Medical Informatics, Bioinformatics. **COMPUTERISED PATIENT RECORD:** Introduction - History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients. **COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING** Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computerized ECG, EEG and EMG, Computer assisted medical imaging- nuclear medicine, ultrasound imaging ultrasonography-computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance. **COMPUTER ASSISTED MEDICAL DECISION-MAKING;** Neuro computers and Artificial Neural Networks application, Expert system - General model of CMD, Computer –assisted decision support system-production rule system cognitive model, semester networks, decisions analysis in clinical medicine-computers in the care of critically patients-computer assisted surgery-designing. **RECENT TRENDS IN MEDICAL INFORMATICS;** Virtual reality applications in medicine, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery computer aids for the handicapped, computer assisted instrumentation in Medical Informatics - Computer assisted patient education and health - Medical education and health care information.

TEXT BOOKS:

1. R.D.Lele Computers in medicine progress in medical informatics, Tata McGraw Hill Publishing computers Ltd, 2005, New Delhi
2. Mohan Bansal, Medical informatics Tata McGraw Hill Publishing computers Ltd, 2003 New Delhi

STRUCTURAL BIOLOGY

Course Code: 13BT435 **L –T – P: 3-0-0**

Prerequisite: Nil **Credits: 3**

Introducing computational Systems biology ; Basic concepts of System biology, Enabling information and integration for systems biology, Databases for Systems biology, Natural language processing and ontology-enhanced biomedical literature mining for Systems Biology. **Foundations of biochemical network analysis and modeling ;** Introduction to computational models of biochemical reaction networks, Biological foundations of Signal transduction and the Systems biology perspective, Reconstruction of metabolic network from genome information and its structural and functional analysis, Metabolic Flux analysis, GEPASI, Gopher. **Computer simulations of dynamic networks;** Discrete approach to network modeling, Gene networks: Estimation modeling and simulation, Computational models for circadian rhythms: Deterministic Versus Stochastic approaches. **Multiscale representation of cells and Emerging phenotypes;** Spatio-temporal Systems biology, Cytomics-from Cell States to predictive medicine, The IUPS Physiome project, E-Cell Concept. Genesis tool and its applications. **Applications and perspectives of Systems biology**; Developments and trends of Systems biology, Long and medium term goals of Systems biology, the potential applications of Systems biology, Microarray analysis and gene networks, BRB Array tool

Text Books:

1. Computational Systems Biology. By Andres Kriete, Roland Eils. Published by Academic Press, 2005, ISBN 013088786X.
2. Systems Biology: Applications and Perspectives. By Peter Bringmann. Published by Springer, 2007, ISBN 3540313389.

REFERENCE BOOKS:

1. Systems Biology: Principles, Methods, and Concepts. By Andrzej K. Konopka. Published by CRC Press, 2007, ISBN 0824725204.
2. Systems Biology: Definitions and Perspectives. By Lilia Alberghina, Hans V. Westerhoff, Published by Birkhäuser, 2005, ISBN 354022968X

DATA BASE MANAGEMENT SYSTEMS

Course Code: 13BT436 **L –T – P: 3-0-0**
Prerequisite: Nil **Credits: 3**

Introduction to Database management Systems ; Introduction: Database System Applications, Database Systems Versus File Systems, View of Data Models, Database Languages ,Database Users and Administrators, Transaction Management, Database System Structure, Application Architectures, History of Database Systems. **Data Models; E**ntity-Relationship Model: Basic Concepts, Constraints, Keys, Design Issues, Entity-Relationship Diagram, Weak Entity sets, extended E-R Features. **Relational Model**: Structure, of Relational Databases The relational Algera, Exten Relational- Algebra Operations, Views. **Relational Databases; SQL:** Basic Structure, Set Operations, Aggregate Functions Null Values, Nested subquires, Views. **Integrity and Security**: Domain Constrains, Referential Integrity, Assertions, Triggers, Security and Authorzation. Relational –Database Design: First Normal Form,Pitfalls in Relational- Database Design, Functional Dependencies, Decomposition Desirable Properties of Decomposition, Boyce – Codd Normal Form, Fourth Normal Form. **Transaction management; Transactions:** Transaction Concept Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serilizability, Recoverability. Concurrency Control: Lock – Based Protocols, Timestamp – Based Protocols, Multiple Granularity Deadlock Handling. **Storage and File Structure**: Overview of Physical Storage Media, Magnatic Disks, RAID, File Organization, Organization of Records in Files. **Query Processing:** Measures of Query Cost, Selection Operations, Sorting, Join Operation.

Textbook:

1.Silber Schatz, Korth G.Sudharshan,” Database system concepts” , Fourth Edition, Tata Mc Graw Hill,2000

References books:

1. Ramez Elmasri Shamkant, B.Navathe,” Fundamentals of Database Systems,” Fifth Edition Pearson Education, 2009.
2. Pratt and J.J.Adamski” Database management, “Third Edition, Thomson education, 2002.

SPECIALIZATION STREAM: IMMUNOLOGY
IMMUNOTECHNOLOGY

Course Code:13BT335 **L –T – P: 3-0-0**
Prerequisite: Nil **Credits: 3**

Cells and Lymphoid organs Immune system overview, innate and acquired immune system. Components of immune system. Phagocytosis; Inflammation, opsonization. Primary and secondary lymphoid organs. Complement. B cell, T cell ontogeny. Characteristics of antigen, T cell dependent and independent antigens and Super antigens. Types and applications of Hapten and Adjuvant. **Immune response** Generation of immune response - Primary and Secondary immune responses. Structure, functions of antibody and BCR.. Generation of Antibody diversity. TCR structure, δγTCR. MHC I and II gene, polymorphism. T helper, T cytotoxic cells. MHC peptide interaction. Antigen presentation, secondary signaling. **Immunological disorders** Immunological disorders; Hypersensitivity and autoimmune diseases. Immune response to viral and bacterial lymphatic infection. Kinetics of immune response. Techniques in humoral and cellular immunology. **Immunotechnology** Animal models and transgenic animals and their use in immunology. Experimental immunology. Hybridoma technology. Chimeric antibodies, phage display, antibody engineering. Large scale manufacture of antibodies. Manufacturing of immunodiagnostics. **Disease diagnosis and Vaccines** Concept of vaccination & Vaccine development. Strategies for development of vaccines against dreadful diseases – malaria, tuberculosis, HIV. Diagnostic tools and Kit development technology.

Textbooks:

1. Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne Immunology, 6th Edition, Freeman, 2002.
2. Janeway et al., Immunobiology, 4th Edition, Current Biology publications., 1999.

Reference books:

1. Brostoff J, Seaddin JK, Male D, Roitt IM., Clinical Immunology, 6th Edition, Gower Medical Publishing, 2002.
2. Paul.W.E, Fundamental of Immunology, 4th edition, Lippincott Raven

STEM CELL TECHNOLOGY

Course Code: 13BT336 **L –T – P: 3-0-0**
Prerequisite: Nil **Credits: 3**

Introduction What are stem cells, types, origin and nature of stem cells? Characteristic features, pluripotent stem cells and its types, Molecular basis of pluripotency. Cell surface markers of stem cells. Embryonic stem cells, factors requirements for maintain stem cells. Differences between human and mouse stem cells. Development of epithelial stem cell concept. Stem cell niches. **Stem cell characterization** Cell cycle regulation in stem cell. Mechanism of stem cell renewal, Changes of phenotypic characters, Characterization of human embryonic stem cells, Isolation and maintenance of Stem cell. Genetic manipulation of Embryonic Stem cell, homologous recombination of stem cells. Surface antigenic markers, lineage marking, Genomic reprogramming. Microarray analysis of stem cells & differentiation. Zebra fish and Stem cell research. **Tissue engineering** Neural stem cells and applications in neurodegenerative diseases, Treatment of heart diseases, diabetes, burns & skin ulcers, muscular dystrophy, regeneration of epidermis, orthopedic applications. Embryonic applications in tissue engineering. Novel sources of multipotent stem cells. Adult stem cells, Stem cell gene therapy. **Biopharming** What is biopharming? Applications of stem cell technology in animal biotechnology. Production of artificial organs using stem cell technology. Artificial pancreas, kidney, heart, liver etc. **Regulations and Ethics** Ethics of human cell research-immortal cells and moral selves, Ethical considerations, stem cell based therapies. FDA products and preclinical regulatory considerations. Patent advocacy, Science policies, ethics in stem cell research, primordial germ cells and germ cell development epigenetics and reprogramming in stem cell biology, norms in clean room.

Text Books:

1. Rober Lanza, Essentials of Stem cell biology, Elsevier academic press, 2009
2. Joseph D. Bronzino Tissue engineering and artificial organs, Biomedical engineering hand book. volume -2, 3rd edition, CRC press, Taylor & Francis publications, 2006

Reference book:

1. Daniel R. Marshak, Stem Cell Biology, Johns Hopkins University and Cambrex Corp.;
2. Richard L. Gardner, University of Oxford; David Gottlieb, Washington University, St. Louis, 2001.

MEDICAL BIOTECHNOLOGY

Course Code: 13BT437 **L –T – P: 3-0-0**
Prerequisite: Nil **Credits: 3**

Introduction Introduction, worldwide market in medical biotechnology, revolution in diagnosis, changing approaches of therapy, FDA – Organization chart and regulatory measures for drug discovery: Investigational new drug. Drug discovery: Overview, rational drug design, combinatorial chemistry in drug development, computer assisted drug design, role of bioinformatics in genome – based therapy, antisense DNA technology for drug designing. **Health care products** Biotechnological approaches to obtain healthcare products: – principle, production and applications, Tissue plasminogen activator (TPA), Insulin, Growth hormone, Interferons and erythropoietin, Vaccine technology: Subunit vaccines, drawbacks of existing vaccines, criteria for successful vaccine, peptide vaccine, minicells as vaccines, impact of genetic engineering on vaccine production, viral vector vaccines, and Malaria & AIDS vaccine, chiral technology: Principle and applications. **Stem cells** Introduction to concepts in stem cell biology, Types of stem cells - Neuronal, Muscle and bone stem cells, Hematopoietic, Epithelial (skin, intestine, breast), Prostate and breast stem cells (segue into cancer). Stem cells and therapeutics, Ethical issues associated with stem cell biology. Application of the stem cells. Artificial tissues and organs – Skin, liver, and pancreas. **Disease diagnosis** Disease diagnosis –Enzyme probes – glucose oxidase, lactate oxidase, monoamine oxidase. Biosensors in clinical diagnosis, Use of nucleic acid probes and antibodies in clinical diagnosis and tissue typing. Nanotechnology in diagnosis. PCR amplification and diagnosis applications in forensic medicine. Gene therapy. **Clinical trials:** Clinical trials – Phase –I Phase II and II trail norms – ICMR guidelines for design and conducting clinical trials, licensing procedure in India, intellectual Property Rights and patents in biotechnology

Textbooks:

1. Albert Sasson. Medical Biotechnology: Achievements, Prospects and Perceptions. United Nations University Press, 2005.
2. Lee Yaun Kun. Microbial Biotechnology – Principles and applications. World Science publications, 2004

Reference books

1. Michels et al., Genetic techniques for Biological Research. Wiley Publications, 2002.
2. Glazer AN, Nikaido H. Microbial Biotechnology – Fundamentals of Applied Microbiology WH Freeman, New York 1994.
3. Vyas. Methods in Biotechnology and Bioengineering, CBS publications, 2003.

CANCER BIOLOGY

Course Code: 13BT438 **L –T – P: 3-0-0**

Prerequisite: Nil **Credits: 3**

BASICS OF CANCER Phenotypic characteristics of cancer cells. Basic feature of normal cell & tissues. Characteristic features of tumour cells. Control of growth in normal cells, Factors influencing the development of cancers, Nomenclature of tumour cells, Effect of cell receptors, Different phases of cell cycle. Cell cycle regulation, Different types of cancer, Role of Diet in cancer. **CARCINOGENESIS**

Chemical carcinogenesis – History, Metabolism & Targets. Physical carcinogenesis – History, Metabolism & Targets. Viral carcinogenesis – History, Retroviruses, SV40, Adenovirus, Papilloma viruses. **MOLECULAR BIOLOGY OF CANCER** Tumour suppressor genes, Role and regulatory mechanism of tumor suppressor genes-Retinoblastoma (Rb), p53. Mechanism leading to tumour suppressor function loss. Oncogenes - Detection of oncogenes, proto-oncogenes, Proto-oncogene activity. Growth factors, EGF family, Receptor activation, Heterodimerization, Tyrosine phosphorylation, VEGF family, gene silencing and switching off the signal pathways in cancer. **CANCER METASTASIS** Cancer Metastasis – The spread of cancer, Pathogenesis of the process, Loss of cell-cell cohesion, Mechanism of tumour invasion, Dissemination of tumour cells in blood stream, Patterns of metastatic spread. Role of inflammation in cancer. **CANCER IMMUNOLOGY** B & T cell biology, Tumour antigens, Monoclonal antibodies, Cytokines in cancer, Complement proteins in cancer, Antigen processing & presentation, Factors influencing the incidence of cancer, Mechanism of immune response to cancer, Immunotherapy.

Recommended Textbooks:

1. Cancer Biology – Roger.G.B. Prentice Hall (May 2006).
2. Margaret A Knowles and Peter. J. Shelly, Introduction to Molecular and Cellular Biology of Cancer. 4th Edition. Elsevier publications

References Books:

1. Introduction to modern virology – Dimmock N.J., Blackwell scientific Publications. Oxford.
2. An Introduction to Cellular and Molecular Biology of Cancer – Oxford Medical Publications.
3. Kenneth M. Murphy, Paul Travers, Mark Walport,
4. Janeway's Immunobiology, 7th Edition, Garland Science Taylor &Francis Group.

NEUROBIOLOGY

Course Code: 13BT439 **L –T – P: 3-0-0**
Prerequisite: Nil **Credits: 3**

Neuroscience Overview, Resting Potential and Active Conductance, Excitable membranes – Action potentials, Channels and Transporters, Synaptic Transmission, Neurotransmitters and Receptors, Synaptic Plasticity, Survey of Human Neuroanatomy, Construction of Neural Circuits. Modification of Brain Circuits, The Somatic Sensory system, The Somatic Sensory System Auditory System, The Vestibular system, Chemical senses, The Eye, Sleep, Association Cortex and Cognition, Pain, Neuroscience in the News: Chronic Pain, Sex, Sexuality, and the Brain, Gender traits and pathways, Central nervous system, Peripheral nervous system, Sensory organs and their functions, Development of the nervous system, Neuronal modulation, Learning and memory, Repair and Regeneration in the Nervous System, Stroke, Epilepsy & Neurodegenerative diseases, Neurobiology of diseases.

Text Books:

1. Gordon M. Shepherd, Neurobiology, Oxford University Press, 1979
2. Fundamentals of Neuroscience by Dana Park, Elsevier publishers

Specialization Stream: Industrial Biotechnology
MICROBIAL TECHNOLOGY

Course Code:13BT337 **L –T – P: 3-0-0**
Prerequisite: Nil **Credits: 3**

Introduction to basics of biotechnology - A historical overview on scope and development of biotechnology and their products; Biotechnology as an interdisciplinary enterprise; A brief survey of organisms, processes, products and market economics relating to modern industrial biotechnology; Concepts of tools and techniques used in biotechnology; Outline and integrated bioprocesses and various unit operations (upstream and downstream) involved in the bioprocesses. Generalized process flow sheets. **Media, Screening and Strain improvement -** Medium requirements for fermentation process- carbon, nitrogen, minerals, vitamins and other nutrients- examples of simple and complex media; Industrial substrates. Primary and Secondary screening. Strain improvement by Physical, Chemical and Molecular techniques. **Production of Primary Metabolites -** A brief outline of processes for the production of some commercially important Organic acids (e.g., Citric acid, Lactic acid , Acetic acid, Gluconic acid); Amino acids (Glutamic Acid, Lysine, Aspartic Acid and Phenylalanine); and Alcohols (Ethanol, 2,3-butanediol) **Secondary Metabolites-** Study of production processes and flow sheets for various classes of low molecular weight secondary metabolites: Antibiotics-beta-lactams (Penicillin's), aminoglycosides (Streptomycin), Macrolids (Erythromycin), Quinines and aromatics. Vitamin B12 and steroids, Dual or multiple fermentation. **Enzymes, Recombinant Proteins, Special bioproducts-** Enzymes- Protease,; Concept of SSF, Advantages and disadvantages,Production of Recombinant Proteins- Insulin and Special Bioproducts- Biopesticides; Biofertilizers Natural Biopreservatives (Nisin); Biopolymers (Xanthan Gum); Single cell protein, High Fructose Corn Syrup; process of bioleaching

Text books:

1. Stanbury PF, A Whitaker ,"Principles of Fermentation Technology" GH Hall.
2. A.H.Patel ,"Industrial Microbiology".

Reference Books:

1. Glazer AN, Nikaido H ,"Microbial Biotechnology", WH Freeman and Company, (1995).
2. JE Baily & DF Ollis ,"Biochemical Engineering Fundamentals"(2nd ed), , McGraw Hill Book Co. New York.(1986).

PHARMACEUTICAL BIOTECHNOLOGY

Course Code: 13BT338 **L –T – P: 3-0-0**
Prerequisite: Nil **Credits: 3**

Fundamentals of pharmaceutical practice-Pharmaceutical biotechnology: An introduction; Origin & definition; Scope &Importance of Biotechnology; their applications; Microbes in Pharmaceutical industry; Methods of Gene transfer; Biotechnology; Production of Secondary Metabolites; Drug Interactions; Surgical supplies. D**rug metabolism and pharmacokinetics-**ADME-properties-Mechanism of Drug Absorption; Distribution of drugs; Drug metabolism(Biotransformation of drugs);Excretion of drugs; Pharmacokinetics; Basic considerations; Controlled Release Medication; Design of Controlled drug delivery systems; Drug release patterns; Oral parental; Trans-dermal ; Ophthalmic ; Intra-vaginal and Intrauterine Drug Delivery systems. P**harmaceutical dosage & blood, plasma products-**Materials & Formulations; Manufacture of Tablets; Capsules; Sustained Release dosage forms; Parental solutions; Oral liquids; Emulsions; Ointments; Suppositories, Aerosols; Topical applications; Collection; Processing and storage of whole human blood; Concentrated human RBC Control of Blood products; Transfusion products. P**harmaceutical products-**Fundamentals of Therapeutic categories such as Analgesics, Anesthetics, Antipyretic; Anti-inflammatory drugs; Antacids; Alkaloids; Glycosides; Hormone & Hormone antagonists; Antineoplastics and Immuno active drugs; Biologicals (Immunizing agents and allergenic extracts).D**rug manufacturing processes-**Good manufacturing practices; Manufacturing facilities; Sources of Biopharmaceuticals; Production & analysis of Biopharmaceuticals.

Texts Books:

1. Leon Lachman ,"The Theory and Practice of Industrial Pharmacy", Cbs Publishers & Distributor Pvt. Ltd. (pur) (2009).
2. Remington ,"The Science and Practice of Pharmacy" (Vol.1&11), Lww (2007)

Reference Books

1. SS Purohit,H N Kakarani &AK Saluja ,"Pharmaceutical Biotechnology", Student Edition (2010).

BIOPROCESS ECONOMICS AND PLANT DESIGN

Course Code: 13BT440 **L –T – P: 3-0-0**
Prerequisite: Nil **Credits: 3**

Economic evaluation Capital cost of a project. Interest calculations, nominal and effective interest rates. Basic concepts in tax and depreciation. Measures of economic performance, rate of return, payout time. Cash flow diagrams; Cost accounting-balance sheet and profit loss account. Break even and minimum cost analysis. **Bioprocess Economics** Introduction, elements of total production cost, outline of the total capital investment, equipment sizing, capital cost estimates large-scale equipment and utilities. Manufacturing cost estimates – Operating costs-Raw materials, utilities, fixed costs and overhead costs, case studies of antibiotics, recombinant products, single cell protein. **Introduction to process design** Schematic representation of unit operations, design information and flow diagrams, material and energy balances, formulation of the design problem, the Hierarchy of chemical process design and integration, optimization, Health and safety Hazards, Environment protection, plant location and lay out. **Basic considerations in equipment design** General design procedure, equipment classification, materials of construction-Mechanical properties-strength, elasticity, ductility, resilience, toughness, hardness, creep, fatigue. Metals-ferrous metals, types of iron & steels, nonferrous metals and Non-metals. Corrosion: Forms of corrosion and their presentation. Choice of materials. Design conventions. **Basic Design Problems** Design examples on continuous fermentation, aeration and agitation. Design calculation of filter for air sterilization. Design of batch and continuous sterilizers. Design calculations for immobilized enzyme kinetics. Practical considerations in designing of Bioreactor/Fermentor construction. Introduction to different types of valves, pumps, steam traps, spargers and impellers used in fermentation industries. Design exercise on trickle flow fermenter. Problems associated with design equations.

Recommended Text Books:

1. Peters & Timmerhaus, Plant design and Economics for Chemical Engineers McGraw Hill Higher Education (2004).
2. M V Joshi & V .V. Mahajani, Process equipment design, 3rd Ed. Macmillan India Limited (2000)

Reference books:

1.Harvey W Blanch, Biochemical Engineering,2nd Ed,Taylor &Francis/bS Publication (Feb 1997)

ALGAL BIOTECHNOLOGY

Course Code: 13BT441 **L –T – P: 3-0-0**
Prerequisite: Nil **Credits: 3**

Basics of algae Classification and systematic, occurrence and distribution. Structure of micro algae. Nutrition, media-marine and freshwater culture media. Types of media and sterilization techniques. Microalgal pigments – PC, PE, APC. Photo-chromatic effects and their adaptations of microalgae. Culture methods. Measurement of growth. **Cultivation of algae:** Microalgae – Basic cultural techniques. Indoor (photobioreactor) and open pond mass culture methods, biotechnological approaches for production of important microalgae. Single cell protein from Spirulina, raceway system of micro algae culture, vitamins, minerals and omega3 fatty acids from micro algae, enrichment of micro algae with micronutrients. **Cyanobacterial Biotechnology** Marine and fresh water microalgae. An Integral Event in the Development of Algae and Higher Organisms, Spirulina: The Superfood and Medicine. UV-B Radiation-Induced Stress and Protection Strategies in Cyanobacteria. Growth Response of Cyanobacteria from Sandy Soil and Mine Waste Burdened Soil to Different Environmental Variables. The Algal Industry Survey, Prospective in

Diatom Nanotechnology. **Applications of algae** Biotechnological applications of microalgae. Biotechnological Relevance of Microbes in Agriculture. Role of Blue Green Algae in Rice Production. Responses of Rice Field Cyanobacteria to Insecticides and fungicides. Lipids and Fatty Acids from Marine microalgae: A Potential Biofuel Resource, Algal Biodiesel: Procedures and Resources for Laboratory Study. Industrial Utilization of microalgal Fatty Acids. Cyanobacterial Toxins and Public Health. **Bio-fertilizers and pesticides** Biofertilizer potential of Cyanobacteria, Bioremediation and Bioactive Compounds. Production of Nutraceuticals and Antioxidant. Enzymes in a Tropical Food Algae, Bioremediation of Heavy Metals. Blue-green algae and Azolla association. Nitrogen fixation and biofertilizers **-** Diazotrophic microorganisms, nitrogen fixation genes. Two component regulatory mechanisms. Transfer of nif genes and nod genes – structure, function and role in nodulation; Hydrogenase - Hydrogen metabolism. Genetic engineering of hydrogenase genes.

Recommended Text Books:

1. E. Wolfgang Becker Microalgae: Biotechnology and Microbiology, Becker Published 1994 Cambridge University Press.
2. Robert A. Andersen, Algae culturing techniques. Elsevier academic press, 2005

Reference books:

1. R. Jhan Stevenson, Algal ecology, Academic press, 1996.
2. Robert Edward Lee. Phycology. Cambridge University press, 2008.
3. Laura Barsanti & Paologualtieri. Algae – Anatomy, Biochemistry, Biotechnology, CRC Press. 2006

METABOLIC ENGINEERING

Course Code: 13BT442 **L –T – P: 3-0-0**
Prerequisite: Nil **Credits: 3**

Introduction of Metabolic Engineering, Identification of metabolic regulation is a key point in metabolic engineering. Synthesis of Primary Metabolites, Metabolic Engineering for Bioproduction , Metaboliic Pathway(MP)Modeling and Obserbability of MP, Metabolic Flux Analysis(Cell Capability Analysis), Metabolic Flux Analysis(Genome Scale Flux Analysis) , Metabolic Control Analysis Molecular Metabolic Engineering, Applications of Bioconversions, Factors affecting bioconversions, Specificity, Yields, Co metabolism, Product inhibition, mixed or sequential bioconversions, Conversion of insoluble substances. Regulation of Enzyme Production, Strain selection, Genetic improvement of strains, Gene dosage, metabolic pathway, manipulations to improve fermentation, Feedback repression, Catabolite, Repression, optimization and control of metabolic activities. The modification of existing - or the introduction of entirely new - metabolic pathways. Experimental Determination, Method of Flux Distribution with Isotope Labeling, Metabolic Engineering with Bioinformatics. Application in pharmaceuticals, chemical bioprocess, food technology, agriculture, environmental bioremediation and biomass conversion.

Text Books:

1. Wang.D.I.C Cooney C.L., Demain A.L., Dunnil.P. Humphrey A.E. Lilly M.D., Fermentation and Enzyme Technology, John Wiley and sons 1980.
2. Stanbury P.F., and Whitaker A., Principles of Fermentation Technology, Pergamon Press, 1984.

GREEN BUILDINGS

Course Code:11CE331 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Green Buildings, Green Building Principles, Benefits of green building Global warming, requirement of Green Building, Rating Systems – IGBC, GRIHA, USGBC, LEED, BREEAM, CASBEE, GBTool, HK–Beam, Requisites for Constructing a Green Building, sustainable construction focus point: site, water, energy, material, indoor air quality, construction procedures.

Rating systems in India, IGBC green home rating system, Benefits of IGBC, procedure to get IGBC certification, procedure to become IGBC certified engineering professional, GRIHA ratings, procedure to get GRIHA certification.

Site issues: site analysis and design, site development and layout, Building and Site Requirements, Transportation, Plant Materials and Management.

Water issues: watershed protection, drainage of concentrated Runoff, water efficiency and conservation, rain water harvesting, water reclamation,

Sustainable materials: Reduce / Reuse / Recycle, Natural Sources, concrete, masonry, metals, wood and plastic, finishes. Green paints

Passive solar design, Day lighting, Building envelope, Renewable energy, Significance, design principle, ventilation control, occupant activity control, significance of acoustics. **Environmental construction guidelines**, building operations and maintenance.

Economics of green buildings, Selecting environmentally and economically balanced building materials, Project cost, Income and expenses.

Text Books:

1. Green homes by R.K .Gautham, BS publications.
2. Sustainable building technical manual- Green building design, constructions and operation; Produced by Public Technology Inc., US Green Building Council.
3. IGBC Green homes rating system Version 1.0 – A bridged reference guide

Reference Books:

1. Green Building A Basic Guide to Building and Remodeling Sustainably; Tree Hugger Consulting.
2. Green Building Handbook, Volume 1, Tom Woolley, Sam Kimmins, Paul Harrison and Rob Harrison; E & FN Spon, an imprint of Thomson Science & Professional
3. Green BIM: Successful Sustainable Design with Building Information Modeling, Eddy Krygiel, Bradley Nies, Willy publishing Inc.

ADVANCED STRUCTURAL ANALYSIS

Course Code:11CE332 **L –T – P: 3-0-0**
Prerequisite: 13CE203 **Credits: 3**

I.L.D for Determinate Structures: Influence line for reactions, simply supported, over hang, I L D for shear force in cantilever, simply supported, I L D for B. M cantilever, over hang and simply supported beams, position and magnitude of maximum shear force and B.M for concentrated load and udl, series of concentrated loads, absolute maximum S.F and B.M.

Analysis of Structure by Flexibility Matrix Method: Concept of flexibility coefficients, analysis of truss, indeterminate beams and rigid frames by this method

Analysis of Structure by Stiffness Matrix Method Concept of degrees of freedom, degree of indeterminacy and stiffness coefficients, analysis of truss, indeterminate beams and rigid frames by this method

Analysis of Cable and Three Hinged Structures: Solution method for cable structure, analysis of three hinged arch,

Plastic Analysis Structures Idealized stress-strain diagram, Plastic Moment of resistance, plastic modulus, shape factors for different sections, load factor, Plastic hinge and mechanism, plastic analysis of indeterminate beams and frames

TEXT BOOKS:

1. Basic Structural Analysis by C S Reddy, Tata McGraw Hill publishing Company ltd. Delhi. 2nd edition 2010

REFERENCE BOOKS:

1. Intermediate Structural Analysis by C. K. Wang, McGraw Hill Book Company, 2010
2. Structural analysis, A Matrix Approach by Pandit & Gupta, Tata McGraw Hill publishing Company ltd. New Delhi.2008
3. Structural Analysis by T.S Thandavamoorthy, Oxford University Press, New Delhi, First edition, 2011.
4. Fundamentals of Structural Mechanics and Analysis by M L Gambhir, PHI learning private limited, New Delhi, 2011.

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

Course Code:11CE333 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Dynamics of Structures and Seismic Response: Equation of motion, single degree of free system, dynamic response of single storey structure (SDOF), , seismic response of SDOF structure, concept of response spectrum, dynamic response of spectrum representation for elastic systems. **Systems with multi degree of freedom (MDOF):** periods and mode of vibration, elatic response, restoring force, damping, damping values for buildings. **Earthquake and ground Motion:** Causes of earthquake, nature and occurrences, seismic waves, effects, consequences, measurements, strong ground motion, seismic zones. **Seismo-resistant building architecture:** Lateral load resisting systems- moment resisting frame, Building with shear wall or bearing wall system, building with dual system; Building configuration – Problems and solutions; Building characteristics – Mode shape and fundamental period, building frequency and ground period, damping, ductility, seismic weight, hyper-staticity/redundancy, non-structural elements, foundation soil/ liquefaction. Foundations; Quality of construction and materials – quality of concrete, construction joints, general detailing requirements. **Design forces for buildings:** Equivalent static method, Determination of lateral forces as per IS 1893(Part 1), Modal analysis using response spectrum. **Ductility considerations in earthquake resistant design of RCC buildings:** Impact of ductility; Requirements for ductility; Assessment of ductility– Member/element ductility, Structural ductility; Factor affecting ductility; Ductility factors; Ductility considerations as per IS13920. **Earthquake resistant design of a long two-storey, two-bay RCC building:** Determination of lateral forces on an intermediate plane frame using Equivalent static method and Modal analysis using response spectrum; various load combinations as per IS1893(Part 1); Identification of design forces and moments in the members; Design and detailing of typical flexural member ,typical column, footing and detailing of a exterior joint as per IS13920. **Masonry building:** categories, plain and reinforced masonry walls, box action and bands, infill walls, improving seismic behavior of masonry building, load combinations and permissible stress, seismic design of masonry building.

References:

1. Earthquake resistant design of structures by Pankaj Agarwal and Manish Shrikhande, Prentice-Hall of India, 2006.
2. Seismic design of reinforced concrete and masonry buildings by T. Paulay and M.J.N. Priestley, John Wiley & Sons, 1991.
3. The seismic design handbook, Edited by F. Naeim, Kluwer Academic publishers, 2001.

PRESTRESSED CONCRETE

Course Code:11CE334 **L –T – P: 3-0-0**
Prerequisite: 13CE305 **Credits: 3**

Basic terminology and concepts of prestressing; Need for High strength steel and high strength concrete; as material for prestressed concrete Advantages of pre stressed concrete. Prestressing Systems: pretensioning; Post tensioning ; Thermo– electric prestressing; chemical prestressing.
Analysis of Prestress and Bending Stresses: Resultant stresses; Pressure (Thrust) line and internal resisting couple; Concept of Load balancing; Stresses in tendons; Cracking moment. Losses of Prestress: due: to elastic deformation , shrinkage , creep of concrete, relaxation of stress in steel, friction and anchorage slip; Total losses allowed for in design.
Deflections; Factors influencing deflections; Short term deflections of un-cracked members; Effect of tendon profile on deflections. Ultimate flexural strength of simple sections using simplified IS code Recommendations.
Shear and principal stresses; IS Code recommendations: Ultimate shear resistance . Design of shear reinforcement. Design of reinforcements for torsion, shear and bending.
Design of end blocks: Transmission of prestress in pretensioned members; Transmission Length; Anchorage stress in post tensioned members; Bearing stress and bursting tensile force stresses in end blocks-Methods. IS-Code provision for the design of end block reinforcement.

TEXTBOOKS:
1. Prestressed Concrete by N. Krishna Raju; Tata Mc.Graw - Hill Publishing Company Limited, New Delhi.
2. Pre-stressed Concrete- P. Dayarathnam: Oxford and IBH Publishing Co.
3. 3.Indian standard code of practice for prestressed concrete (IS -1343-1980): Bureau of Indian stanadards New Delhi

REFERENCE BOOKS:
1. Prestressed concrete by N. Rajagopalan; Narosa Publishing House.
2. Design of pre-stressed concrete structures- T.Y. Lin and Ned H. Burns - John Wiley & Sons, New York.
3. Fundamental of pre-stressed concrete- N.C. Sinha & S.K. Roy

BRIDGE ENGINEERING

Course Code:11CE335 **L –T – P: 3-0-0**
Prerequisite: 13CE305 & 13CE306 **Credits: 3**

Concrete Bridge: Various types of bridges; I.R.C. specifications for road bridges. Culverts: Design of R.C. slab culvert. T-Beam Bridge: Pigeaud's method for computation of slab moments; courbon's method for computation of moments in girders; Design of simply supported T-beam bridge. Sub Structure for Bridges: Pier and abutment caps; Materials for piers and abutments' Design of pier; Design of abutment; Backfill behind abutment; approach slab. Bearings for Bridges: Importance of bearings; bearings for slab bridge; bearings for girder bridges; Expansion bearings; Fixed bearings; Design of elastomeric pad bearing. Foundations For Bridges: scour at abutments and piers; Grip length; Types of foundations; Design of well foundation. Cable Supported Bridge: Different types of cable supported bridge, difference between suspension bridge and cable stayed bridge. Different components and factors considered for design of a) suspension bridge, b) cable stayed bridge.

TEXT BOOKS:
1. Essentials of Bridge Engineering by Dr. Johnson Victor; Oxford & IBH publishing Co. Pvt. Ltd.
2. Cable supported bridges, concepts and design by N J Gimsing. John Willey and Sons

REFERENCE BOOKS:

1. Design of Bridge Structures by T. R Jagadeesh, M.A Jayaram, Prentice Hall of India Pvt. Ltd.

GROUND IMPROVEMENT TECHNIQUES

Course Code: 11CE341 **L –T – P: 3-0-0**

Prerequisite: 13CE304 **Credits: 3**

Necessity of ground improvement- objectives, Introduction to different methods – Mechanical stabilization- Types of rollers, effect on engineering properties- Chemical stabilization- cement stabilization- factors affecting soil cement mixing-admixtures- lime stabilization-effect of lime on soil properties-construction of lime stabilized bases-bituminous stabilization.

Dewatering-well-point system-electro osmosis-pre-loading- sand drains- methods of installation - PVD's, Types, Design, construction -stone columns in clays - vibro-flotation in sands and clays, Designs as per BIS and case histories. Introduction to grouts and grouting- basic functions – groutability ratio –classification of grouts, properties of grouts - grouting applications- Impermeability grouting seepage control in soil under dams and for cut off walls- seepage control in rock under dams-stabilization grouting for under pinning. Geosynthetics – Types, functions, typical Applications of filtration and drainage, use in road /airport pavements and strengthening existing pavements.

Earth Reinforcement- mechanism and concept - laboratory behavior of reinforced soil-Reinforced Soil retaining Structures – Types of Reinforcements, fascia and connections - design concepts and stability analysis – Use in India

TEXT BOOKS:

1. IRC (1995). Ground Improvement Techniques
3. Stabilization of clays, Indian Raods congress, New Delhi , Spl Publication No. Venkatappa Rao, Gand Ramana, G.V. (2000)
4. Relevant I.S.Codes

REFERENCES :

1. Bowles, J.F. Foundation Design
2. Das, B.M, Geotechnical Engineering
3. Jones, C.J.F.P.Earth Reinforcement and Soil structures
4. Koerner, R.M. (2005) Designing with Geotextiles

ADVANCED FOUNDATION ENGINEERING

Course Code: 11CE342 **L –T – P: 3-0-0**

Prerequisite: 13CE304 **Credits: 3**

Foundation on collapsible and expansive soils: Collapse potential and settlement, Computation of collapse settlement, Foundation design, Treatment methods for collapsible soils, Distribution of expansive soils, General characteristics of swelling soils, Clay mineralogy and mechanism of swelling, Definition of some parameters, Evaluation of the swelling potential of expansive soils by single Index Method, Classification of swelling soils by Indirect Measurement, Swelling pressure by direct measurement, Effect of initial moisture content and initial dry density on swelling pressure, Estimating the magnitude of swelling, Design of foundation in swelling soils, drilled pier foundations, Elimination of swelling

Factors to consider in foundation design: Footing Depth and spacing, Displaced soil effects, Net versus gross soil pressure design soil pressures, erosion problems for structures adjacent to flowing water, Corrosion protection, Water table fluctuation, Foundations in Sand deposits, Foundations on Loess and other collapsible soils, Foundations on sanitary landfill sites, Frost depth and foundations on permafrost, Environmental considerations problems.

Spread footing design: Footing Classification and purpose, Allowable soil pressures in spread footing design, Assumptions used in footing design, reinforced concrete design – USD, Structural design of spread footings, Bearing plates and anchor bolts, Pedestals, Rectangular footings, Eccentrically loaded spread footings, Unsymmetrical footings, Wall footings and footings for residential constructions, Design of spread footings with overturning moment problems.

Spread footing and beams on elastic foundations: Rectangular combined footings, design of trapezoid shaped footings, design of strap (or cantilever) footings, footings for industrial equipment, Modulus of sub grade reaction, Classical solution of Beam on Elastic foundation, Finite Element solution of beam on elastic foundation, General Comments on the finite element procedure problems.

Mat foundations: Types of Mat foundations, Bearing capacity of Mat foundations, Mat settlements, Modulus of subgrade reaction for mats, Design of Mat foundation, Finite difference Method for Mats, Finite element method for Mat foundations, The finite grid method, Mat superstructure interaction, Circular mats or plates.

Machine foundations: Design criteria for satisfactory action of a machine foundation, Theory of linear weightless spring, Methods of analysis of a block foundation, Soil spring constants, Determination of soil spring constants, Degrees of freedom of block foundation, vertical vibrations of a block foundations, Rocking vibrations of a block foundations, pure sliding of a block foundation, Indian Standard on design and construction of foundations for reciprocating machines.

TEXT BOOKS

1. Foundation analysis and design by J.E.Bowles, published by Mc Graw-Hill International Editions
2. Basic and applied soil mechanics by Gopal Ranjan and A.S.Rao, Wiley Eastern Limited

REFERENCE BOOKS

1. Soil Mechanics and Foundation Engineering by VNS Murthy, CBS publishers&distributors
2. Theory and Analysis of Foundations by N.N.Som &S.C.Das, Prentice Hall India Ltd.
3. Hand Book of Machine Foundations by CV Vaidyanathan and Srinivasulu P. Tata Mcgraw Hill Publishing Co. Ltd.

GEOTECHNICAL EARTHQUAKE ENGINEERING

Course Code: 11CE343 **L –T – P: 3-0-0**
Prerequisite: 13CE206 **Credits: 3**

Seismology and Earthquakes: Seismic Hazards, seismic waves, internal structure of earth, Continental drift and plate tectonics, faults, elastics rebound theory, geometric notations, location of earthquakes, size of earthquakes.

Strong Ground Motion: Strong ground motion measurement, ground motion parameters, estimation of ground motion parameters.

Seismic Hazard Analysis: Identification and Evaluation of Earthquake Sources, deterministic seismic hazard analysis, probabilistic seismic hazard analysis.

Wave Propagation Waves in unbounded media, waves in a semi – infinite body, waves in a layered media, attenuation of stress waves.

Artificial Ground Motion Generation: Modification of actual ground motion records, time domain generation, frequency domain generation. **Dynamic Soil Properties** Representation of stress conditions by Mohr circle, measurement of dynamic soil properties using field and laboratory tests, stress strain behavior of cyclically loaded soils, strength of cyclically loaded soils.

Ground Response Analysis: One– Dimensional Ground response Analysis – Linear and Non-Linear Approaches. **Local Site Effects:** Effect of local site conditions on ground motion, design parameters, development of design parameters.

Liquefaction Flow liquefaction, cyclic mobility, evaluation of liquefaction hazards, liquefaction susceptibility, initiation of liquefaction, effects of liquefaction.

Soil Improvement for Remediation of Seismic Hazards: Densification techniques, Reinforcement Techniques, Grouting and Mixing techniques, Drainage techniques.

TEXT BOOK:

1. Geotechnical Earthquake Engineering by Steven L. Kramer, prentice Hall

REFERENCE BOOK:

1. Geotechnical Earthquake Engineering Handbook by Robert W. Day, McGraw-Hill

DESIGN OF EARTH RETAINING STRUTURES

Course Code: 11CE344 **L –T – P: 3-0-0**
Prerequisite: 13CE206 **Credits: 3**

Retaining walls – different types - Gravity, Cantilever-counter fort and Crib types. Basement or foundation retaining walls. Design principles of retaining walls, Design and Construction of Reinforced Soil Walls, Reinforced Soil Wall (A Case Study),Geosynthetics for Warehouse Grade Slab and Retaining Wall,Geogrid-Reinforced Retaining Walls, Restoration of Wharf Road by Geosynthetic Reinforced Soil Wall, Abutments and wing walls and allowable bearing capacity settlement tilting. Safety against general slip failure. Type of Failures of Retaining Walls – Stability Requirements – Drainage behind Retaining walls – Provision of Joints – Relief Shells.

Braced cuts – Lateral Pressure in Braced cuts – Design of Various Components of a Braced cut – Stability of Braced cuts – Bottom Heave in cuts.

Sheet Pile Structures – Types of Sheet piles – Cantilever sheet piles in sands and clays –Anchored sheet piles – Free earth and fixed earth support methods – Row's moment Reduction method – Location of anchors, Forces in anchors.

Soil reinforcement – Reinforced earth - Different components – their functions – Mechanics of reinforced earth – Failure modes-Failure theories – Design of Embankments on problematic soils.

Cofferdams – types, suitability, merits and demerits – Design of single – wall Cofferdams and their stability aspects – TVA method and Cummins' methods.

TEXT BOOKS:

1. Gopal Ranjan and A.S.R. Rao "Basics and Applied soil mechanics ", New age International Publishing, second edition, 2007
2. G Venkatapparao P.K. Banerjee, J.T.Shahu, G.V. Ramana By Geo-Synthetics-New Horizons - 2004
3. P.C.Varghese Foundation Engineering Prentice-Hall of India Pvt Ltd , New Delhi - 2006

REFERENCE BOOKS:

1. Principles of foundation engineering by Braja M. Das,PWS-KENT Publishing company,boston
2. Foundation analysis and design- Bowles, JE- McGraw Hill

3. Analysis and design of foundation and retaining structures, Prakash, SSaritha Prakashan, Mearut

ROCK MECHANICS

Course Code: 11CE345 **L –T – P: 3-0-0**
Prerequisite: 13CE206 **Credits: 3**

Classification of Intact rock mini fissures, joints in rock masses and Engineering Classifications Rock masses Strength. Physico-mechanical properties, Laboratory tests Seno Controlled Systems. Field shear test, Deformability tests in rock mass. Failure criteria for rock and rock masses, Strength and deformability of jointed rock mass. Rock Joints – Types Insitu stress, various methods of stress measurement, Hydro fracturing technique, Flat jack technique, Overcoming technique. Underground openings Stresses in Tunnels. Stability of rock slopes, Modes of failure, Plane failure, Wedge failure, Circular failure, Toppling failure. Foundation on rocks, Estimation of bearing capacity, Stress distribution in rocks, Settlement in rocks, Pile foundation in rocks. Methods to improve rock mass responses, Grouting in Rocks, Rock bolting, Rock Anchors.

TEXT BOOKS:

1. Introduction to Rock Mechanics by Goodman. R.E, John Wiley & Sons..
2. Foundation and Tunnels by Ramanamurthy. T, Engineering in Rocks for Slopes, Prentice Hall India Pvt. Ltd.

REFERENCE BOOKS:

1. Fundamentals of Rock Mechanics by Jaeger, Cook and Zimmerman, Blackwell Publishing., Fourth Edition,
2. ISRM and B. I. S Text Methods of Rocks and Rock Masses

ADVANCED OPEN CHANNEL HYDRAULICS

Course Code: 11CE351 **L –T – P: 3-0-0**
Prerequisite: 13CE202 **Credits: 3**

Basic Concepts of Free Surface Flow: Difference between open channel flow and pipe flow, geometrical parameters of a channel, Classification of Channels and Classification of Flows, Continuity equation. Saint Venant equation, Resistance equations for uniform flow in open channel, velocity, Pressure and shear stress distribution, Most efficient channel section. Energy and Momentum Principles, specific energy and specific force Critical flow, Control section. Non-Uniform Flow in Open Channel Equation of gradually varied flow and its limitations, Classification of surface profiles, integration of varied flow equation by analytical and numerical methods, Flow through Channel Transition. **Rapidly Varied Flow**: Hydraulic Jump, Equation of motion for unsteady flow, open channel surge, celerity of the gravity wave, deep and shallow water waves. **Spatially-varied flow**: Differential equation of SVF, classification, profile computation, Sediment Transport: Sediment properties, Inception of sediment motion, bed forms, Bed load suspended load,Total sediment transport. Design of stable channels and regime channels. Reservoir sedimentation and trap efficiency. Dam break flow.

TEXT BOOKS:

1. Open Channel Hydraulics by Chow., V.T., Mc Graw Hill Inc. N York, 1997.
2. Open Channel Flow by Henderson, Mc Millan Pub., London, 1996.

REFERENCE BOOKS:

1. Flow in Open Channels by K.Subramanya, Tata Mcgraw Hill.

DESIGN OF HYDRAULIC STRUCTURES

Course Code:11CE352 **L –T – P: 3-0-0**
Prerequisite: 13CE202 **Credits: 3**

Irrigation canal, Canal drop-Notch type. Canal regulator Vertical drop weir on permeable foundationsDirect sluice. Surplus weir of a tank Syphon Aqueduct (Type – III Aqueduct). Profile of a Ogee spillway

Text Book

1. Design of Minor Irrigation and Canal Structures by C. Satyanarayana Murthy; Wiley Eastern Ltd., New Delhi.

Reference Book

1. Irrigation and Water Power Engineering by Dr. B.C.Punmia & Dr.Pande B.B. Lal; Laxmi Publications pvt. Ltd., New Delhi.

ENVIRONMENTAL IMPACT ASSESSMENT

Course Code:11CE353 **L –T – P: 3-0-0**
Prerequisite: 13CE207 **Credits: 3**

Conceptual Facts of EIA: Introduction, Definition, Scope, Objectives and Basic Principles, Classification, Project Cycle, Grouping of Environmental Impacts: Direct Impacts, Indirect Impacts, Cumulative Impacts and Induced Impacts. Significance of Impacts: Criteria/Methodology to Determine the Significance of the Identified Impacts.

Methods for Impact Identification: Background Information, Interaction-Matrix Methodologies: simple matrices, stepped matrices, development of a simple matrix, other types of matrices, summary observations on matrices, Network Methodologies: Checklist methodologies, simple checklists, descriptive Checklists, summary observations on simple and descriptive Checklists.

Prediction of Impacts (Air and Water): Air Environment: Basic information on air quality, Sources of Pollutants, effects of pollutions, Conceptual approach for addressing air environment impacts, Air quality standards, Impact Prediction, Impact significance. Water Environment: Basic Information on surface-Water Quantity and Quality, Conceptual Approach for Addressing Surface-Water-Environment Impacts, Identification of Surface-Water Quantity or Quality Impacts, Procurement of Relevant Surface-Water Quantity-Quality Standards, Impact Predictions, Assessment of Impact Significance.

Predictions of Impacts (Noise, Soil, Biological and Socio-economic): Basic Information on Noise Key Federal Legislation and Guidelines, Conceptual Approach for Addressing Noise-Environment Impacts, Identification of Noise Impacts, Procurement of Relevant Noise Standards and/or Guidelines, Impact Prediction, Assessment of Impact Significance. Soil Environment: Human Health and Society, Biological Environment: Basic Information on Biological Systems, Conceptual Approach for Addressing Biological Impacts, Identification of Biological Impacts, Description of Existing Biological Environment Conditions, Procurement of Relevant Legislation and Regulations, Impact Prediction, Assessment of Impact Significance.

Environmental Management Plan (EMP): Case Study, identification of Impacts, EMP for Air Environment: Dust Control Plan, Procedural Changes, Diesel Generator Set Emission Control Measures, Vehicle Emission Controls and Alternatives, Greenbelt Development. EMP for Noise Environment, EMP for Water Environment: Water Source Development, Minimizing Water Consumption, Domestic and Commercial Usage, Horticulture, Storm Water Management. EMP for land Environment: Construction Debris, hazardous Waste, Waste from temporary Labour settlements.

TEXT BOOKS:

1. Environmental impact assessment by Canter,L.W, Mc Graw Hill, New York,1996.
2. Technological guidance manuals of EIA. MoEF
3. Environment Impact Assesment methodologies, Y.Anjaneyulu and Valli Manickan, B.S.Publications, Hyderabad.

REFERENCES

1.Hand book of Environment Impact Assesment, Vol. I and II, Blackwell Science, London, 1999.
2. The world bank group, Environmental Impact Assesment source book, Vol. I, II and III.
3. Textbook of Environmental Science & Technology by M.Anji Reddy, BS Publications, 2010

SOLIDWASTE MANAGEMENT AND LANDFILLS

Course Code:11CE354 **L –T – P: 3-0-0**
Prerequisite: 13CE207 **Credits: 3**

Municipal Solid Wastes: Types of solid wastes, Sources of Municipal and Hazardous wastes, Properties of solid wastes-Physical and Chemical composition. Solid Waste Management: An Overview, Introduction – Reduction, Reuse and Recovery, Waste Disposal Options, Current Scenario and Challenges Engineered Systems For Solid Waste Management: Functional Elements, Solid waste generation, On-site handling, Storage and Processing, Collection of solid wastes, Transfer and Transport, Processing of Solid wastes, Ultimate disposal. Conversion of Solid wastes and Recovery: Mechanical processing and Material recovery systems. Biological Conversion-Composting, Anaerobic Digestion. Thermal Conversion- Combustion, Incineration, Gasification, Pyrolysis, Refuse Derived Fuel, Energy recovery systems. Landfills for Municipal Solid Wastes: Land Filling of Municipal Solid Wastes, Site selection, Planning, Design and Operation. Landfill Gas-composition, Collection. Lechate-environmental effects, Lechate collection systems, Treatment of lechate, MoEF rules, CPCB guidelines for hazardous waste land filling. Lechate Control By Clay Liners: Clay Liners-Types-Compacted clay liners and their design-Construction of clay liners. Geosynthetic Lining Systems: Geosynthetics – Types and Functions-Geosynthetic clay liners-Properties , Hydraulic conductivity, Installation.

TEXT BOOKS:

1. Howard S. Peavy, Donald R. Rowe and George Tchobanoglous (1985), Environmental Engineering, Mc Graw-Hill International Editions, NewYork.
2. Venkatappa Rao. G and Sasidhar. R.S.(2009), Solid waste management and Engineered Landfills, Sai Master Geoenvironmental Services Pvt.Ltd, Hyderabad.

REFERENCE BOOKS:

1. Solid waste Engineering by P.Aarne Vesilind, Willium Worrell and Debra Reinhart,(2004), Cengage Learning India Private Limited, New Delhi.
2. Environmental Science and Engineering by J.Glynn Henry, Gary W.Heinke,(2004),Low Price Edition, Pearson Education Inc, Singapore.
3. MoEF(2000) Municipal Waste Management and Handling Rules, Govt. of India.
4. CPCB(2001) Criteria for Hazardous waste Landfill(HASWAMS/17/2000-01)
5. Solid and hazardous waste management by M.N.Rao and Razia Sultana, BS Publications, Hyderabad.

RURAL WATER SUPPLY AND SANITATION

Course Code: 11CE355 **L –T – P: 3-0-0**
Prerequisite: 13CE207 **Credits: 3**

Magnitude of problem of water supply and sanitation in rural areas National policy. Various approaches for planning of water supply systems in rural areas. Selection and development of underground sources of water, Collection of raw water from surface source. Specific pollutants in rural water supply and treatment e.g. iron, manganese, fluorides etc. Low cost treatment , appropriate technology for water supply and sanitation. Improvised method and compact system of treatment of surface and ground waters. Water supply through spot-sources, hand pumps, open dug –well. Planning of distribution system in rural areas. Water supply during fairs, festivals and emergencies. Simple wastewater treatment system for rural areas and small communities such as stabilization ponds, septic tanks, soakage pits etc. Treatment and disposal of wastewater/sewage. Various method of collection and disposal of night soil. On site sanitation system and community latrines. Disposal of solids waste composting, land filling. Biogas plants.

Text books

1. Manual of water supply and treatment, 3rd edition, CPHEEO, GOI, New Delhi.
2. Kapoor, B. S. Environmental Sanitation, S. Chand and company, New Delhi, 2001
3. Garg, S. K. Water Supply Engineering: Environmental Engineering (Vol I), Khanna Publishers, New Delhi, 2012
4. Murali Krishna, KVSG; Rural, Municipal and Industrial Water Management, Environmental Protection Society, Kakinada, ISBN 13: 9788183510066

REFERENCE Books:

1. Low cost on site sanitation option, Hoffman & Heijno Occasional Nov.1981 paper No. 21, P.O. Box 5500, 2280 HM Rijswijk, the Netherlands offices, J.C. Mokeniaan, 5Rijswijk, the Haque.
2. Wagner, E.G. and Lanoik, J.N. Water supply for rural areas and small communities, Geneva: W.H.O., 1959.
3. Wright, F. B. Rural water supply and sanitation, Robert E. Kriegier Publishing company, 3rd Edition, new York, 1977.

RAILWAY, AIRPORT AND DOCK & HARBOUR ENGINEERING

Course Code: 11CE361 **L –T – P: 3-0-0**
Prerequisite: 13CE303 **Credits: 3**

Railway Engineering: Historical Development of Railways in India, Advantages of Railways, Classification of Railways, Permanent Way & its components, functions. Track volume and Track capacity. Rail Joints, Welding of rails and Creep of rails; **Track Geometric Design** - Gradients, Horizontal and Vertical curves, super elevation, Negative Super elevation, Coning of Wheels. Turnouts: Left/ Right Hand Turnout, Track Junctions, Points and crossings, Tracks Drainage, Railway Stations and Yards, Signaling. **Airport Engineering:** Factors affecting Selection of site for Airport – Aircraft Characteristics- Geometric Design of Runway- Computation of Runway length – Correction for runway length – Orientation of Runway –geometric design of taxiway, Wind Rose Diagram – Runway Lighting system. **Dock & Harbour Engineering:** Layout of Port components – Functions – Classification of Ports – Site selection – Natural Phenomenon – Tides, Winds, Waves, Currents – Drift – Navigational aids. Harbours - layouts, shipping lanes, anchoring, location identification; Littoral transport with erosion and deposition; sounding methods; Dry and Wet docks, components and operational Tidal data and analyses.

TEXT BOOKS:

1. Railway Engineering by S.C. Saxena & S. Arora.
2. Airport Planning and Design- S.K.Khanna and Arora,Nemchand Bros.
3. Dock & Harbour by Srinivasan

REFERENCE BOOKS:

1. Railway Engineering by Rangwala.
2. Air Transportation Planning & design – Virendhra Kumar & Statish Chandhra – Gal Gotia Publishers (1999).
3. Dock & Harbour Engineering by Ozha & Ozha

ADVANCED HIGHWAY ENGINEERING

Course Code: 11CE362 **L –T – P: 3-0-0**
Prerequisite: 13CE303 **Credits: 3**

Hill Roads: General Considerations, Alignment of Hill Roads, Geometrics of Hill Roads, Design & Construction of Hill Roads, Drainage in Hill Roads, Maintenance Problems in Hill Roads, Tunnels, Miscellaneous Structures in Hill Roads, Landslides, Snow Removal. **Low Volume Roads:** Introduction, Types of Rural Road Pavements, Use of Low – Grade Aggregates and Stabilized soil, Pavement Design for Low volume Roads, Technologies in Rural Road Construction and Maintenance, Appropriate Quality control in Rural Road Construction. **Desert Roads**: Desert Regions in India, Sand Dunes, their functions and Type, Principles of Road Location in Dune Areas, Guidelines for Design, Maintenance. **Roads in Swampy and water-logged Areas and in Black cotton Soils:** Swampy Ground, Water-logged Area – its Features, Treatment of Roads in water-logged areas, Roads in Black Cotton Soils. **Special Roads**: Expressways - Common Terms, Features of Expressways, Design Standards, Safety Barriers, Expressway Signs and Markings. Toll Roads - Background, Advantages and disadvantages of toll roads, Forms of Toll Projects, International Experience on Toll Roads. Urban Roads - Functional Classification of Roads in Urban Area, Pedestrian Facilities on Urban Roads, Separate Cycle Tracks and Bus Facilities.

TEXT BOOKS:

1. Principles and practices of highway Engineering by Dr. L. R. Kadiyali & Dr. N. B. Lal Khanna publishers, Latest Edition

REFERENCE BOOKS:

1. Highway Engineering by S.K.Khanna & C.J.Justo, Nemchand & Bros., Latest Edition.

CODES:

1. MORT&H: Guidelines for Expressways Part-I and Part-II
2. MORT&H Guidelines for Maintenance Management of Primary, Secondary and Urban Roads
3. IRC:86-1983 Geometric Design Standards for Urban Roads in Plains
4. IRC:52-2001 Recommendations About the Alignment Survey and G.Design of Hill Roads
5. IRC:SP:48-1998 Hill Road Manual
6. IRC:SP:72-2007 Guidelines for the Design of Flexible Pavements for Low Volume Rural Roads
7. IRC:SP:20-2010 Rural Roads Manual
8. IRC:SP:62-2004 Guidelines for the D&C of Cement Concrete Pavement for Rural Roads
9. MORD Specifications for Rural Roads
10. MORD Standard Data Book for Analysis of Rates for Rural Roads
11. IRC:34-2011 Recommendations for Road Construction in Areas Affected by Water Logging, Flooding and/or Salts Infestation (First Revision)

Note: Use Latest codes if revised

TRAFFIC ENGINEERING

Course Code: 11CE363 **L –T – P: 3-0-0**
Prerequisite: 13CE303 **Credits: 3**

Statistical Methods for Traffic Engineering: Need, Elementary concepts of Probability, Mean, Standard Deviation and Variance, Poisson and Binomial Distribution, Normal Distribution, Sampling Theory and Significance Testing, Linear Regression and Correlation, Multiple Linear Regression **Traffic Flow Theory:** Introduction, Fundamentals of Traffic Flow, Uninterrupted Traffic Flow – Stream Characteristics, Data Collection, Microscopic and Macroscopic Traffic flow Models, Capacity and LOS, Fundamentals of Interrupted Traffic flow – Shock Waves, Traffic flow at signalized and Un signalized Intersection. **Design Of Traffic Facilities:** Introduction, Freeways, Intersections – Un signalized Intersections, Signalized Intersections, Interchanges – Warrants for Interchanges, Design of Interchanges, Parking Facilities – Parking Demand, On street parking, Off street Parking, Parking stalls, Vehicle Circulation, Road Signs. **Traffic Safety:** Road Accidents, Accident Situation in National & International, Road, Weather and its effect on accidents, Speed in relation of Safety, Pedestrian Safety, Parking and its Influence, Traffic Management Measures and its Influence, Legislation, Enforcement, Education and Propaganda, Cost of Road Accidents, Road Safety Audit. **Traffic and the Environment:** Introduction, Detrimental Effects of traffic on the environment – Noise, Air pollution, Vibration, Visual Intrusion and degrading the aesthetics, Severance and Land Consumption, Evaluation Procedures, Environmental Areas, Situation in India.

Text Books

1. Principles and practices of highway Engineering by Dr. L. R. Kadiyali & Dr. N. B. Lal Khanna publishers – (2003).
2. Principles of Transportation Engineering by Partha Chakroborty and Animesh Das. Prentice Hall of India, New Delhi, 2003.

Reference Books:

1. Principles of Highway Engg., and Traffic Analysis by Fred L. Mannering etc., Wiley Publications, 4th edition, 2012 reprint
2. Transportation Engineering by C . Jotin Khisty, B.Kent Lall, Prentice Hall of India, New Delhi, 2008

ADVANCED PAVEMENT DESIGN ENGINEERING

Course Code: 11CE364 **L –T – P: 3-0-0**
Prerequisite: 13CE303 **Credits: 3**

Material Characterization: Characterization of test types, Plate- Load Tests, Triaxial Compression Test, CBR Test, Stabilometer and Cohesionmeter. Tests for Bituminous Mixtures: Modulus of Rupture, Indirect Tensile Test, Layered input Parameter Tests, Resilient Modulus Test, Complex (Dynamic) Modulus Test, Diametrical Resilient Modulus, Asphalt Mix Stiffness (Shell Nomograph), Creep Test, Wave Propagation Techniques, CBR-Modulus correlation, Typical Modulus Values, Poisson's Ratio. Fatigue Testing and Permanent Deformation. **Design of Flexible Pavements:** Design of Flexible Airport Pavements: Corps of Engineers (CBR) Method, FAA, CDOT, The Asphalt Institute Method.

Design of Flexible Highway Pavements: Differences between Airport and Highway Pavements, Differences in Design Methods, AASHO Flexible Pavement Design, Multi Layer Elastic Analysis, The asphalt Institute Design. **Design of Rigid Pavements:** Design of Rigid Airport Pavements: Determination of Modulus of Subgrade Reaction, Modulus of Rupture, Factor of Safety, Design Charts, PCA, Corps of Engineers Method, FAA. Base courses, compaction requirements, Joints and

Reinforcement Requirements, Joints at Intersections, Design of Steel Reinforcement, Continuously Reinforced concrete pavements, Use of eel Section and Junction of Flexible and Rigid Pavements. Design of Rigid Highway Pavements: Development of Design, Test Roads, Definition of Pavement types, Design Factors, Load Stresses, Thickness Design, Jointing and Reinforcement Requirements, Joints, Load-transfer Devices, Continuously Reinforced Concrete Pavements, Approach slabs, Subgrade and Sub bases, Slip-Form Construction.

TEXT BOOKS:

1. Principles of pavement design – Yoder & wit zorac – Jhonwilley & Sons.

REFERENCE BOOKS:

1. Pavement Analysis and Design – Yang H. Huang, Pearson
2. Relevant codes and handouts of abroad practices

URBAN TRANSPORTATION SYSTEMS PLANNING

Course Code: 11CE365 **L –T – P: 3-0-0**
Prerequisite: 13CE303 **Credits: 3**

Transportation Planning: Introduction to transportation planning; systems approach to transportation planning; types of models; concept of travel demand and supply; socio-economic, land use, network, and transport system characteristics affecting transportation planning. **Transportation Survey:** Study area definition, zoning principles, cordon and screen lines, data collection through primary and secondary sources, sampling techniques. **Sequential modeling approach:** Four-stage sequential modeling approach; trip generation; trip distribution; modal split; trip assignment.

Planning For Public Transport: Public transport planning, Fares and Subsidies Introduction to Intermediate Public Transport Type and Characteristics of IPT Modes in India, Integration of different modes.

Urban and intelligent transportation systems: ITS, first generation of ITS and it's applications, ITS in Various Countries, Mature ITS Applications, Safety and Liability, Second Generation of ITS

Text Books:

1. Principles and practices of highway Engineering by Dr. L. R. Kadiyali & Dr. N. B. Lal Khanna publishers – (2003).
2. Principles of Transportation Engineering by Partha Chakroborty and Animesh Das. Prentice Hall of India, New Delhi, 2003.

Reference Books:

1. Principles of Highway Engg., and Traffic Analysis by Fred L. Mannering etc., Wiley Publications, 4th edition, 2012 reprint
2. Transportation Engineering by C. Jotin Khisty, B.Kent Lall, Prentice Hall of India, New Delhi, 2008

DATA ENGINEERING STREAM

DATA WAREHOUSING & MINING

Course Code: 13CS331 **L –T – P: 3-0-0**
Prerequisite: 13CS204 **Credits: 3**

Data Mining, Kinds of Data and Patterns to be Mined, Technologies Used in data mining, Applications, Major Issues in Data Mining. **Getting to Know Your Data:** Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity and Dissimilarity. **Data Preprocessing** Data Preprocessing: An Overview, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Data Discretization. **Data Warehousing and Online Analytical Processing** Data Warehouse: Basic Concepts, Data Warehouse Modeling: Data Cube and OLAP, Data Warehouse Design and Usage, Data Warehouse Implementation, Data Generalization by Attribute-Oriented Induction. **Data Cube Technology** Data Cube Computation: Preliminary Concepts, Data Cube Computation Methods, Processing Advanced Kinds of Queries by Exploring Cube Technology Multidimensional Data Analysis in Cube Space. **Mining Frequent Patterns, Associations, and Correlations: Basic Concepts and Methods** Basic Concepts, Frequent Itemset Mining Methods, Interesting Patterns &Pattern Evaluation Methods. **Classification: Basic Concepts** Basic Concepts, Decision Tree Induction, Bayes Classification Methods, Rule-BasedClassification, Classification by Backpropagation Model Evaluation and Selection, Techniques to Improve Classification Accuracy. **Cluster Analysis: Basic Concepts and Methods** Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based Methods, Evaluation of Clustering **Outlier Detection** Outliers and Outlier Analysis, Outlier Detection Methods, Statistical Approaches, Proximity-Based Approaches, Clustering-Based Approaches, Classification-Based Approaches, Mining Contextual and Collective Outliers, Outlier Detection in High-Dimensional Data. **Data Mining Trends and Research Frontiers** Mining Complex Data Types, Other Methodologies of Data Mining, Data Mining Applications, Data Mining and Society, Data Mining Trends.

Textbooks:

1.Jiawei Han, Micheline Kamber, Jian Pie, “Data Mining: Concepts and Techniques”, 3rd edition, Morgan Kaufmann, Elsevier, 2012.

Reference Books:

1..N. Tan, M. Steinbach, V. Kumar. “Introduction to Data Mining”, Addison Wesley, 2005.
2.A.K. Pujari, “Data Mining Techniques”, Universities Press, 2001.
3.Ian H.Witten, Eibe Frank, Mark A.Hall, "Data Mining:Practical Machine Learning Tools and Techniques", 3rd Edition,Morgan Kaufmann, Elsevier 2011.
4.Richard J.Roiger, Michael W.Geatz, "Data Mining: A Tutorial Based Primer", Pearson Education, 2003.
5.Daniel T. Larose, "Data Mining Methods and Models", Wiley, 2006.

ADVANCED DATABASE MANAGEMENT SYSTEMS

Course Code:13CS332 **L –T – P: 3-0-0**
Prerequisite: 14CS204 **Credits: 3**

Query optimization, Heuristic in query optimization, selectivity and cost estimates in query optimization. **Database tuning:** An overview of databases Tuning in relational systems. **Database Recovery Protocols:** Recovery concepts, NO-UNDO/REDO Recovery Based on Deferred Update, Recovery techniques Based on Immediate Update, Shadow Paging, ARIES Recovery Algorithm. **Advanced Database Models and Applications**: Active Database Concepts, Temporal Database Concepts, Spatial Database Concepts, Deductive Databases. **Emerging Database Technologies and Applications:** Mobile Data Management, Geographical Information Systems (GIS), Genomic Databases. **Distributed Databases:** distributed database concepts, Types of Distributed database systems, Distributed database Architecture, Data Fragmentation, Allocation Techniques For Distributed Database Design, Query Processing and optimization in distributed database design ,Overview of Transaction Management in distributed database, Overview Of Concurrency Control and Recovery in distributed database design. **Object Oriented database systems:** Object DBMSs, Weakness of RDBMSs,Object Oriented Concepts, Storing Objects in a Relational Database, Advantages and disadvantages of OODBMSs.Object Oriented DBMSs-Standards and Systems**:** Object Management Group, Object Data Standard ODMG 3.0,Object Store. **Object Relational DBMSs:**, Query Processing and Optimization, New Index Types, Object Oriented Extension in Oracle, Comparision of ORDBMS and OODBMS. **Multimedia Databases**: Multimedia databases, Multimedia Data, SQL and Multimedia-Manipulating Large objects, Querying Multimedia-

Introduction, Manipulating Multimedia data. Multimedia modeling data Multimedia Database Architecture and performance. Dealing with Multimedia text, image, video.

Text books:

1.Ramez Elmasri, Shamkanth B.Navathe, "Fundamentals of Database Systems", 5th Edition Pearson, 2007.
2.Thomas Connolly, Carolyn Begg "Database Systems", 4th Edition, Pearson, 2012.
3.Dunckley Lynne, "Multimedia Databases: An Object Relational Approach", 1st Edition, Pearson Education, 2009.

Reference Books:

1.M.Tamer Ozsu,Patrick Ualduriel, "Principles of Distributed Database Systems", 3rd Edition, Pearson Education ,2009.
2.Peter Rob and Corlos coronel,"Database Systems-Design, Implementation and Management ", 5th Edition, Thompson Learning, Course Technology, 2005.
3.Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", 3rd Edition McGraw-Hill, 2003.
4.Abraham Silberschatz, Henry Korth, S. Sudarshan," Database System Concepts", 6th Edition, McGraw-Hill.
5.C.S.R. Prabhu, "Object-Oriented Database Systems: Approaches and Architectures", 3rd Edition, PHI, 2003.
6.Carlo Zaniolo, "Advanced database systems", Morgan Kaufmann, Elsevier, 1997.
7.Jan L. Harrington, "Relational Database Design", Morgan Kaufmann, Elsevier, 2009.

DATABASE SECURITY

Course Code: 13CS333 **L –T – P: 3-0-0**
Prerequisite: 15CS204 **Credits: 3**

Security Architecture Introduction, Security, Information Systems, Database Management Systems, Information Security, Information Security Architecture, Database Security, Asset Types and their Values, Security Methods **Operating System Security Fundamentals** Introduction, Operating System Overview, The Operating System Security Environment, The Components of an Operating System Security Environment, Authentication methods, User Administration, Password policies, Vulnerabilities of Operation Systems, Email Security **Administration of Users** Introduction, Documentation of User Administration, Operating System Authentication, Creating Users, Creating a SQL Server User, Removing Users, Modifying Users, Default Users, Remote Users, Database Links, Linked Servers, Remote Servers, Practices for Administrators and Managers, Best Practices. **Profiles, Password Policies, Privileges and Roles** Introduction, Defining and Using Profiles, Designing and Implementing Password Policies, Granting and Revoking User Privileges, Creating, Assigning and Revoking User Roles, Best Practices. **Implementing Single Sign On, Implementing Two-Factor Authentication, Application Identification and Authorization, Database Application Security Models** Introduction, Types of Users, Security Models, Application Types, Application Security Models, **Transparent Data Encryption,** The Transparent Data Encryption Solution, Table Space Encryption**, Virtual Private Databases** Introduction, Overview of Virtual Private Databases, Implementing a VPD Using Views, Implementing a VPD Using Application Context in Oracle, Implementing Oracle Virtual Private Databases, Viewing VPD policies and Application Context Using the Data Dictionary, Viewing VPD Policies and Application Context Using Policy Manager, Implementing Row and Column-level Security with SQL Server **Database Auditing Models** Introduction, Auditing Overview, Environment, Process, Objectives, Classifications and Types, Benefits and Side Effects of Auditing, Auditing Models, Application Data Auditing: Introduction, DML Action Auditing Architecture, Oracle Triggers, SQL Server Triggers, Fine Grained Auditing with Oracle. DML Statement Audit Trail, Auditing, Auditing Application Errors with Oracle, Oracle PL/SQL Procedure Authorization, Auditing Database Activities: Introduction, Using Oracle Database Activities, Creating DLL Triggers with Oracle, Auditing Database Activities with Oracle, Auditing Server Activity with Microsoft SQL Server 2000, Implementing SQL Profiler, Security Auditing with Server, Applied Auditing and Audit Vault, Database Vault Introduction, Database Vault Fundamentals.

Textbooks:

1. Hassan A. Afyouni, “Database Security and Auditing”, Cengage Learning, 2005.

Reference Books:

1. Ron Ben Natan, "Implementing Database Security and Auditing", Elsevier, 2005.
2. Michael Gertz, Sushil Jajodia, "Handbook of Database Security: Applications and Trends", Springer, 2008.
3. David Coffin, "Expert Oracle and Java Security: Programming Secure Oracle Database Applications with Java", Apress, 2011.
4. David Knox, Scott Gaetjen, Hamza Jahangir, Tyler Muth, Patrick Sack, Richard Wark, Bryan Wise, "Applied Oracle Security: Developing Secure Database and Middleware", Oracle Press, 2010.

DISTRIBUTED DATABASES

Course Code: 13CS431 **L –T – P: 3-0-0**
Prerequisite: 16CS204 **Credits: 3**

Distributed Query Processing and optimization, Transaction management, Concurrency Control, Reliability, Distributed Object Database Management, Parallel Databases and Grid Databases, Analytical Models, Parallel Search, Parallel Sort and Group-By, Parallel Join, Parallel Group by-Join, Parallel Indexing Parallel Universal Quantification, Collection Join Queries, Parallel Query Scheduling and Optimization, Transactions in Distributed and Grid Databases, Grid Concurrency Control, Grid Transaction Atomicity and Durability, Replica Management in Grids, Grid Atomic Commitment in Replicated Data, Parallel Online Analytic Processing (OLAP) and Business Intelligence, Parallel Data Mining - Association Rules and Sequential Patterns, Parallel Clustering and Classification.

TextBooks:

1. Principles of Distributed Database Systems, M. Tamer Ozsu, Patrick Valduriez, Pearson Education. 2nd Edition.
2. High Performance Parallel Database Processing and Grid Databases, by David Taniar, Clement H. C. Leung, Wenny Rahayu, Sushant Goel, Wiley Edition

Reference Books

1. Distributed Systems: Concept and Design. Coulouris, Dollimore, and Kindberg. AW.
2. Recovery Mechanisms in Database Systems. Kumar and Hsu, Prentice Hall.
3. Concurrency Control and Recovery in Database Systems. Bernstein, Hadzilacos and Goodman, AW.

BIG DATA ANALYTICS

Course Code: 13CS432 **L –T – P: 3-0-0**
Prerequisite: 17CS204 **Credits: 3**

Introduction to Big Data Analytics: Big Data Overview, State of the Practice of Analytics, Big Data Analytics in Industry Verticals. It also covers Overview of Data Analytics Lifecycle, Discovery, Data

Preparation, Model Planning, Model Building, Communicating Results and Findings, Operationalizing. Initial Analysis of the Data: Initial Exploration and Analysis of the Data, Basic Data Visualization. Basic data analytics, reporting, and apply basic data visualization techniques to your data. Apply basic analytics methods such as distributions, statistical tests and summary operations, and differentiate between results that are statistically sound vs. statistically significant. Identify a model for your data and define the null and alternative hypothesis. Experimentation and demonstration of initial analysis of data using R. Advanced Analytics and Statistical Modeling for Big Data — Theory and Methods: Need of analytic and select an appropriate technique based on business objectives; initial hypotheses; and the data's structure and volume. Apply some of the more methods in Analytics solutions, algorithms and the technical foundations for the methods. The environment (use case) in which each technique can provide the most value. Use appropriate diagnostic methods to validate the models created Use R and in-database analytical functions to fit, score and evaluate models. Advanced Analytics and Statistical Modeling for Big Data — Technology & Tools: Tool to Perform Analytics on Unstructured data using MapReduce Programming paradigm. Use Hadoop, HDFS, HIVE, PIG and other products in the Hadoop ecosystem for unstructured data analytics, Effectively use advanced SQL functions and Greenplum extensions for in-database analytics. Use MADlib to solve analytics problems in-database. Endgame - Operationalizing an Analytics Project: Tasks needed to operationalize an analytics project. Four common deliverables of an analytics lifecycle project meet the needs of key stakeholders. Use a framework for creating final presentations for sponsors and analysts. Evaluate a data visualization and identify ways to improve it. Apply these concepts to a big data analytics problem in the final lab.

Text Books:

1. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data by EMC Education Services 2014

2. EMC Material/Courseware :https://education.etnc.com/

Reference Books:

1. MapReduce Design Patterns, Author: Donald Miner, Publisher: O'Reilly (2012), ISBN-13:-9789350239810
2. Practical Data Science with R-Nina Zumel, John Mount-Manning Publications-2014
3. R for Business Analytics-A. Ohri-Springer-2012.
4. Agile data science: building data analytics applications with Hadoop-Russell Jurney- O'Reilly Media-2013
5. An Introduction to Applied Multivariate Analysis with R -Brian Everitt, Torsten Hothorn-Springer-2011
6. Statistical Modeling and Analysis for Database Marketing: Effective Techniques for Mining Big Data-Bruce Ratner-Chapman and Hall/CRC-2003
7. Big Data Analytics with R and Hadoop-Vignesh Prajapati-Packt Publishing-2013

COMPUTER NETWORKS STREEM

TCP/IP PROTOCOL SUITE

Course Code: 13CS334 **L –T – P: 3-0-0**
Prerequisite: 13CS205 **Credits: 3**

Transmission Control Protocol, Internet Protocol, Ip Addressing, Socket Interface, Applications And Network Management, Case Study: Simulation Of Network Protocols Using Ns.

Text Books:

1.Richard Stevens W, "TCP/IP Illustrated Volume 1", Prentice Hall of India/ Pearson Education, New Delhi, 2004.

2. Douglas E Comer, "Internetworking with TCP/IP- Volume I", Prentice Hall of India/ Pearson Education, New Delhi, Fourth Edition, 2002.

Reference Books:

1.Washburn K and Evans J, "TCP/IP", Addison Wesley, USA, Second Edition, 2003.

2.Behrouz A Forouzan, "Local Area Networks", Tata McGraw Hill Publishing Company, New Delhi, 2002.

3.Behrouz A Forouzan, "TCP/IP- Protocol Suite", Tata McGraw Hill Publishing Company, New Delhi, 2002.

4.BehrouzA.Forouzan, "TCP/IP Protocol Suite", 3rd Edition, McGraw-Hill, 2005.

5.Pete Loshin, "TCP/IP Clearly Explained", 4th Edition, Morgan Kaufmann, 2003.

6.Buck Graham "TCP/IP Addressing", 2nd Edition, Morgan Kaufmann, 2001.

NETWORK PROGRAMMING

Course Code: 13CS335 **L –T – P: 3-0-0**
Prerequisite: 13CS205 **Credits: 3**

The Transport Layer: TCP and UDP, Sockets, Elementary TCP Sockets, TCP Client-Server Example, The Select and Poll Functions, Socket Options, Elementary UDP Sockets, Elementary Name and Address Conversions, IPv4 and IPv6 Interoperability, UNIX Do main Protocols, Routing Sockets, Threads, Raw Sockets, Sun RPC

Textbooks:

1.W. Richard Stevens, "UNIX Network Programming, Volume 1: Networking APIs - Sockets and XTI", 2nd Edition, Prentice Hall, 1998.

2.W. Richard Stevens, "UNIX Network Programming, Volume 2: Interprocess Communications", 2nd Edition, Prentice Hall, 1998.

Reference Books:

1.Donahoo, Calvert "TCP/IP Sockets", 2nd edition, Elsevier, 2009.

2.Gary R. Wright, W. Richard Stevens, "TCP/IP Illustrated, Volume 2: The Implementation", Addison Wesley, 1995.

3.Douglas E Comer, David L Stevens, "Internetworking with TCP/IP Volume: III Client and Server Programming and Appliations BSD Socket Versions", 2nd Edition, PHI, 1999.

4.Fall. Wright, W. Richard Stevens, "TCP/IP Illustrated, Volume 1: The Implementation", 2nd Edition, Addison Wesley, 1995.

5.Michel Kerrisk, "The Linux Programming Interface", No Starch Press, 2010.

ROUTING ALGORITHMS

Course Code: 13CS336 **L –T – P: 3-0-0**
Prerequisite: 13CS205 **Credits: 3**

Network and Network routing: An Introduction, Routing Algorithms: Shortest Path Widest Path, Routing Protocols: Frame Work and Principles, Network Flow Modeling, IP

Routing and Distance Vector Protocol Family, OSPF and Integrated IS-IS, IP Traffic Engineering, BGP, Internet Routing Architectures, Router Architectures, IP Address Lookup Algorithms, IP Packet Filtering and Classification, Quality of Service Routing, MPLS and GMPLS, Routing and Traffic Engineering With MPLS, VOIP Routing: Interoperability Through IP and PSTN

Text Books:

1.Network Routing Algorithms, Protocols, and Architectures Deepankar Medhi, Karthikeyan Ramasamy 2007 by Morgan Kaufmann, Elsevier Inc.

Reference Books:

1.Nader F.Mir, "Computer and Communication Networks", PHI,2006

2.Kurose & Ross, "Computer Networking" – A Top-down approach featuring the Internet", Pearson Education – Alberto Leon – Garciak. 3rd Edition ,2005

3.Tanenbaum, "Computer Networks", 4th Edition, (Pearson Education / PHI),2003.

HIGH SPEED OPTICAL COMMUNICATION NETWORKS

Course Code: 13CS433 **L –T – P: 3-0-0**
Prerequisite: 13CS205 **Credits: 3**

Introduction, Ray theory transmission, Total internal reflection, Acceptance angle, Numerical aperture, Skew rays, Electromagnetic mode theory of optical propagation, EM waves, modes in planar guide, phase and group velocity, cylindrical fibers, SM fibers. Attenuation, Material absorption losses in silica glass fibers, Linear and non-linear scattering losses, Fiber bend losses, Midband and farband infra red transmission, intra and inter model dispersion, overall fiber dispersion, Polarization – non-linear phenomena, Optical fiber connectors, fiber alignment and joint losses, Fiber splices, fiber connectors, Expanded beam connectors, Fiber couplers. Optical sources: Light Emitting Diodes, LED structures, surface and edge emitters, mono and hetero structures, interanal – quantum efficiency, injection laser diode structures, comparison of LED and ILD. Optical detectors: PIN photo detectors, Avalanche photo diodes, construction, characteristics and properties, Comparison of performance, Photo detector noise, Noise sources, Signal to Noise ratio, detector response time. Fundamental receiver operation, Pre amplifiers, Error sources- Receiver Configuration, Probability of Error, Quantum limit, Fiber attenuation measurements, Dispersion measurements, Fiber Refractive index profile measurements, Fiber cut-off Wavelength measurements, Fiber Numerical Aperture Measurements, Fiber diameter measurements. Basic Networks, SONET/ SDH, Broadcast, and select WDM networks, Wavelength routed networks, Non linear effects on Network performance, Performance of WDM + EDFA system, Optical CDMA, Ultra High Capacity Networks.

Textbooks:

1. Optical Fiber Communication – John M. Senior –Pearson Education – Second Edition, 2007.
2. Optical Fiber Communication – Gerd Keiser – Mc Graw Hill – Third Edition, 2000.

Reference Books:

1. Optical Communication System – J. Gower, Prentice Hall of India, 2001.
2. Optical Networks – Rajiv Ramaswami, Elsevier, Second Edition, 2004.
3. Fiber Optic communication Systems – Govind P. Agrawal, John Wiley & Sons, Third Edition, 2004.
4. Fiber Optics and Optoelectronics – R. P. Khare, Oxford University Press, 2007.

WIRELESS COMMUNICATIONS AND NETWORKING

Course Code: 13CS434 **L –T – P: 3-0-0**
Prerequisite: 13CS205 **Credits: 3**

Types of services, Requirement of services, Multipath propagation, Spectrum limitations, Noise and Interference limited systems, Principles of Cellular Networks, Propagation mechanisms, propagation effects with mobile radio, channel classification, link calculations, Narrow band and Wideband models. Spread Spectrum Systems – Cellular Code Division Multiple Access – Principle, Power control. Orthogonal Frequency Division Multiplexing – Principle, Cyclic Prefix, Transceiver implementation. **Multiple Radio Access**: Medium access alternatives, Fixed assignment for voice oriented networks, Random access for data oriented networks, Handoff and Roaming Support, **Wireless WANs**: First Generation Analog, Second Generation TDMA – GSM, Short Messaging Service in GSM, Second Generation CDMA: IS-95, GPRS – Third Generation System (WCDMA/ CDMA 2000). **Wireless LANs:** Introduction to wireless LANs, IEEE 802.11 WLAN – Architecture and services, Physical Layer, MAC sub-layer, MAC Management Sub-layer, Other IEEE 802.11 standards, HIPERLAN, WiMax standard. **Adhoc and Sensor Networks**: Characteristics of MANETs, Table-driven and Source-initiated On demand Routing protocols, Hybrid protocols, Wireless Sensor Networks- Classification, MAC and routing protocols. **Wireless MANs and PANs**: Wireless MANs – Physical and MAC layer details, Wireless PANs – Architecture of Bluetooth systems, Physical and MAC layer details.

Text Books:

1. Wireless Communications – Andreas F. Molisch, John Wiley India, 2006.
2. Wireless Communications and Networks – William Stallings, Pearson/ Prentice Hall of India, 2^{nd} Edition, 2007.
3. Introduction to Wireless and Mobile Systems – Dharma Prakash Agrawal & Qing-An Zeng, Thomson India Edition, 2^{nd} Edition, 2007.

Reference Books:

1. Wireless Communication – Andrea Goldsmith, Cambridge University Press, 2007.
2. Wireless Communications – Rappaport, T.S., Pearson Education, 2003.
3. Modern Wireless Communications – Simon Haykin & Michael Moher, Pearson Education, 2007.
4. Principles of Wireless Networks – Kaveth Pahlavan & Prashant Krishnamurthy, Pearson Education Asia, 2002.
5. Wireless Communication and Networking – Vijay K. Garg, Morgan Kaufmann Publishers, 2007.
6. An Introduction to Wireless Technology – Gary S. Rogers & John Edwards, Pearson Education, 2007.

OBJECT ORIENTED ANALYSIS AND DESIGN

Course Code: 13CS337 **L –T – P: 3-0-0**
Prerequisite: 13CS301 **Credits: 3**

Overview of OOAD, Objects and UML; UML structure; UML building blocks; UML common mechanisms; Architecture., Unified Process (UP), Rational Unified Process; Instantiating UP for a project; UP Axioms; UP structure; UP phases. The requirements workflow. Software requirements – meta model; Requirements Workflow Detail, Use case modeling; UP activity: Identifying Actors and Use Cases; UP activity: Detail a use case; Use case specification; Requirements tracing; use case Modeling, Advanced use case modeling; Actor generalization; Use case generalization; The analysis workflow; Analysis artifacts – Meta model; Analysis workflow detail; Analysis model ,Objects and classes; Finding analysis classes; UP activity: Analyze a use case; Introduction to analysis classes. Finding classes; creating a first-cut analysis model. Relationships; Advanced generalization. Analysis package, UP activity: Interaction diagrams; Sequence diagrams; Combined fragments and operators; Communication diagrams. Advanced use case realization; Interaction occurrences; Interruptible activity regions; Exception handling; Expansion nodes; Interaction overview diagrams. The design workflow; Design artifacts – meta model; Design workflow detail; UP activity: Architectural design. Design classes; UP activity: Design a class; refine analysis relationships; One-to-one associations; Many-to-one associations; One-to-many associations; Collections; Reified relationships; Exploring composition with structured classes. Interfaces and components; UP activity: Design a subsystem, provided and required interfaces; Interface realization vs. inheritance; Ports; Interfaces and component-based development; Introduction to component. Component stereotypes; Subsystems; Finding interfaces; Designing with interfaces; Advantages and disadvantages of interfaces. Use case realization-design; Interaction diagrams in design; Modeling concurrency; Subsystem interactions; Timing diagrams; State machines;. Advanced state machines; Composite states; Implementation workflow detail; Artifacts. Deployment; UP activity.

Textbooks:

1. Jim Arlow, Ila Neustadt, "UML 2 and the Unified Process: Practical Object-Oriented Analysis and Design", 2nd Edition, Pearson, 2005.

Reference Books:

2. Craig Larman, "Applying UML and Patterns: An introduction to OOAD and design and interface deployment", Pearson, 2002.
3. Simon Bennett, Steve McRobb and Ray Farmer,"Object-Oriented Systems Analysis And Design Using UML", Second Edition, Tata McGraw-Hili Edition, 2004.
4. Tom Pender, "UML Bible", 1st Edition, John Wiley, 2003.
5. Mike O Docherty, "OOAD: Understanding System Development with UML 2.0", 1st Edition, Wiley, 2005.

REQUIREMENT ENGINEERING

Course Code: 13CS338 **L –T – P: 3-0-0**

Prerequisite: 13CS301 **Credits: 3**

Overview of Domain Engineering, Domain Stack Holders, Domain Facets, The Domain Process Engineering Model, Overview of Requirement Engineering, Requirement Facets, The Requirements Engineering Models , Methods And Methodology, Modeling and Models, on Defining and on Definitions, Jacksons Description Principles, Domain Attributes and Domain Acquisition, Domain Analysis and Concepts Formation, Domain Validation and Verification, Requirement Stockholders , Requirement Acquisition, Requirement Analysis and Concept Formation, Requirement Verification and Validation, Requirements Satisfiability and Feasibility, Hardware/Software Co -Design, Software Architecture Design , A Case Study in Component Design.

Text books:

1.Dines Bjorner, "Software Engineering Vol-3, Domains, Requirements, Software Design", Springer, 2005.

Reference Books:

1.Ralph R Young, Artech House, "The Requirements Engineering Handbook", Artech House, 2004.

2.Dines Bjorner, Software Engineering Vol-2, Domains, Requirements, Software Design, Springer, 2004.

3.Dines Bjorner, Software Engineering Vol-1, Domains, Requirements, Software Design, Springer, 2003.

4.Pohl, Klaus, "Requirements Engineering: Fundamentals, Principles, and Techniques", Springer, 2010.

SOFTWARE TESTING AND QUALITY

Course Code: 13CS339 **L –T – P: 3-0-0**
Prerequisite: 13CS301 **Credits: 3**

Basic concepts and preliminaries: theory of program testing, unit testing, control flow testing, data flow testing, domain testing, system integration testing, system test categories, functional testing, test generation from fs m models. System test design, system test planning and automation, system test execution**,** acceptance testing**,** test team organization. Organizing for quality management, commercial and governmental standards for use in software quality assurance, personnel requirements to make software quality assurance work, training for quality management, the pareto principle applied to software quality assurance, inspection as an up - front quality technique, software audit methods. Software safety and its relation to software quality assurance, cmmi ppqa relationship to sqa, sqa for small projects, development quality assurance, quality management in it, Costs of software quality.

Text books:

1. Paul Ammann and Jeff Offutt, "Introduction to Software Testing", Cambridge Press, 2008.
2. Kshirasagar Naik, Priyadarshi Tripathy Software Testing and Quality Assurance Theory and Practice John Wiley & Sons, Inc., Publication 2008.
3. G. Gordon Schulmeyer Handbook of Soft ware Quality Assurance Fourth Edition A RTECH HOUSE 2008.

Reference Books:

1. Ilene Burnstein Practical Software Testing Springer 2003
2. William E. Lewis Soft ware Testing and Continuous Quality Improvement 3rd Edition CRC press 2009.
3. Jeff Tian Software Quality Engineering Testing, Quality Assurance, and Quantifiable Improvement JOHN WILEY 2005.
4. Ron Patton, " SoftwareTesting", 2nd Edition, Pearson Education, 2005.
5. Dirk Meyerhoff, BegonaLaibarra, "Software Quality and Software Testing In Internet Times", Springer, 2002.
6. S. Dick, A. Kandel, "Computational Intelligence in Software quality Assurance", World Scientific, 2005.

SOFTWARE RELIABILITY

Course Code: 13CS435 **L –T – P: 3-0-0**
Prerequisite: 13CS301 **Credits: 3**

Reliability Engineering Measures Reliability Function for Common Distributions, maintainability and Availability. **Software Engineering Assessment** Software Reliability and testing concepts, Software Life Cycle, Software Development process and its Applications, Software Verification and Validation , Data collection and Analysis. **Software Reliability Modeling** Halstead's Software Metric, McCabes cyclomatic complexity metric, Error Seeding Models, Failure rate models, Curve fitting models, Reliability growth models, Non homogenous poison process models, Markov structure models. **NHPP Software Reliability Models**, Parameter Estimation, NHPP Models, Applications , Imperfect debugging vs. Perfect debugging, A Generalized NHPP Software Reliability Model, Mean time between failures for NHPP **Software Cost Models**, A Software Cost Model with Risk factor, A generalized Software Cost Model ,A cost model with multiple failure errors, Applications, **Fault - tolerant software,** Basic Fault - tolerant software techniques, Self - checking duplex scheme, Reliability Modeling ,Reduction of common-cause failures. Testing Coverage and Removal Models, **Software Reliability Models with Environmental Factors** Definition of Environmental Factors, Environmental Factors Analysis, A Generalized model with Environmental Factors, Enhanced proportional Hazard Jelinski - Moranda(EPJM) model An Application with Environmental Factors. Calibrating Software Reliability Models, **Optimal Release policies** A Software Cost Model with risk factor, Cost model with testing coverage, A Generalized Software Cost Model, Cost Model with multiple failure errors, Gain model with random field environments, Other cost models. **Complex Fault – tolerant system reliability modeling** Basic Fault – tolerant software techniques ,other advanced techniques, Triple version programming model with common failures ,Complex system reliability modeling ,application example.

Text books:

1.Hoang Pham, 'Application Software Reliability', Springer 2000.
2.Hoang Pham, 'System Software Reliability', Springer 2006.

Reference Books:

1.John Musa, "Software Reliability Engineering", 2/e, TMH, 2005.
2.Michael Lyu," Handbook of Software Reliability Engineering", 1/e, 1996.
3.Doron Peled, "Software Reliability Methods", Springer, 2001.
4.KK Aggarwal & Yogesh Singh, "Software Engineering", 2/e, New age International Publisher, 2006.
5.Ilene Burnstein Practical Software Testing Springer 2003
6.Willi6.m E. Lewis Soft ware Testing and Continuous Quality Improvement 3rd Edition CRC press 2009.
7.Jeff Tian Software Quality Engineering Testing, Quality Assurance, and Quantifiable Improvement JOHN WILEY 2005.
8.Ron Patton, " SoftwareTesting", 2nd Edition, Pearson Education, 2005.
9.Dirk Meyerhoff, BegonaLaibarra, "Software Quality and Software Testing In Internet Times", Springer, 2002.
10.S. Dick, A. Kandel, "Computational Intelligence in Software quality Assurance", World Scientific, 2005.

SOFTWARE PROJECT MANAGEMENT

Course Code:13CS436 **L –T – P: 3-0-0**
Prerequisite: 13CS301 **Credits: 3**

Project Management context, Project Integration Management, Requirements Specification & Management, Scope Management, Time Management, Cost Management, Quality Management, Configuration Management, Human Resource Management, Communications Management, Project documentation, Initiating, planning, executing & controlling projects.

Textbooks:

1.Schwalbe, K. (2012) Information Technology Project Management, 7th edition, Thomson Learning.
2.Robert K. Wysocki, "Effective Software Project Management", John Wiley, 2006.
3.Bob Hughes and mike Cottrell "Software Project Management" , McGraw-Hill Education, 2006

Reference Books:

1.Richard H. Thayer "Software Engineering Project Management", 2/e, Wiley-IEEE Computer Society Press, 2001.
2.PMI, (2002) **Project Management Body of Knowledge (The PMBOK Guide)**, Project Management Institute. (ISBN: 1880410257)
3.W Heldman & B Heldman, (2002) **IT Project+ Study Guide**, Sybex. (ISBN: 0782140688)

4.Kiern Conway, “Software Project Management from Concept to Deploy”, Wiley, 2000.
5.Bob Hughes, Mike Cotterell,” Software Project Management”, McGraw-Hill Higher Education, 2009.
6.Walker Royce, ”Software Project Management A Unified Frame Work”, 1st Edition, Pearson, 1998.

SECURE PROGRAMMING

Course Code:13CS340 **L –T – P: 3-0-0**
Prerequisite: 13CS205 **Credits: 3**

Security Design Principles: Security Goals, Secure Systems Design Secure Design Principles. **Secure Programming Techniques:** Worms And Other Malware, Buffer Overflows. **Secure Programming Techniques**: Client-State Manipulation, Sql Injection, Password Security, Cross-Domain Security In Web Applications. **Software Security and Static Analysis:** The Software Security Problem, Introduction To Static Analysis, Static Analysis As Part Of The Code Review Process, Static Analysis Internals. **Pervasive Problems:** Handling Input, Buffer Overflow, Bride Of Buffer Overflow, Errors And Exceptions. **Secure Coding Techniques:** Features And Flavors: Web Applications, Xml And Web Services, Privacy And Secrets, Privileged Programs.

Text books:
1.Christoph Kern, Anita Kesavan, Neil Daswani: “Foundations Of Security: What Every Programmer Needs To Know”, Apress, 2007.
2.Brian Chess, Jacob West: “Secure Programming with Static Analysis”, Pearson Education, 2007.

Reference books:
1.Michael Howard, David Leblanc: “Writing Secure Code “, .2/E, Microsoft Corporation, 2003.
2.Kenneth R. Van Wyk: “Secure Coding: Principles and Practices; [Designing & Implementing Secure”, O’ Reilly & Associates, Inc, 2003.
3.Mark Curphey, Joel Scrambray, Erik Olson, and Michael Howard: “Improving Web Application Security: Threats and Countermeasures”, Microsoft Corporation, 2003.

CRYPT ANALYSIS

Course Code:13CS341 **L –T – P: 3-0-0**
Prerequisite: 13CS205 **Credits: 3**

Classic Ciphers: Introduction, Good Guys And Bad Guys, Terminology, Selected Classic Crypto Topics. World War Ii Ciphers: Introduction, Enigma, Purple, Sigaba. Stream Ciphers: Introduction, Shift Registers, Oryx, Rc4, Pkzip. Block Ciphers: Introduction, Block Cipher Modes, Feistel Cipher, Hellmans Time-Memory Trade-Off, Cmea, Akelarre, Feal. Hash Functions: Introduction, Birthdays And Hashing, Md4, Md5. Public Key Systems: Introduction, Merkle-Hellman Knapsack, Diffie-Hellman Key Exchange, Arithmetica Key Exchange, Rsa, Rabin Cipher, Ntru Cipher, Elgamal Signature Scheme. Public Key Attcaks: Introduction, Factoring Algorithms, Discrete Log Algorithms, Rsa Implementation Attacks.

Textbooks:
1.Mark Stamp, Richard M. Low John: “Appllied Cryptanalysis Breaking Ciphers in the Real World “ John Wiley & Sons, 2007.

Reference Books:
1.Bruce Schneier: “ Applied cryptography: protocols, algorithms, and source code in C” , 2/e, John Wiley & Sons Inc, 2006
2.William Stallings :”Cryptography and network Security”, 4/e, , PHI/Pearson, 2006.
3.Christopher Swensen: “Modern Cryptanalysis: Techniques for Advanced Code Breaking” Wiley Publishing Inc, 2008.

4.V.K. Pachghare: “Cryptography and Information System”, PHI Learning , 2009.
5.Charles P. Pfleeger, Shari Lawrence Pfleeger: “ Security in Computing “ , 3/e, 2003.

ELLIPTIC CURVE CRYPTOGRAPHY

Course Code:13CS342 **L –T – P: 3-0-0**
Prerequisite: 13CS205 **Credits: 3**

Introduction, The Basic Theory: Weierstrass Equations, The Group Law, Projective Space And The Point At Infinity, Proof Of Associativity, Other Equations For Elliptic Curves, Other Co-Ordinate Systems, The J-Invariant, Elliptic Curves In Characteristic 2, Endomorphisms, Singular Curves, Elliptic Curves Mod N. **Torsion Points:** Torsion Points, Division Polynomials, The Weil Pairing, The Tate-Lichtenbaum Pairing. **Elliptic Curves Over Finite Fields:** Examples, The Frobenius Endomorphism, Dertermining the Group Order, A Family Of Curves, Schoof's Algorithm, Supersingular Curves. **The Discrete Logarithm Problem:** The Index Calculus, General Attacks On Discrete Logs, Attacks With Pairings, Anomalous Curves, Other Attacks. **Elliptic Curve Cryptography:** The Basic Setup, Diffie-Hellman Key Exchange, Massey-Omura Encryption, Elgamal Public Key Encryption, Elgamal Digital Signatures, The Digital Signature Algorithm, Ecies, A Public Key Scheme Based On Factoring, A Cryptosystem Based On The Weil Pairing. **Other Applications:** Factoring Using Elliptic Curves, Primality Testing. **Divisors:** Definitions And Examples, The Weil Pairing, The Tate-Lichtenbaum Pairing, Computation Of The Pairings, Genus One Curves And Elliptic Curves, Equivalance Of The Defintitions Of The Pairings, Nondegeneracy Of The Tate-Lichtenbaum Pairing, **Hyperelliptic Curves:** Basic Definitions, Divisors, Cantor's Algorithm, The Discrete Logarithm Problem.

Text books:

1.Elliptic Curves Number Theory and Cryptography Second Edition by Lawrence C. Washington Publisher: Chapman & Hall/CRC Taylor & Francis Group 2008

Reference Books:

1.Bruce Schneier: “Applied Cryptography: protocols, algorithms, and source code in C” 2/e, Wiley India Edition, 2007.
2.William Stallings: “Cryptography and network Security” 4/e, William Stallings, PHI/Pearson, 2006.
3.Darrel Hankerson, Scott Vanstone, Alfred J. Menezes: “Guide to Elliptic Curve Cryptography”, Springer-Verlag New York Inc, 2004
4.Henri Cohen, Gerhard Frey, Roberto Avanzi, Christophe Doche: “Elliptic and Hyperelliptic Curve Cryptography”, 2/e, Taylor & Francis Group, 2012.
5.Ian F. Blake, G. Seroussi, N. Smart: “Elliptic Curves in Cryptography”, Cambridge University Press, 1999.

CYBER SECURITY

Course Code:13CS437 **L –T – P: 3-0-0**
Prerequisite: 13CS205 **Credits: 3**

Web Application (In)security, Core Defense Mechanisms, Web Application Technologies, Mapping the Application, Bypassing Client-Side Controls, Attacking Authentication, Attacking Session Management, Attacking Access Controls, Injecting Code, Exploiting Path Traversal, Attacking Application Logic, Attacking Other Users, Attacking Compiled Applications, Attacking Application Architecture, Attacking the Web Server, Finding Vulnerabilities in Source Code.

Text books:

1.Dafydd Stuttard, "The Web Application Hacker's Handbook: Discovering and Exploiting Security Flaws", Wiley, 1st Edition, 2007.

Reference Books:

1.Bryan Sullivan, Vincent Liu, "Web Application Security, A Beginner's Guide", TMH, 2012.
2.Mike Schiffman, Bill Pennington, David Pollino, Adam O'Donnell, "Hacker's Challenge 2: Test Your Network Security & Forensic Skills", TMH, 2003.
3.Rich Cannings, Zane Lackey, "Hacking Exposed Web 2.0: Web 2.0 Security Secrets and Solutions", TMH, 2008.
4.Vincent Nestler, Wm. Arthur Conklin, Gregory White, Matthew Hirsch, "Computer Security Lab Manual", TMH, 2006.
5.Christoph Kern , Anita Kesavan , Neil Daswani, "Foundations of Security: What Every Programmer Needs to Know", Apress, 1st Edition, 2007.

TRUST WORTHY COMPUTING

Course Code: 13CS438 **L –T – P: 3-0-0**
Prerequisite: 13CS205 **Credits: 3**

Fundamentals of component and system reliability and review of software reliability, Software reliability modeling with clustered failure data and Stochastic measures to compare predictive accuracy of failure-count models, Quntitative modeling of security risk management, Stopping rules in software testing, Availability modeling using the Sahinogulu-Libby Probability distribution function. Reliability block diagramming in complex systems, Trustworthy Computing, Software Engineering, and Computer Science, Aspect-Oriented Programming and Aspect.NET, Principles and Application of AOP in TWC.

Text Books:
1. M. Sahinogulu: "Trustworthy Computing analysis and Quantitative Engineering Evaluation", John Wiley & Sons Inc, 2007.
2. Vladimir O. Safonov : "Using Aspect-Oriented Programming for Trustworthy Software Development ", John Wiley & Sons, Inc., Publication, 2008.

Reference Books:
1. Peter C. Patton, Bijay K. Jayaswal : "Design for Trustworthy Software: Tools, Techniques, and Methodology of Developing" , Pearson Education, Inc, 2007.
2. Lawrence Bernstein, C. M. Yuhas: "Trustworthy Systems Through Quantitative Software Engineering", John Wiley & Sons Inc, 2005.
3. Kathryn Rupchock Pizzo, Jerry Dyer: "Trustworthy Computing: Reliable in Operations", Microsoft, 2004.

PARALLEL & DISTRIBUTED COMPUTING SPECIALISATION STREAM

ADVANCED COMPUTER ARCHITECTURE

Course Code: 13CS343 **L –T – P: 3-0-0**
Prerequisite: 13CS201/13EM201 **Credits: 3**

Overview of von Neumann architecture- Instruction set architecture, The Arithmetic and Logic Unit, The Control Unit, Memory and I/O devices and their interfacing to the CPU, Measuring and reporting performance, CISC and RISC processors. Pipelining- Basic concepts of pipelining, data hazards, control hazards, and structural hazards, Techniques for overcoming or reducing the effects of various hazards. Hierarchical Memory Technology- Inclusion, Coherence and locality properties, Cache memory organizations, Techniques for reducing cache misses, Virtual memory organization, mapping and management techniques, memory replacement policies. Instruction-level parallelism- Concepts of instruction-level parallelism (ILP), Techniques for increasing ILP, Superscalar, super-pipelined and VLIW processor architectures Vector and symbolic processors, Case studies of contemporary microprocessors. Multiprocessor Architecture- Taxonomy of parallel architectures, Centralized shared memory architecture, synchronization, memory consistency, interconnection networks, Distributed shared-memory architecture, Cluster computers.

Text book

1.Kai Hwang, Advanced Computer Architecture: Parallelism, Scalability, Programmability, McGraw-Hill

Reference books

1.John L. Hennessy and David A. Patterson, Computer Architecture: A Quantitative Approach, Morgan Kaufmann.

2.John Paul Shen and Mikko H. Lipasti, Modern Processor Design: Fundamentals of Superscalar Processors, Tata McGraw-Hill.

3.M. J. Flynn, Computer Architecture: Pipelined and Parallel Processor Design, Narosa Publishing House.

PARALLEL COMPUTING

Course Code: 13CS344 **L –T – P: 3-0-0**

Prerequisite: 13CS201/ 13EM201 **Credits: 3**

Parallel hardware and parallel software –some background, modifications of the von Neumann model, parallel hardware, and parallel software parallel program design, writing and running parallel programs. Distributed memory programming with MPI-getting started, the trapezoidal rule in MPI, dealing with I/O, collective communication, MPI derived data types, performance evaluation of MPI programs, A parallel sorting algorithm . Shared memory programming with pthreads – processes, threads and pthreads , hello, world, matrix vector multiplication, critical sections, busy waiting, mutexes, producer consumer synchronization and semaphores , barriers and condition variables, read write locks, caches, cache coherence and false sharing, thread safety. Shared memory programming with openMP-getting started, the trapezoidal rule, scope of variables, the reduction clause, the parallel for directive, more about loops in openMP:sorting , scheduling loops, producers and consumers, caches, cache coherence and false sharing, thread safety. PRAM Model, Sorting Networks, Networking, Algorithms on a Ring of Processors, Algorithms on Grids of Processors, Load Balancing on Heterogeneous Platforms.

Text books:

1.Peter S. Pacheco, "An Introduction to Parallel Programming", 1st Edition, Elsevier, 2011.

2.Henri Casanova, Arnaud Legrand, and Yves Robert, "Parallel Algorithms", 1st Edition, CRC Press, 2010.

Reference Books:

1.Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", 2nd Edition, University Press, 2008.

2.Thomas Ruber,"Parallel Programming for Multicore and Cluster Systems", 1st Edition, Springer, 2010.

3.Barry Wilkinson, "Parallel Processing Techniques and applications using, workstations and parallel computers, 2nd Edition, Pearson, 2007.

4.Ananth Grama, Anshul Guptha, Vipin Kumar, "Introduction to Parallel Computing", 2nd Edition. Addison-Wesley, 2003.

5.Maurice Herlihy, Nir Shavit, "The Art of Multiprocessor Programming", Morgan Kaufmann, 2008.

GRID COMPUTING

Course Code:13CS345 **L –T – P: 3-0-0**
Prerequisite: 13CS201/13EM201 **Credits: 3**

Introduction: Cluster to Grid Computing, Parset: System-independent Parallel Programming on Distributed Systems, Anonymous Remote Computing Model, Integrating Task Parallelism with Data Parallelism, Anonymous Remote Computing and Communication Model, Parallel Programming Model on CORBA, Sneha-Samuham:Grid Computing Model. Cluster Computing at a Glance, Cluster Setup and its Administration, Constructing Scalable Services, Dependable Clustered Computing, Deploying a High Throughput Computing Cluster, Performance Models and Simulation, Metacomputing: Harnessing Informal Supercomputers, Specifying Resources and Services in Metacomputing Environments.

Text Books:

1.D. Janakiram, Grid Computing, Tata McGraw Hill, 2005
2.R. K. Buyya, High Performance Cluster Computing: Archtitectures and Systems, Vol 1, Prentice Hall; 1 edition (May 31, 1999).

Reference Books:

1.PankajJalote, Fault Tolerance in Distributed Systems, Prentice Hall, 1994.
2.J. J. Jos & R. K. Buyya, High Performance Cluster Computing: Architectures and Systems, Vol I, Prentice Hall, NJ, USA, 1999.
3.R. K. Buyya & C. Szyperski, Cluster Computing, Nova Science, New York, USA, 2001.
4.R. K. Buyya & K. Bubendorfer, Market Oriented Grid and Utility Computing, Wiley, 2008.
5.J. Jaseph & C. Fellenstein, Grid Computing, Pearson, 1st Ed, 2004.

CLOUD COMPUTING

Course Code:13CS439 **L –T – P: 3-0-0**
Prerequisite: 13CS201/ 13EM 201 **Credits: 3**

Journey to the Cloud: This unit focuses on the business drivers, definition, essential characteristics, and phases of journey to the Cloud. Business drivers for Cloud computing, Definition of Cloud computing, Characteristics of Cloud computing as per NIST, Steps involved in transitioning from Classic data center to Cloud computing environment. Classic Data Center (CDC): This unit focuses on the key elements of CDC — compute, storage, and network, with focus on storage networking, business continuity, and data center management. Application, DBMS, Compute, Storage and Networking, Object based and Unified storage technologies, Business continuity overview and backup, Replication technologies, CDC Management. Virtualized Data Center (VDC): Virtualization of core technologies in a data center, leading to Virtualized Data Center (VDC). Fundamental concepts of compute, storage, networking, desktop and application virtualization. Concepts and techniques employed for ensuring business continuity in a virtualized data center. Compute, Storage, Network virtualization techniques, Virtual machine (VM) components and process of converting physical to VMs, Block and file level storage virtualization, Virtual provisioning and automated storage tiering, Virtual LAN (VLAN) and its benefit, Methods for implementing desktop virtualization, their benefits, and considerations, Application virtualization methods, benefits, and considerations. Cloud Computing and Infrastructure: Essential characteristics of Cloud Computing, the different Cloud services and deployment models, the economics of Cloud, Cloud infrastructure components, and Cloud service creation processes. Cloud service management processes that ensure that the delivery of Cloud services is aligned with business objectives and expectations of Cloud service consumers. Cloud services models, Cloud deployment models, Economics of Cloud, Cloud infrastructure components, Cloud service creation processes, Cloud service management processes. Cloud Security and Migration to cloud: Security concerns and migration considerations to cloud. Key security concerns and threats and details Cloud model suitable for different categories of users. Security concerns and counter measures in a VDC and Cloud environment, Governance, Risk, and Compliance aspects in Cloud, Cloud security best practices, Cloud models suitable for different categories of users, Considerations for choosing applications suitable for Cloud, Different phases to adopt the Cloud, Major security issues filed by the enterprises.

Text Books:

I. The information storage and management and management book. Second Edition, EMC Education Services 2014, https://education.emc.com/ISMbookv2/default.aspx

2. EMC Material/Courseware: littps://education.emc.com/

Reference Books:-

1) Mastering cloud computing: foundations and applications programming, Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Elsevier / Morgan Kaufmann.

2) Cloud Computing For Dummies Author: Halper Fern, Kaufman Marcia, Bloor Robin, Hurwit Judith, Publisher: Wiley India Pvt Ltd (2009), ISBN: 8126524871

3) Data Center Networks Topologies, Architectures and Fault-Tolerance Characteristics -Yang Liu , Jogesh K. Muppala, Malathi Veeraraghavan, Dong Lin, Mounir Hamdi -Springer-2013

4) VMware ESX Essentials in the Virtual Data Center-David Marshall, Stephen S. Beaver, Jason McCarty-CRC Press-2009

5) Cloud Networking- Understanding Cloud-based Data Center Networks - Gary Lee -Morgan Kaufmann -2014

6) Securing the cloud - cloud computer security techniques and tactics - J R Winkler -Elsevier -2011

HIGH PERFORMANCE COMPUTING

Course Code: 13CS440 **L –T – P: 3-0-0**
Prerequisite: 13CS201/13EM201 **Credits: 3**

Parallel Programming platforms - Parallel Algorithm - Basic Communication Operations - Analytical Modeling of Parallel Programs - Programming using MPI - Matrix - graph and sorting algorithms.

Brief History of GPUs, An Overview of GPU, Programming, Evolution of GPGPUs, An Overview of GPU Memory Hierarchy Features. Introduction to Heterogeneous Computing –Introduction to CUDA C, Parallel Programming in CUDA C.

Text books:

1. Ananth Grama, Anshul Gupta and Vipin Kumar, Introduction to Parallel Computing, 2nd Edition, Pearson Edition 2009.
2. Jason Sanders, Edward Kandrot, CUDA By Example - An Introduction to General-Purpose GPU Programming, Addison Wesley, 2011.

Reference book:

1. Michael J Quinn, Parallel Computing Theory and Practice, 2nd Edition, TMH, 2002

GRAPHICS & MULTIMEDIA STREAM

2D/3D GRAPHICS

Course Code:13CS346 **L –T – P: 3-0-0**
Prerequisite: 13CS202 **Credits: 3**

Two-Dimensional Computer Graphics: From Common Curves to Intricate Fractals Turtle Graphics , Fractals from Recursive Turtle Programs , Some Strange Properties of Fractal Curves, Affine Transformations , Affine Geometry: A Connect-the-Dots Approach to Two-Dimensional Computer Graphics , Fractals from Iterated Function Systems , Fixed-Point Theorem and Its Consequences, Recursive Turtle Programs and Conformal Iterated Function Systems, Mathematical Methods for Three-Dimensional Computer Graphics, Vector Geometry: A Coordinate-Free Approach Coordinate Algebra , Some Applications of Vector Geometry, Coordinate-Free Formulas for Affine and Projective Transformations, Matrix Representations for Affine and Projective Transformations, Projective Space versus the Universal Space of Mass-Points , Quaternions: Multiplication in the Space of Mass-Points, Three-Dimensional Computer Graphics: Realistic Rendering Color and Intensity, Recursive Ray Tracing , Surfaces I: The General Theory, Surfaces II: Simple Surfaces, Solid Modeling, Shading, Hidden Surface Algorithms , Geometric Modeling: Freedom Curves and Surfaces, Bezier Curves and Surfaces , Bezier Subdivision, Blossoming , B-Spline Curves and Surfaces , Knot Insertion Algorithms for B-Spline Curves and Surfaces, Subdivision Matrices and Iterated Function Systems , Subdivision Surfaces.

Text book:

1.Ronald Goldman, Rice University, Houston, An Integrated Introduction to Computer Graphics and Geometric Modeling, Chapman & Hall/CRC Computer Graphics, Geometric Modeling, and Animation Series, 2009.

Reference Books:

1.C. M. Hoffmann, Geometric and Solid Modeling: An Introduction. San Mateo, CA: Morgan Kaufmann, 1989.
2.M.E. Mortenson, Geometric Modeling. New York: Wiley, 1985.
3.An Introduction to Splines for Use in Computer Graphics and Geometric Modeling by Bartels, Beatty, Barsky, Morgan Kaufmann.
4.P. Schnelder, D. Eberly, Geometric Tools for Computer Graphics (Morgan Kaufmann Series in Computer Graphics and Geometric Modeling), 1st ed, Morgan Kaufmann, 2002.

DIGITAL IMAGE PROCESSING

Course Code:13CS347 **L –T – P: 3-0-0**
Prerequisite: 13CS202 **Credits: 3**

The Origins of Digital Image Processing. Examples of Fields that Use Digital Image Processing. Fundamental Steps in Digital Image Processing. Components of an Image Processing System. Elements of Visual Perception. Light and the Electromagnetic Spectrum. Image Sensing and Acquisition. Image Sampling and Quantization. Some Basic Relationships Between Pixels. Linear and Nonlinear Operations. Background. Some Basic Gray Level Transformations. Histogram Processing. Enhancement Using Arithmetic/Logic Operations. Basics of Spatial Filtering. Smoothing Spatial Filters. Sharpening Spatial Filters. Combining Spatial Enhancement Methods. A Model of the Image Degradation/Restoration Process. Noise Models. Restoration in the Presence of Noise Only-Spatial Filtering. Periodic Noise Reduction by Frequency Domain Filtering. Linear, Position-Invariant Degradations. Estimating the Degradation Function. Inverse Filtering. Minimum Mean Square Error (Wiener) Filtering. Constrained Least Squares Filtering. Geometric Mean Filter. Geometric Transformations. Color Fundamentals. Color Models. Pseudocolor Image Processing. Basics of Full-Color Image Processing. Color Transformations. Smoothing and Sharpening. Color Segmentation. Noise in Color Images. Color Image Compression. Background. Multiresolution Expansions. Wavelet Transforms in One Dimension. The Fast Wavelet Transform. Wavelet Transforms in Two Dimensions. Wavelet Packets. Image Compression Models. Elements of Information Theory. Error-Free Compression. Lossy Compression. Image Compression Standards. Preliminaries. Dilation and Erosion. Opening and Closing. The Hit-or-Miss Transformation. Some Basic Morphological Algorithms. Extensions to Gray-Scale Images. Detection of Discontinuities. Edge Linking and Boundary Detection. Thresholding. Region-Based Segmentation. Segmentation by Morphological Watersheds. The Use of Motion in Segmentation. Representation. Boundary Descriptors. Regional Descriptors. Use of Principal Components for Description. Relational Descriptors. Patterns and Pattern Classes. Recognition Based on Decision-Theoretic Methods. Structural Methods.

Text Book:

1.Digital Image Processing by Rafael C. Gonzalez / Richard E. Woods , 3 rd Edition, Pearson Education

Reference Books:

1.Introduction to Digital Image Processing with MATLAB, 1/e, McAndrew Alasdair, Publisher: cengage

2.Bézier and Splines in Image Processing and Machine Vision, Sambhunath Biswas, Brian C. Lovell, Springer, 2007

3.Machine Learning for Audio, Image and Video Analysis - Theory and Applications, Nicu Sebe, Ira Cohen, Ashutosh Garg, Thomas S. Huang, Springer, 2008

4.Digital Image Processing - Rafael C. Gonzalez

5.Digital Image Processing, Sridhar, Oxford Press, 2011.

ANIMATION

Course Code: 13CS348 **L –T – P: 3-0-0**
Prerequisite: 13CS202 **Credits: 3**

Introduction, Technical Background, Interpolating Values, Interpolation-Based Animation, Kinematic Linkages, Motion Capture, Physically Based Animation, Fluids: Liquids & Gases, Modeling and Animating Human Figures, Facial Animation, Behavioral Animation, and Special Models for Animation.

Text book:

1.Computer Animation, 3rd Edition, Algorithms and Techniques, R Parent , Morgan Kaufmann, 2012.

Reference Books:

1.Shroeder, Martin & Lorenson, 'The Visualization Toolkit', 2nd ed., Prentice Hall, 1998. (or 3rd Edition).

2.M. O'Rourke, "Principles of Three Dimensional Computer Animation," 3rd ed., W. W. Norton & Company, 2003.

3.Schaum's Outline of Computer Graphics" (2000) by Zhigang Xiang, Roy A. Plastock; 2nd Edition; McGraw-Hill.

VIDEO AND AUDIO STREAMING

Course Code: 13CS441 **L –T – P: 3-0-0**
Prerequisite: 13CS202 **Credits: 3**

Introduction, **Video formats:** scanning colour space conversion, digital component coding, video tape formats, time code, interconnection standards, high definition **video compression:** compression basics, compression algorithms, compression codes, discrete cosine transform, MPEG compression **Audio compression:** Anolog compression, digital audio, The ear and psychoacoustics, The human voice, Lossy compression, codecs **Introduction to streaming media**

: Applications, architecture, band width, **video encoding** : video capture, compression, encoding enhancements **audio encoding :** audio formats, capture, encoding, file formats **preprocessing :** video and audio processing **stream serving** : streaming, webcasting, on-demand serving, inserting advertisements, play lists **Live web casting:** planning a webcast, video capture, graphics, audio capture, encodingt Applications of streaming media.

Text Book:

1.The Technology of Video and Audio Streaming by David Austerberry pubs: Elsevier, 2nd edition, 2004

Reference Books:

1.Streaming media bible by Steve Mack, publisher :Hungry minds , 2002
2.Streaming media by Gregory C. Demetriades pub: Wiley, 2003

MULTIMEDIA TECHNOLOGIES

Course Code: 13CS442 **L –T – P: 3-0-0**
Prerequisite: 13CS202 **Credits: 3**

Multimedia Communications: Human Communication model, Evolution and Convergence, Technology Framework, Standardization Framework, Frameworks For Multimedia Standardization: Standardization Activates, Standards to build a new global information infrastructure, Standardization process on multimedia communications, ITU-T Mediacom 2004 Frame work for Multimedia Communications, ISO/IEC MPEG-21 Multimedia Framework, IETF Multimedia Internet Standard, Industrial For a and Consortia, Application Layer: ITU Applications, MPEG Applications, Digital Broad Casting, Mobile Services and Applications, Universal Multimedia Access. Middleware Layer: Middleware for Multimedia, Media Coding, Media Streaming, Infrastructure for Multimedia content Distribution, Middleware technologies for multimedia networks. Network Layer: Network Aspects of standardization projects, Network Functions, Network Traffic Analysis, Quality of Service in Network Multimedia Systems, Generic Networks, Access Broadband Networks, Core Broadband Networks, and Content Delivery Networks.

Text book:

1.Kamisetty Rao, Zoran Bojkovic, Dragorad Milovanovic, Introduction to Multimedia Communications: Applications, Middleware, Networking, Wiley Publisher, 2005.

Reference Books:

1.Suzanne (Suzanne Weixel) Weixel, Jennifer Fulton, Karl Barksdale, Cheryl Beck Morse, Bryan Morse, “Multimedia BASICS, Course Technology”, 1st edition, 2003.
2.Li, Z.-N. & Drew, M. S, “Fundamentals of Multimedia”, 2004, Prentice Hall.
3.Williams,”The Non-Designer's Design Book”, 2/e, Berkeley, CA: Peachpit Press, 2004.
4.Tannenbaum, R. S, “Theoretical Foundations of Multimedia”, W.H. Freeman & Co, 1998.

INTELLIGENT COMPUTING STREAM

SOFT COMPUTING

Course Code: 13CS349 **L –T – P: 3-0-0**
Prerequisite: 13CS304 **Credits: 3**

Introduction to Intelligent systems and soft computing: Intelligence systems, Knowledge -based systems, knowledge representation and processing, soft computing. **Fundamentals of Fuzzy Logic Systems:** Fuzzy sets, Fuzzy logic operations, generalized operations, Fuzziness and fuzzy resolution, fuzzy relations, composition and interface, considerations of fuzzy decision- making. **Fuzzy logic control:** Basic of fuzzy control, Fuzzy control architecture, Properties of fuzzy control, robustness and stability. **Fundamentals of Artificial neural networks:** Learning and acquisition of knowledge, features of artificial neural networks, fundamentals of connectionist modeling. **Major classes of neural networks**: The multi-layer perceptrons, radial basis function networks, Kohonen's self-organizing network, The Hopfield network, industrial and commercial application of ANN. **Dynamic neural networks and their applications to control and chaos prediction:** Training algorithms, fields of applications of RNN, dynamic neural networks for identification and control, neural network –based control approaches,dynamic neural networks for chaos time series prediction, artificial neural networks for chaos predictions. **Neuro Fuzzy Systems**: Architecture of neuro fuzzy systems, construction of neuro fuzzy systems. **Evolutionary computing:** Over view of Evolutionary computing, Genetic algorithms and optimization, the schema theorem: the fundamental algorithm of Genetic algorithms, Genetic algorithms - operations, integration of Genetic algorithms with neural networks, integration of Genetic algorithms with fuzzy logic, known issues in Genetic algorithms, population-based incremental learning, Evolutionary Strategies, ES applications

Text books:

1.Fakhreddine O. Karry, Clarence De Silva, "Soft Computing and Intelligent systems Design Theory, Tools and Applications", Pearson, 2009

Reference Books:

1.Laurene Fausett, "Fundamentals of Neural Networks", Pearson, 2004.
2.Timothy J Ross "Fuzzy Logic with Engineering Applications", 3rd Edition, Wiley, 2010.
3.Bart Kosko, "Neural Networks and Fuzzy Systems", PHI, 2004
4.S N Sivanandam, S N Deepa, "Principles of Soft Computing", Wiley India,2008

MACHINE LEARNING

Course Code: 13CS350 | **L –T – P: 3-0-0**
Prerequisite: 13CS304 | **Credits: 3**

Supervised Learning: Learning a Class from Examples, Vapnik Chervonenkis (VC) Dimension, Probably Approximately Correct (PAC) Learning, Noise, Learning Multiple Classes, Regression, Model Selection and Generalization, Dimensions of a Supervised Machine Learning Algorithm **Bayesian Decision Theory:** Classification, Losses and Risks, Discriminant Functions, Utility Theory, Association Rules **Parametric Methods:** Maximum Likelihood Estimation, Evaluating an Estimator: Bias and Variance, The Bayes' Estimator, Parametric Classification, Regression, Tuning Model Complexity: Bias/Variance Dilemma, Model Selection Procedures **Multivariate Methods:** Multivariate Data, Parameter Estimation, Estimation of Missing Values, Multivariate Normal Distribution, Multivariate Classification, Tuning Complexity, Discrete Features, Multivariate Regression **Dimensionality Reduction:** Subset Selection, Principal Components Analysis, Factor Analysis, Multidimensional Scaling, Linear Discriminant Analysis **Clustering:** Mixture Densities, k-Means Clustering, Expectation-Maximization Algorithm, Mixtures of Latent Variable Models, Supervised Learning after Clustering, Hierarchical Clustering, Choosing the Number of Clusters **Nonparametric Methods:** Nonparametric Density Estimation, Generalization to Multivariate Data, Nonparametric Classification, Condensed Nearest Neighbor, Nonparametric Regression: Smoothing Models, Choosing the Smoothing Parameter **Decision Trees:** Univariate Trees, Pruning, Rule Extraction from Trees, Learning Rules from Data, Multivariate Trees **Linear Discrimination:** Generalizing the Linear Model, Geometry of the Linear Discriminant, Pairwise Separation, Gradient Descent, Logistic Discrimination, Discrimination by Regression **Local Models:** Competitive Learning, Radial Basis Functions, Incorporating Rule-Based Knowledge, Normalized Basis Functions, Competitive Basis Functions, Learning Vector Quantization, Mixture of Experts, Hierarchical Mixture of Experts **Kernel Machines:** Optimal Separating Hyper plane, The Non-separable Case: Soft Margin Hyper plane, v-SVM, Kernel Trick, Vectorial Kernels, Defining Kernels, Multiple Kernel Learning, Multiclass Kernel Machines, Kernel Machines for Regression, One-Class Kernel Machines, Kernel Dimensionality Reduction **Bayesian Estimation:** Estimating the Parameter of a Distribution, Bayesian Estimation of the Parameters of a Function, Gaussian Processes **Hidden Markov Models:** Discrete Markov Processes, Hidden Markov Models, Three Basic Problems of HMMs, Evaluation Problem, Finding the State Sequence, Learning Model Parameters, Continuous Observations, The HMM with Input, Model Selection in HMM.

Text books:

1.Ethem Alpaydin, "Introduction to Machine Learning", The MIT Press, 2010

Reference Book:

1.Stephen Marsland, "Machine Learning an Algorithmic Perspective", CRC Press, 2009.

NATURAL LANGUAGE PROCESSING

Course Code: 13CS351 **L –T – P: 3-0-0**

Prerequisite: 13CS304 **Credits: 3**

Mathematical Foundations, Linguistic Essentials, Corpus-Based Work. **Words:** Collocations, Statistical Inference: n-gram Models over Sparse Data, Word Sense Disambiguation, Lexical Acquisition. **Grammar:** Markov Models, Part-of-Speech Tagging, Probabilistic Context Free Grammars, Probabilistic Parsing. **Applications and Techniques:** Statistical Alignment and Machine Translation, Clustering, Topics in Information Retrieval, Text Categorization.

Textbooks:

1.Christopher D Manning, Hinrich Schutze, "Foundations of Statistical Natural Language Processing", MIT Press, 2003.

References Books:

1.Lucja M Iwanska, Stuart C Shapiro, "Natural Language Processing And Knowledge Representation: Language For Knowledge And Knowledge For Language", AAAI Press, 2000.
2.Anne Kao, Stephen R Poteet, "Natural Language Processing and Text Mining", Springer, 2010.
3.Daniel Jurafsky, James H Martin, "Speech and Language Processing", Pearson, 2000
4.James Allen, "Natural Language Understanding", 2nd Edition, Pearson, 2008.

MULTI AGENT SYSTEMS

Course Code: 13CS443 **L –T – P: 3-0-0**

Prerequisite: 13CS304 **Credits: 3**

Intelligent Agents: Environments, Intelligent Agents, Agents and Objects, Agents and Expert Systems, Agents as Intentional Systems, Abstract Architectures for Intelligent Agents. **Deductive Reasoning Agents:** Agents as Theorem Provers, Agent-Oriented Programming, Concurrent MetateM. **Practical Reasoning Agents:** Practical Reasoning Equals Deliberation Plus Means-Ends Reasoning, Means-Ends Reasoning, Implementing a Practical Reasoning Agent, The Procedural Reasoning System. **Reactive and Hybrid Agents:** Reactive Agents, Hybrid Agents. **Understanding each other:** Ontology fundamentals, Ontology Languages, RDF, Constructing an Ontology, Software Tools for Ontologies **Communication:** Speech Acts, Agent Communication Languages. **Working Together:** Cooperative Distributed Problem Solving, Task Sharing and Result Sharing, Result Sharing, Combining Task and Result Sharing, Handling Inconsistency, Coordination, Multiagent Planning and Synchronization **Methodologies:** Appropriate Agent-Based Solution, Agent-Oriented Analysis and Design Techniques, Pitfalls of Agent Development, Mobile Agents.

Applications : Agents for Workflow and Business Process Management, Agents for Distributed Sensing, Agents for Information Retrieval and Management, Agents for Electronic Commerce, Agents for Human-Computer Interfaces, Agents for Virtual Environments, Agents for Social Simulation

Text Book:
1.Michael Wooldridge, "An Introduction to MultiAgent Systems", 2/e, John-Wiley & sons, 2009.

Reference Books:
1.Adelinde M. Uhrmacher, Danny Weyns, Multi-Agent Systems: Simulation and Applications, CRC Press, 2009.
2.Shoham, Kevin Leyton-Brown, "MultiAgent Systems - Algorithmic, Game-Theoretic, and Logical Foundations", Cambridge University Press, 2009.

COMPUTER VISION

Course Code:13CS444 **L –T – P: 3-0-0**
Prerequisite: 13CS304 **Credits: 3**

Cameras: Sensing, **Sources, Shadows, and Shading**: Qualitative Radiometry, Sources and their effects, Local shading models, Application: photometric stereo, Inter-reflections: global shading models **Color**: The physics of color, Human color Perception, Representing color, A Model for image color, Surface color from image color **Linear Filters**: Linear filters and convolution, Shift Invariant linear systems, Spatial Frequency and Fourier Transforms, Sampling and Aliasing, Filters as Templates, Technique: Scale and Image Pyramids, **Edge Detection**: Noise, Estimating Derivatives, Detecting Edges **Texture**: Representing Texture, Analysis Using Oriented Pyramids, Application: Synthesizing Textures for Rendering, Shape from Texture **The Geometry of Multiple Views**: Two Views, Three Views **Stereopsis**: Reconstruction, Human Stereopsis, Binocular Fusion, Using More Cameras **Segmentation by Clustering**: Human Vision: Grouping and Gestalt, Applications: shot boundary detection and background subtraction, Image segmentation by clustering pixels, Segmentation by Graph-Theoretic Clustering **Segmentation by Fitting a Model**: The Hough Transform, Fitting Lines, Fitting Curves, Robustness, Example: Using RANSAC to fit Fundamental matrices **Segmentation and Fitting Using Probabilistic Methods**: Missing Data Problems, Fitting, and Segmentation, The EM Algorithm in practice, Model selection: best Fit, **Model-Based Vision**: Initial Assumptions, Obtaining Hypotheses by Pose Consistency, Obtaining Hypotheses Using Invariants, Verification, Application: Registrations in Medical Imaging Systems, Curved Surfaces and Alignment **Finding Templates Using Classifiers:** Classifiers, Building Classifiers from Class Histograms, Feature selection, Neural Networks, The Support Vector Machine **Recognition by Relations between Templates**: Finding objects by voting on relations between templates, Relational Reasoning Using Probabilistic Models and Search, Using Classifiers to Prune Search, Technique: Hidden Markov Models, Applications: Hidden Markov Models and Sign Language Understanding **Geometric Templates from Spatial Relations**: Simple Relations between object and image, Primitives, Templates, and Geometric Inference, Object Recognition.

Text Book:
1.Forsyth David A and Ponce J, "Computer Vision – A Modern Approach", Pearson Publication 2003.

Reference Book:
1.Computer Vision: Algorithms and Applications, R. Szeliski, Springer Verlag, 2011

COMMUNICATION SYSTEMS STREAM

INFORMATION THEORY & CODING

Course Code: 13EC340 **L –T – P: 3-0-0**
Prerequisite: 13EC207/13EM202 **Credits: 3**

Introduction: Measure of information, Average information content of symbols in long independent sequences, Average information content of symbols in long dependent sequences, Entropy calculation for extension of source. Mark-off statistical model for information source, Entropy and information rate of mark-off source. **Encoding of The Source Output**, Shannon's encoding algorithm for dependent and independent sequences. Discrete communication channels, Continuous channels. Source coding theorem, Huffman coding, Discrete memory less Channels, Mutual information, Properties of mutual information, Channel Capacity. Channel coding theorem, Differential entropy and mutual information for continuous ensembles, Channel capacity Theorem **Error Control Coding**, Introduction, Types of errors, examples, Types of codes Linear Block Codes: Matrix description, Error detection and correction, Standard arrays and table look up for decoding. **Binary Cycle Codes,** Algebraic structures of cyclic codes, Encoding using an (n-k) bit shift register, Syndrome calculation, BCH codes ,RS Codes**,** Golay codes, Shortened cyclic codes, Burst error correcting codes. Burst and Random Error correcting codes. **Convolution Codes:** Block diagram of encoder, Impulse response of encoder, Time domain approach and Transform domain approach. State representation and state diagram, Tree diagram, trellis diagram.

TEXT BOOKS

1. K. Sam Shanmugam **,"Digital and Analog communication systems,** John Wiley, 1996.
2. Simon Haykin **,"Digital communication,** , John Wiley, 2003.

REFERENCE BOOKS

1. Ranjan Bose **,"ITC and Cryptography**, TMH, II edition, 2007
2.Wells," Applied Coding and Information Theory for Engineers", Pearson Ed
3. Glover and Grant **,"Digital Communications** ",Pearson Ed. 2nd Ed 2008
4. Robert H. Morelos-Zaragoza ,"The Art of Error Correcting Coding ,"JOHN WILEY & SONS,
5. Thomas M. Cover& Joy A. Thomas, "Elements Of Information Theory, Second Edition",A John Wiley & Sons, Inc
6. Michael Purser ,"Introduction to Error-Correcting Codes ",Artech House

SIMULATION BOOKS

1. Yuan Jiang, "A Practical Guide to Error-Control Coding Using MATLAB" , Artech House

TV AND VIDEO ENGINEERING

Course Code: 13EC341 **L –T – P: 3-0-0**
Prerequisite: 13EC207/13EM202 **Credits: 3**

Fundamentals of Television: Geometry form and Aspect Ratio - Image Continuity - Number of scanning lines - Interlaced scanning - Picture resolution, composite video signal, video signal dimension, horizontal sync, vertical sync details, Block diagram of Broad Cost T V Transmitter, T V Receiver. Camera tube Principles, Image orthicon, vidicon, plumbicon. **Television Transmitter and Receiver:** Picture signal transmission, sound signal transmission, standard channel bandwidth, VSB transmission, positive and negative modulation, Low level and High level TV transmitters, TV signal propagation Interference, TV transmission Antennas, Monochrome TV receiver block level, Sync separation. **Essentials of Colour Television:** Compatibility, Colour perception, Three colour theory, luminance, hue and saturation, Values of luminance and colour difference signals, colour signal transmission, Bandwidth, Modulation of colour difference signals, weighting factors, Formation of chrominance signal, I and Q, U and V Signals. **Digital TV:** Introduction to Digital TV, Principle of Digital TV, Digital TV signals and parameters, Digital TV Transmitters, MAC signals, Advanced MAC signal transmission, Digital TV receivers, Principles of Digital Video compression, MPEG1, MPEG2, MPEG4, Video compression ITU-Standards(H),Digital TV recording techniques. **HDTV & Broadcasting systems:** HDTV standards and systems, HDTV transmitter and receiver/encoder, Digital TV satellite Systems, CCTV, CATV, direct to home TV, conditional access system (CAS), Digital Broadcasting

TEXT BOOKS

1.R.R.Gulati, " Monochrome Television Practice, Principles, Technology and servicing , Second edition, New age International Publishes, 2004
2. A. M. Dhake,"Television and video Engineering,TMH Publication
3. Kelth jack ,"Video Demisified, Penram International Publication.
4. R.G. Gupta ,"Audio Video Systems", Technical Education.

REFERENCE BOOKS

1. S. P. Bali, "Color TV Theory and Practice".
2. Bernard Grobb, Charles E, "Basic TV and Video Systems"

OPTICAL COMMUNICATIONS

Course Code:13EC342 **L –T – P: 3-0-0**
Prerequisite: 13EC207/13EM202 **Credits: 3**

Introduction: Advantages of Optical fibers, Applications of Optical Fiber, Ray Theory Transmission, Total internal reflection, Acceptance angle, Critical Angle, Numerical Aperture, Fiber types: Step Index, Graded Index: Modes of Propagation: single mode and multimode fibers. **Transmission Characteristics of Optical Fibers**: Attenuation, absorption, scattering and bending losses in fibers, Dispersion: Inter-model and intra-model, Polarization mode dispersion **Optical Transmitters and Detectors**: LED'S: Principles of Light Emission, Light Emitting Diodes: Simple structure and characteristics. LASER: Principle, Simple structures of semiconductor Laser and its characteristics, Optical Transmitter Circuits. Electro Optic Modulation: Kerr effect, Pockle's effect, Amplitude and Phase modulations. Detectors: Principles of photo detection. PIN Photodiode, Avalanche Photodiode and their characteristics, Optical Receiver Circuit. **Optical Fiber Systems**: Digital System planning considerations, Optical power budgeting, Advanced Multiplexing Strategies: WDM,OTDM and SCM. Optical Amplifiers: Semiconductor Optical Amplifiers, Raman Amplifiers, Erbium Doped Fiber Amplifiers. **Optical Fiber Measurements & Instrumentation**: Numerical Aperture, attenuation, refractive index, cutback and OTDR. **Advanced Optical Systems:** Fiber Optic LAN's, Wavelength routing Networks, Optical switching networks, SONET/SDH, FDDI.

TEXT BOOKS

1.Keiser G, "Optical Fiber Communication, " McGraw-Hill.
2.G. P. Agrawal, "Fiber-Optic Communications Systems," 3 rd Edition, John Wiley & Sons.
3. J C Palais ," Fiber Optic Communications", 2nd Edition, PHI

REFERENCE BOOKS

1.W Tomasi ," Advanced Electronic Communication Systems", PHI
2.J Powers, "An introduction to fiber optic systems," 2Nd Edition, Mc. Graw Hill.
3.John Gowar, "Optical communication systems," PHI.
4.John M Senior, "Optical Fiber Communications: Principles and Practice", 2nd Edition, PHI.

SATELLITE COMMUNICATION

Course Code:13EC443 **L –T – P: 3-0-0**
Prerequisite: 13EC207/13EM202 **Credits: 3**

Introduction: Basic Concepts of Satellite Communications, Frequency Allocations for Satellite Services, Applications. **Orbital Mechanics And Launchers:** Orbital Mechanics, Look Angle determination, Orbital perturbations, Orbit determination, launches and launch vehicles, Orbital effects in communication systems performance. **Satellite Subsystems:** Attitude and Orbit Control

System, Telemetry, Tracking, Command and Monitoring, Power Systems, Communication Subsystems, Satellite Antennas**. Satellite Link Design:** Basic Transmission Theory, System Noise Temperature and G/T Ratio, Design of Down Links, Up Link Design, Design Of Satellite Links For Specified C/N, System Design Examples. **Earth Station Technology:** Introduction, Transmitters, Receivers, Antennas, Tracking Systems, Terrestrial Interface, Primary Power Test Methods. **Multiple Access Techniques and Error Control :** Frequency Division Multiple Access (FDMA), Inter-modulation, Calculation of C/N, Time Division Multiple Access (TDMA), Frame Structure, Satellite Switched TDMA, Onboard Processing, Code Division Multiple Access (CDMA), Error control requirements for satellite link—ARQ, Concatenated Codes, Interleaving, Turbo codes. **Satellite Navigation & Global Positioning System :** Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers and Codes, Satellite Signal Acquisition, GPS Navigation Message, GPS Signal Levels, GPS Receiver Operation.

TEXT BOOKS

1.Timothy Pratt, Charles Bostian and Jeremy Allnutt Satellite Communications, WSE, Wiley Publications, 2nd Edition, 2003.
2.L.Pritchard, Robert A Nelson and Henri G.Suyderhoud,"Satellite Communications Engineering – Wilbur, 2nd Edition, Pearson Publications,

REFERENCES

1.M. Richharia, »Satellite Communications: Design Principles »BS Publications, 2nd Edition.
2.K.N. Raja Rao, "Fundamentals of Satellite Communications", PHI, 2004
3.D.C Agarwal ,"Satellite Communication, Khanna Publications, 5th Ed.
4.Dennis Roddy Satellite Communications , McGraw Hill, 4th Edition, 2009.
5.Robert M Gagliardi, Satellite Communications, DTS Publishers Ltd.

CELLULAR COMMUNICATIONS

Course Code: 13EC344 **L –T – P: 3-0-0**
Prerequisite: 13EC-308 /13EM202 **Credits: 3**

Introduction to Mobile Communication: Evolution of Mobile Radio Communication, Examples of Wireless Communication Systems, Cellular telephone Systems, 2G & 3G wireless networks, Cellular concept, frequency reuse, Channel Assignment strategies, Hand off strategies, Interference and system capacity, improving coverage and capacity in cellular systems. **Mobile Radio Propagation:** Large Scale Fading, Free space propagation model, Three basic propagation mechanisms: Reflection, diffraction, scattering, Small Scale Fading, Multipath Propagation, Types of small scale fading, Parameters of Mobile Multipath channels, fading effects due to multipath delay Spread and Doppler spread, Statistical models for multipath fading channels. **Equalization& Diversity**: Fundamentals of Equalizers, Linear equalizers, nonlinear equalizers, Decision feedback equalizers, MLSE, Algorithms for adaptive equalization, Space diversity, MRC, EGC, selection diversity, Polarization diversity, Frequency diversity, Time diversity, Rake receiver. **Wireless Systems & Standards:** GSM Services, Features, Architecture, channel types, Frame Structure, Signal processing in GSM, CDMA Digital cellular Standards IS-95. **OFDM for Wireless Communications:** Basic OFDM, FFT Implementation, Cyclic Extension, Power Spectrum, and Efficiency, Comparison with Single-Carrier, Design Example, Baseband versus Passband, Impairments of Wireless Channels to OFDM Signals: Time-Varying Impairments, Effect of Sampling Clock Offset, Effect of Timing Offset, Effect of Delay Spread, System Nonlinearity.

TEXT BOOKS

1. Theodore S. Rappaport, "Wireless Communications Principles and Practice", 2nd Edition, Pearson Education, 2003.
2. David Tse and Pramod Viswanath "Fundamentals of Wireless Communication" Cambridge University Press, 2005
3. Ye (Geoffrey) Li, Gordon Stuber, "Orthogonal Frequency Division Multiplexing for Wireless Communications", Springer, 2006.

REFERENCE BOOKS

1. W. C. Y. Lee, “Mobile Cellular Communications, 2nd Edition”, Mc Graw Hill,
2. Gottapu Sasi Bhushana Rao” Mobile Cellular Communication”, Pearson Education
3. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press,
4. Simon R. Saunders, Alejandro Aragon Zavala, “Antennas and Propagation for Wireless Communication Systems”, 2nd Edition, John Wiley & Son,
5. Vahid Tarokh “New Directions in Wireless Communications Research”, Springer.

EMI/EMC

Course Code: 13EC345 **L –T – P: 3-0-0**

Prerequisite: 13EC202 **Credits: 3**

EMI Environment: Sources of EMI, Conducted and Radiated EMI, Transient EMI, EMI –EMC Definitions and Units of Parameters. EMI Specifications/Standards/Limits: Units of specifications, Civilian Standards and Military Standards **EMI Control Techniques:** Shielding, Filtering, Grounding, Bonding, Isolation Transformer, Transient Suppressors, Cable Routing, Signal control, Component Selection and mounting. **EMC Design Guidelines and Choice of passive components for EMC:** EMC Design Guidelines: Typical Sub systems in Electronic Equipment, Transmitters, Receivers, Antenna Systems, Power Supplies, Motors, Control Devices, Digital Circuits, Digital Computers. **Choice of Passive Components for EMC**: Capacitors, Inductors, Transformers, Resistors, Conductors, Ferrite Beads, Coaxial Connectors, Conductive Gaskets. **EMI Measurements:** EMI Test Instrument / Systems, EMI Test, EMI Shielded Chamber, Open Area Test Site, TEM cell Antennas

TEXT BOOKS

1.V P Kodali, “Engineering EMC Principles, Measurements and Technologies”, IEEE press,
2.Bernard Kieser, “Principles of Electromagnetic Compatibility”, Artech House 3rd Edition,
3.Henry W.Ott, “Electromagnetic Compatibility Engineering” , A John wiley & sons publication

REFERENCE

1.Clayton R Paul, “Electromagnetic Compatibility, John Wiley
2.Tim Williams, “EMC for Product Designer”, Elsevier
3.PR Chatterton, ”Electromagnetic Theory to practical design”, Wiley
4.Sonia Ben Dhia,” Electromagnetic Compatibility as Integrated Circuits, Springer

RF SYSTEM DESIGN

Course Code: 13EC346 **L –T – P: 3-0-0**

Prerequisite: 13EC414 **Credits: 3**

Introduction: Importance of RF and Microwave Circuit Design-Dimensions and Units-Frequency Spectrum - RF Behavior of Passive Components: High Frequency Resistors, High Frequency Capacitors, High Frequency Inductors, General Introduction, Types of Transmission Lines-Equivalent Circuit representation. **The Smith Chart:** Introduction, Derivation of Smith Chart, Description of two types of smith chart, Z-Y Smith chart, Distributed Circuit Applications, Lumped Element Circuit Applications. **Single And Multiport Networks**: Basic Definitions, Interconnecting Networks, Scattering Parameters related problems **RF Filter Design:** Scattering Parameters: Definition, Meaning, Chain Scattering Matrix, Conversion Between S- and Z-parameters, Signal Flow Chart Modeling, Generalization-Basic Resonator and Filter Configurations: Low Pass, High Pass, Band Pass and Band Stop type Filters-Filter Implementation using Unit Element and Kuroda's Identities Transformations. **Stability and Gain Considerations – RF Design** RF Source, Transducer Power Gain, Additional Power Relations-Stability Considerations: Stability Circles, Unconditional Stability, and Stabilization Methods-Unilateral and Bilateral Design for Constant Gain- Noise Figure Circles- Constant VSWR Circles. **RF Amplifiers – Small Signal Design** Introduction, Types and

Characteristics of Amplifiers, Small Signal Amplifiers, Design of different types of amplifiers (NBA, HGA, MGA, LNA, MNA, BBA)

TEXT BOOKS

1.Mathew M. Radmanesh, "Radio Frequency & Microwave Electronics", Pearson Education Asia, Second Edition,

2.Reinhold Ludwig and Powel Bretchko," RF Circuit Design – Theory and Applications", Pearson Education Asia, First Edition.

REFERENCES

1.Joseph . J. Carr, "Secrets of RF Circuit Design", McGraw Hill Publishers, Third Edition.

2.Ulrich L. Rohde and David P. New Kirk, "RF / Microwave Circuit Design", John Wiley & Sons USA, 2000.

3.Roland E. Best, "Phase - Locked Loops: Design, simulation and applications", McGraw Hill Publishers 5^{th} edition

4.Devendra K.Misra ,"Radio Frequency and Microwave Communication Circuits – Analysis and Design "John Wiley & Sons, Inc.

5. Jon B. Hagen, " Radio Frequency Electronics ", Cambridge university press, Cambridge, 1996.

6. James Hardy, " High Frequency Circuit Design ", Resto Publishing Co., NewYork, 1979.

7. Ian Hickman, " RF HandBook ", Butter Worth Heinemann Ltd., Oxford, 1993.

8. Ulrich L.Rohde, T.T.N.Bucher, " Communication Recievers ", McGraw-Hill, New York, 1998.

RADAR AND NAVIGATIONAL AIDS

Course Code: 13EC447 **L –T – P: 3-0-0**

Prerequisite: 13EC313 **Credits: 3**

Introduction, Basic Radar , Advantage of Basic Radar, Block Diagram of Pulse Radar, simple form of Radar equation, Detection of signals in noise, Receiver noise and signal to noise ratio, integration of Radar pulses, RCS: RCS of simple targets, RCS of multiple targets, PRF and Range Ambiguities, Doppler Effect, Limitations of CW Radar, FMCW Radar, Altimeter. **MTI Radar**, Delay line cancellers: Frequency response of single delay line cancellers, Clutter Attenuation, MTI improvement factor, N-pulse delay line canceller, Non recursive and Recursive filters, staggered PRF, Doppler filter banks **Tracking:** Types of tracking Radar Systems, Sequential Lobing Radar, Conical Scan and Mono pulse Tracking Radar Super heterodyne Receiver, Types of Duplexers and receiver protectors, types of Displays, Radomes. **Radar Transmitter**: Introduction, Linear- Beam Power Sources, Magnetron, Crossed- Field Amplifiers, Other RF Power Sources. **Radar Receivers**: The Radar Receivers, Receiver Noise Figure, Super heterodyne Receivers, Duplexers and Receiver Protectors, Radar Displays **Electronic Warfare:** Objectives an definitions, Noise jamming, Types of Electronic counter measures and Electronic counter to counter measures, Stealth applications. **Elementary ideas of Navigational Aids**, DME, VOR, DVOR, TACAN, ILS, MLS, GPS, Automatic Direction Finder, Hyperbolic Navigational (LORAN, DECA, OMEGA).

TEXT BOOKS

1.Merrill I Skolnik, " Introduction to Radar Systems", 3^{rd} Edition, TMH, 2003

2. GSN Raju,"Radar Engineering and Fundamentals of Navigational Aids", I K International

REFERENCE BOOKS

1.Peyton Z Peebles Jr, "Radar Principles", John Wiley Inc., 2004

2. Hamish Meikie," Modern Radar Systems", Artech House

3. AK Sen and Dr AB Bhattacharya, "Radar Systems and Radio Aids to Navigation"

SIMULATION BOOK

1. Bassem R.Mahafza "Radar systems Analysis and design using Matlab" Chapman & Hall

MICROWAVE AND MILLIMETRIC WAVE CIRCUITS

Course Code: 13EC448 **L –T – P: 3-0-0**
Prerequisite: 13EC313 **Credits: 3**

Analysis of Microwave Circuits: Introduction, Microwave Components – E-plane Tee, H-plane Tee, Magic Tee, Directional Coupler, Isolator, Circulator & their Scattering **Transformers & Resonators:** Parameters, Impedance Transformers – Quarter wave Transformers, Microwave Resonators – Rectangular and Cylindrical Resonators. **Filters And Periodic Structures:** Design of Narrow Band Low Pass, Band Pass and High Pass Filters, Maximally flat and Chebyshev Designs, Introduction to Periodic Structures, Floquet's Theorem, Circuit Theory Analysis of Infinite and Terminated Structures, **Obstacles in Wave Guides:** Introduction, Posts in Waveguides, Diaphragms in Waveguides, Waveguide Junctions, Waveguide Feeds, Excitation of Apertures **Millimeter Wave Circuits:** Wave Propagation in microstriplines, Discontinues in Microstrips, Parallel Coupled lines, Power Dividers and Directional Couplers, Microwave and Millimeter Wave Integrated Circuits.

TEXT BOOKS

1.Roger F. Harrington, "Time-Harmonic Electromagnetic Fields", Mc graw-hill
2.Robert E Collin, "Foundation For Microwave Engineering", Mc Graw-Hill.

REFERENCE BOOKS

1.Analysis Methods for RF, Microwave, and Millimeter-Wave Planar Transmission Line Structures by Cam Nguyun

RADIATION SYSTEMS

Course Code: 13EC349 **L –T – P: 3-0-0**
Prerequisite: 13EC313 **Credits: 3**

Basics Concepts Of Radiation: Radiation from surface current and current line current distribution, Basic antenna parameters, Radiation mechanism-Current distribution of Antennas, Impedance concept-Balanced to Unbalanced transformer **Radiation From Apertures** Field equivalence principle, Rectangular and circular apertures, Uniform distribution on an infinite ground plane, Aperture fields of Horn antenna-Babinets principle, Geometrical theory of diffraction, Reflector antennas, and Design considerations - Slot antennas **Synthesis Of Array Antennas** Types of linear arrays, current distribution in linear arrays, Phased arrays, Optimization of Array patterns, Continuous aperture sources, Antenna synthesis techniques **Micro Strip Antennas** Radiation mechanisms, Feeding structure, Rectangular patch, Circular patch, Ring antenna. Input impedance of patch antenna, Microstrip dipole, Microstrip arrays **EMI/EMC/Antenna Measurements:** Log periodic, Bi-conical, Log spiral ridge Guide, Multi turn loop, Traveling Wave antenna, Antenna measurement and instrumentation, Amplitude and Phase measurement, Gain, Directivity, Impedance and polarization measurement, Antenna range, Design and Evaluation

TEXT BOOKS

1. Kraus.J.D.,"Antennas"II Edition, John wiley and Sons.
2. Balanis.A, "Antenna Theory Analysis and Design", John Wiley and Sons, New York, 1982

REFERENCES

1. RF System Design**,** Peter Kinget Bell Laboratories, Lucent Technologies Murray Hill,
2. Practical RF system design, Wiley-IEEE, 2003 - Technology & Engineering

VLSI STREAM

ANALOG VLSI DESIGN

Course Code: 13EC461 **L –T – P: 3-0-0**
Prerequisite: 13EC206 / 13EC312 **Credits: 3**

Introduction to Analog Design: General Concepts, **Basic MOS Device physics:** General considerations of MOS devices, second order effects, MOS device models. **Amplifiers design:** Single Stage (CS, CG and CD) configurations, Cascade Stage; **Differential pair:** Operation, Basic Differential Pair, differential pair with MOS loads, Gilbert cell. **Passive & Active Current Mirrors:** Basic current mirrors, Cascode current mirror, Active Current Mirrors- large signal analysis, small signal analysis and common mode properties. **Frequency response of Amplifiers:** General Considerations, Common-Source Stage, Source Followers, Common Gate Stage, Cascode Stage, Differential Stage. **Operational Amplifiers:** Op-Amp topologies, single stage, two stages, Gain Boosting, Slew rate.

TEXT BOOKS

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2005
2. Phillip E. Allen, Douglas R. Holberg, "CMOS analog circuit design" Oxford University Press

REFERENCE

1. Jacob Baker, "CMOS Mixed Signal Circuit Design", John Wiley, 2008
2. Gray & Mayer, Analysis & Design of Analog Integrated Circuits, 4th edition, Wiley, 2001
3. David A. Johns, Ken Martin "Analog Integrated Circuit Design, John Wiley

LOW POWER VLSI DESIGN

Course Code: 13EC362 **L –T – P: 3-0-0**
Prerequisite: 13EC206 / 13EC312 **Credits: 3**

Introduction: Need for low power VLSI chips, Sources of power dissipation on Digital Integrated circuits. Emerging Low power approaches, Physics of power dissipation in CMOS devices. **Device & Technology Impact on Low Power:** Dynamic dissipation in CMOS, Transistor sizing& gate oxide thickness, Impact of technology Scaling, Technology & Device innovation **Simulation Power Analysis**: SPICE circuit simulators, gate level logic simulation, capacitive power estimation, static state power, gate level capacitance estimation, architecture level analysis, data correlation analysis in DSP systems, Monte Carlo simulation. **Probabilistic power analysis**: Random logic signals, probability & frequency, probabilistic power analysis techniques, signal entropy. **Low Power Design Circuit Level**: Power consumption in circuits. Flip Flops & Latches design, high capacitance nodes, low power digital cells library **Logic level:** Gate reorganization, signal gating, logic encoding, state machine encoding, precomputation logic **Low Power Architecture & Systems:** Power & performance management, switching activity reduction, parallel architecture with voltage reduction, flow graph transformation, low power arithmetic components, low power memory design. **Low power Clock Distribution:** Power dissipation in clock distribution, single driver Vs distributed buffers, Zero skew Vs tolerable skew, chip & package co design of clock network . **Algorithm & Architectural Level Methodologies:** Introduction, design flow, Algorithmic level analysis & optimization, Architectural level estimation & synthesis.

TEXT BOOKS

1. Gary K. Yeap, "Practical Low Power Digital VLSI Design", KAP, 2002
2. Rabaey, Pedram, "Low Power Design Methodologies" Kluwer Academic

REFERENCE BOOKS

1. Kaushik Roy, Sharat Prasad, "Low-Power CMOS VLSI Circuit Design" Wiley,2000
2. Yeo, "CMOS/BiCMOS ULSI Low Voltage Low Power" Pearson Education

ASIC DESIGN

Course Code: 13EC363 **L –T – P: 3-0-0**

Prerequisite: 13EC206 / 13EC312 **Credits: 3**

Types of Asics: Design flow - CMOS transistors CMOS Design rules - Combinational Logic Cell – Sequential logic cell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance- Logical effort - Library cell design - Library architecture**.** Anti fuse - static RAM - EPROM and EEPROM technology - PREP benchmarks - Actel ACT - Xilinx LCA -Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks. Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 - Altera FLEX Design systems - Logic Synthesis - Half gate ASIC -Schematic entry - Low level design language - PLA tools - EDIF- CFI design representation. **Synthesis and Simulation:** Verilog and logic synthesis -VHDL and logic synthesis - types of simulation -boundary scan test - fault simulation - automatic test pattern generation. **Data Logic Cells:** Data Path Elements, Adders, Multiplier, Arithmetic Operator, I/O cell, Cell Compilers. **System partition:** FPGA partitioning -partitioning methods - floor planning - placement - physical design flow - global routing - detailed routing - special routing - circuit extraction - DRC.

TEXT BOOK

1.M.J.S .Smith, " Application - Specific Integrated Circuits" - Addison -Wesley Longman

REFERENCES BOOKS

1.S.D. Brown, R.J. Francis, J. Rox, Z.G. Uranesic, " Field Programmable Gate Arrays " -Kluever Academic Publishers, 1992.

2.Mohammed Ismail and Terri Fiez, " Analog VLSI Signal and Information Processing ", Mc Graw Hill, 1994.

3.S. Y. Kung, H. J. Whilo House, T. Kailath, " VLSI and Modern Signal Processing ", Prentice Hall, 1985.

DESIGN FOR TESTABILITY

Course Code: 13EC364 **L –T – P: 3-0-0**

Prerequisite: 13EC206 / 13EC312 **Credits: 3**

Basic Concepts: Need for testing, Reliability concepts, Reliability and failure rate, Relation between reliability and MTBF, Maintainability, Availability, series and parallel systems, Failure and faults, Modeling of faults, Temporary faults **Fault Diagnosis and Test Generation:** Fault diagnosis and testing, Test generation for combinational logic circuits: Fault table method, Path sensitization, Boolean difference, D-Algorithm, PODEM, Kohavi algorithm, Detection of multiple faults in combinational logic circuits, Test generation for sequential logic circuits, Random testing, Transition continuous testing, Signature analysis **PLA Testing:** Faults in PLA, PLA minimization, EPC Theorems, PLA folding, Foldable compatibility matrix, the Compact algorithm, the maximum folding. **Fault Tolerant Design:** Importance of fault tolerance, Basic concepts of fault tolerance, Static redundancy, Dynamic redundancy, Hybrid redundancy, Self purging redundancy, Sift-out reconfiguration scheme, 5MR reconfigurable scheme, Time redundancy, Software redundancy, Fail-Safe Operation, A Scheme for fault tolerant Design of VLSI chips, Fault tolerant VLSI processor arrays **Design for Testability:** Controllability and Observability, Design of testable combinational circuits, Design of testable sequential circuits: Scan path technique, LSSD, RAS technique; Built in self test: BIST concepts, TPG for BIST, BIST architectures-CSBL, BEST, RTS, LOCST, STUMPS, CBIST,CEBS, RTD, SST, CATS, CSTP, BILBO.

TEXT BOOKS

1.P.K. Lala, "Digital Circuit Testing and Testability", Academic Press.

2.N.N.Biswas, "Logic Design Theory", Prentice-Hall.

REFERENCES

1.M. Abramovici, M.A. Breuer and A.D. Friedman, "Digital Systems and Testable Design", Jaico Publishing House.

2.M.L. Bushnell and V.D. Agrawal, "Essentials of Electronic Testing For Digital, Memory And Mixed-Signal VLSI Circuits", Kluwer Academic Publishers.
3.A.L Crouch, "Design Test For Digital Ics And Embedded Core Systems", Prentice-Hall International.

MIXED SIGNAL CIRCUITS & SYSTEMS

Course Code: 13EC465 **L –T – P: 3-0-0**
Prerequisite: 13EC206 / 13EC312 **Credits: 3**

Data Converter Fundamentals: Analog versus Digital Discrete Time Signals, Converting Analog Signals to Data Signals, Sample and Hold Characteristics, DAC Specifications, ADC Specifications, Mixed-Signal Layout Issues**. Analog To Digital Conversion:** Performance Metrics of Analog-to-Digital Converters, Sampling, Band-pass Sampling Quantization, Types of Analog-to-Digital Converters, Sigma-Delta Analog-to-Digital Converters, **Data Converters Architectures:** DAC Architectures, Digital Input Code, Resistors String, R-2R Ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, Pipeline DAC, ADC Architectures, Flash, 2-Step Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC. **Data Converter SNR:** Improving SNR Using Averaging, Decimating Filters for ADCs, Interpolating Filters for DAC, B and pass and High pass Sync filters, **Amplifier Design For Wireless Communication Systems:** Amplifier Design, Low Noise Amplifier, Automatic Gain Control Amplifiers, Power amplifiers, **PLL:** Operation of the Phase Locked Loop, Phase Detectors, Frequency Dividers, Oscillator Design, **Frequency Synthesizers:** Frequency synthesizer parameters, Frequency Synthesizer Techniques, Analyzing phase noise in frequency synthesizers.

TEXT BOOKS

1. R. Jacob Baker, "CMOS mixed signal circuit design" IEEE series on microelectronic systems, Wiley publications.
2. Emad N. Farag and Mohamed I. Elmasry, "Mixed signal VLSI Wireless Design Circuits and Systems", Kluwer academic Publishers.

REFERENCE BOOKS

1.Yichuang Sun**,** "Test and Diagnosis of Analogue, Mixed-signal and RF Integrated Circuits", Published by The Institution of Engineering and Technology, London, United Kingdom.
2. Walt Kester**,** "Mixed-Signal and DSP Design Techniques", Analog Devices, Inc
3.R. Best, "Phase-Locked Loops Design, Simulation,& Applications," 6th Edition, McGraw-Hill
4.Edgar Sánchez-Sinencio ,"Low-Voltage/Low-Power Integrated Circuits and Systems: Low-Voltage Mixed-Signal Circuits", Wiley Publications
5.Yichuang Sun,"**T**est and Diagnosis of Analogue, Mixed-Signal and RF Integrated Circuits: The System on Chip Approach", IET
6Marc Tiebout ,"Low Power VCO Design in CMOS" , Springer
7.H R Rategh, T H Lee, "Frequency Synthesizer Design for 5GHz wireless LAN Systems", Kluwer Academic Publishers

SPECIALIZATION STREAM - SIGNAL PROCESSING

ARRAY SIGNAL PROCESSING

Course Code : 13EC470 L – T – P: 3-0-0
Pre-requisite : 13ES205 Credits: 3

Spatial Signals, Signals in space and time. Spatial frequency, Direction vs. frequency. Wave fields. Far field and Near field signals. **Sensor Arrays**, Spatial sampling, Nyquist criterion. Sensor arrays. Uniform linear arrays, planar and random arrays. Array transfer (steering) vector. Array steering vector for ULA. Broadband arrays. **Spatial Frequency,** Aliasing in spatial frequency domain. Spatial Frequency Transform, Spatial spectrum. Spatial Domain Filtering. Beam Forming. Spatially white signal. **Direction Of Arrival Estimation**, Non parametric methods - Beam forming and Capon methods. Resolution of Beam forming method. Subspace methods - MUSIC, Minimum Norm and ESPRIT techniques. Spatial Smoothing.

TEXT BOOKS

1. Dan E. Dugeon and Don H. Johnson.," Array Signal Processing: Concepts and Techniques. Prentice Hall.
2. Petre Stoica and Randolph L. Moses. "Spectral Analysis of Signals. Prentice Hall.

MODERN DIGITAL SIGNAL PROCESSING

Course Code	: 13EC371	L – T – P: 3-0--0
Pre-requisite	: 13ES205	Credits : 3

Multirate Digital Signal Processing: Decimation by an factor D- Interpolation by a Factor I - Sampling Rate Conversion by a Rational Factor I/D Filter Design and Implementation for sampling rate Conversion: Direct form FIR filter structures – Poly-phase filter structures - Time Variant filter structure, Multistage Implementation of Sampling Rate Conversion. **Non Parametric Power Spectrum Estimations:** Spectral Analysis of deterministic Signals, Estimation of the Autocorrelation of Stationary Random Signals, Estimation of the Power Spectrum of Stationary Random Signals, Joint signal analysis. **Parametric Method of Power Spectrum Estimation:** Parametric Methods for power spectrum estimation, Relationship between Auto-Correlation and Model Parameters, AR (Auto-Regressive) Process and Linear Prediction, Yule-Walker, Burg and Unconstrained Least Squares Methods, Sequential Estimation, Moving Average (MA) and ARMA Models, Minimum variance spectral estimation, Pisarenko Harmonic Decomposition Methods, MUSIC algorithm, ESPIRIT algorithm. **DFT Filter Banks and Trans-multipliers**: Maximally decimated DFT Filter Banks, Two channel perfect reconstruction conditions, Lattice implementation of orthonormal filter banks, trans-multiplexer **Applications:** Design of phase shifters – interfacing of Digital Systems with different sampling rates- Narrow band low pass filters – Digital filter banks – Spectrum estimation, Sub band coding of speech signal/Sensor application.

TEXT BOOKS

1 Roberto cristi, "Modern Digital Signal Processing ", Thomson Learning
2.Proakis JG and Manolakis DG, "Digital Signal Processing Principles, Algorithms and Application", Pearson Education.
3.Dimitris G Manolakis, Vinak K Ingle and Stephen M Kogan, "Statistical and adoptive signal processing " Artech House, London

REFERENCE BOOKS

1.Openheim AV & Schafer RW, "Discrete Time Signal Processing", Pearson Education, Asia.
2.Raghuveer M. Rao, Ajit S Bopardikar," Wavelet Transform, Introduction to Theory and Applications", Pearson Education, Asia
3.Orfanadis S, "Introduction to Digital Signal Processing", Pearson Education,
4.Sanjit K.Mitra , "DSP computer Based Approach " 2nd Edition, MC Graw Hill
5.Hams Georg stark "Wavelet & Signal Processing", Springer, 2005.

SIMULATION TEXT BOOKS

1.Samuel D Steams, "Digital Signal Processing with examples in Matlab", CRC Press, 2000.
2.ES Gopi. "Algorithm collections for Digital Signal Processing Applications using Matlab ", Springer, 2007.
3.Taan S. Elali, "Discrete Systems and Digital Signal Processing with Matlab", CRC Press,2005.

DIGITAL IMAGE PROCESSING

Course Code	: 13EC372	L – T – P: 3-0-0
Pre-requisite	: 13ES205	Credits: 3

Introduction: Origin of Digital Image Processing, Fields that uses Digital Image Processing, Fundamental steps in Digital Image Processing, Components of an Image Processing System. Digital Image Fundamentls: Elements of Visual perception, Image sampling and Quantization, Basic relationships between Pixels, Linear and Non-linear operations. **Digital Image Transforms:** Image Transforms – The Discrete Fourier Transform, Walsh, Hadamard, Discrete Cosine Transform, Haar Transform, the Slant Transform, **Image Enhancement in Spatial Domain:** Some basic Grey level transformations, histogram processing, enhancement using Arithmetic/Logic operations, Smoothing Spatial Filters, Sharpening Spatial Filters. **Image Enhancement in Frequency Domain:** Introduction to Fourier Transform and the Frequency Domain, Smoothing Frequency Domain Filters, Sharpening Frequency Domain Filters. **Image Restoration:** Noise models, Restoration in the presence of Noise, only Spatial Filtering, Periodic Noise reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Inverse Filtering, Wiener Filtering. **Image Compression:** Fundamentals – Image Compression models – Error Free Compression, Lossy Compression. **Image Segmentation:** Detection of discontinuities, Thresholding, Edge based Segmentation and Region based Segmentation. **Image Representations and Description:** Representation schemes, Boundary Descriptors, Regional Descriptors.

TEXT BOOKS

1.Rafael C Gonzalez, Richard E Woods," Digital Image Processing", Second Edition, Pearson Education Asia, 2002. (Chapter 3)

2.Gonzalez. R & Woods B.E.," Digital Image Processing", Addison Wesley Longman Pearson Education, 2000. (Chapter 1, 2, 4, 5, 6, 7, 8, 9)

REFERENCE BOOKS

1.Milan Sonka, Vaclav Hlavac and Roger Boyle, Image Processing Analysis and Machine Vision, Thomson learning, Second Edition, 2001.

2.William J Prati, "Digital Image Processing", John Wiley & sons

3. Alasdair McAndrew, " Introduction to Digital Image Processing" CENGAGE Learing.

MULTI-RATE SIGNAL PROCESSING

Course Code	: 13EC373	L – T – P: 3--0--0
Pre-requisite	: 13ES205	Credits: 3

Fundamentals Of Multirate Theory: The sampling theorem - sampling at subnyquist rate - Basic Formulations and schemes. Basic Multirate operations- Decimation and Interpolation - Digital Filter Banks- DFT Filter Bank- Identities- Polyphase representation **Maximally Decimated Filter Banks**: Polyphase representation - Errors in the QMF bank- Perfect reconstruction (PR) QMF Bank - Design of an alias free QMF Bank **M-Channel Perfect Reconstruction Filter Banks**: Uniform band and non uniform filter bank - tree structured filter bank- Errors created by filter bank system- Polyphase representation- perfect reconstruction systems **Perfect Reconstruction (Pr) Filter Banks:** Paraunitary PR Filter Banks- Filter Bank Properties induced by paraunitarity- Two channel FIR paraunitary QMF Bank- Linear phase PR Filter banks- Necessary conditions for Linear phase property- Quantization Effects: -Types of quantization effects in filter banks. - coefficient sensitivity effects, dynamic range and scaling. **Cosine Modulated Filter Banks:** Cosine Modulated pseudo QMF Bank- Alias cancellation phase - Phase distortion- Closed form expression- Polyphase structure- PR Systems

TEXT BOOKS

1. P.P. Vaidyanathan. Multirate systems and filter banks. Prentice Hall. PTR.

2. N.J. Fliege. Multirate digital signal processing . John Wiley 1994.

REFERENCES

1.Sanjit K. Mitra. Digital Signal Processing: A computer based approach. McGraw Hill. 1998.

2.R.E. Crochiere. L. R. "Multirate Digital Signal Processing", Prentice Hall.

3J.G. Proakis. D.G. Manolakis, "Digital Signal Processing: Principles. Algorithms and Applications" , 3rd Edn. Prentice Hall India, 1999

SPEECH PROCESSING

Course Code : 13EC474 L – T – P: 3-0-0

Pre-requisite : 13ES205 Credits: 3

Speech Fundamentals: Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – acoustics of speech production; Review of Digital Signal Processing concepts. **Digital models for the speech signal** - Lossless tube models - digital models - linear predictive coding of speech - auto correlation - formulation of LPC equation - solution of LPC equations - Levinson Durbin algorithm - Levinson recursion - Schur algorithm -lattice formulations and solutions - PARCOR coefficients. **Spectral analysis of speech -** short time fourier analysis - filter bank design - speech coding – subband coding of speech - transform coding - channel vocoder - formant vocoder - cepstral vocoder – vector quantizer coder. **Speech synthesis** - pitch extraction algorithms - Gold Rabiner pitch trackers - autocorrelation pitch trackers - voice/unvoiced detection - homomorphic speech processing - homomorphic systems for convolution - complex cepstrums - pitch extraction using homomorphic speech processing. **Automatic speech recognition systems** - isolated word recognition - connected word recognition – large vocabulary word recognition systems - pattern classification - DTW, HMM - speaker recognition systems - speaker verification systems - speaker identification systems.

TEXT BOOKS

1. Rabiner L.R. & Schafer R.W., "Digital Processing of Speech Signals", Prentice Hall Inc.
2. Thomas Parsons, "Voice and Speech Processing", McGraw Hill Series .
3. Saito S. & Nakata K., "Fundamentals of Speech Signal Processing", Academic Press, Inc.

REFERENCE BOOKS

1.Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing", California Technical Publishing.

2.Thomas F Quatieri, "Discrete-Time Speech Signal Processing – Principles and Practice", Pearson Education.

3.Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", John Wiley and Sons.

4.Ben gold and Nelson Morgan, "Speech and audio signal processing", processing and perception of speech and music, Wiley- India Edition, 2006 Edition.

5.Frederick Jelinek, "Statistical Methods of Speech Recognition", MIT Press.

6. Owens F.J., "Signal Processing of Speech", Macmillan New Electronics

7. Papamichalis P.E., "Practical Approaches to Speech Coding", Texas Instruments, Prentice Hall .

8**.** Rabiner L.R. & Gold, "Theory and Applications of Digital Signal Processing", Prentice Hall of India.

EMBEDDED SYSTEMS – STREAM

REAL TIME OPERATING SYSTEMS

Course Code: 11EM330 L –T – P: 3-0-0

Prerequisite: 13CS203 Credits: 3

Review of Operating Systems: Basic Principles, Operating System structures, System Calls, Files, Processes, Design and Implementation of processes, Communication between processes, Introduction to Distributed operating system, distributed scheduling. **Overview of RTOS:** RTOS Task and Task state, Process Synchronisation- Message queues, Mail boxes, pipes, Critical section, Semaphores, Classical synchronisation problem, Deadlocks **REAL TIME MODELS AND LANGUAGES:** Event Based – Process Based and Graph based Models, Real Time Languages, RTOS Tasks, RT scheduling, Interrupt processing, Synchronization, Control Blocks, Memory Requirements. **REAL TIME KERNEL:** Principles, Design issues, Polled Loop Systems, RTOS Porting to a Target, Comparison and study of various RTOS like QNX, VX works, PSOS, C Executive- Case studies. **RTOS APPLICATION DOMAINS:** RTOS for Image Processing, Embedded RTOS for voice over IP, RTOS for fault Tolerant Applications, RTOS for Control Systems.

REFERENCES:

1. Raj Kamal, "Embedded Systems- Architecture, Programming and Design" Tata McGraw Hill, 2006.
2. Herma K., "Real Time Systems – Design for distributed Embedded Applications", Kluwer Academic, 1997.
3. Charles Crowley, "Operating Systems-A Design Oriented approach" McGraw Hill 1997.
4. Krishna.C.M, Kang, Shin.G, "Real Time Systems", McGraw Hill, 1997.
5. Raymond J.A.Bhur, Donald L.Bailey, "An Introduction to Real Time Systems", PHI 1999.
6. Mukesh Sighal and Shi.N.G "Advanced Concepts in Operating System", McGraw Hill 2000.

PCB DESIGN

Course Code	: 13EM 332	L – T – P: 3-0-0
Pre-requisite	: NIL	Credits: 3

ELECTRONICS COMPONENTS & MOUNTING: Active and passive components – resistor, capacitor, inductor, semiconductor diode, LED, zener diode, Bipolar junction transistor, IC's, SMD, connectors use of multimedia & CRO. Preparation & mounting of components – lead cutting. **BASIC OF PCB & SOLDERING TECHNIQUES:** Introduction – Classification of PCB – single, double, multilayer and flexible boards – copper clad laminates materials of copper clad laminates – manufacturing process – properties of laminates (electrical & physical) - types of laminates. Hand soldering Tools Solder alloys – soldering flexes – soldering techniques – Iron soldering – mass soldering, DIP soldering – wave soldering – solder mask. **SCHEMATIC & LAYOUT DESIGN:** Schematic diagram – Net list – Design rule check – creating components for library – Imperial – metric Tracks – Pads – Vias – Clearances – Rats nest – silk screen – selection of board size – power plane – grounding. **DESIGN OF PCB'S:** Single sided PCB – Double sided PCB – Multilayer PCB – Auto routing – manual routing – Design rule check – creating of foot print for library creating Gerber file. **PCB FABRICATION:** Film master preparation - Image transfer - photo printing – Screen Printing – Plating techniques etching techniques – Mechanical Machining operations.

TEXT BOOKS

1. Printed Circuit Board – Design, Fabrication, Assembly & Testing by R.S.Khandpur,
TATA McGraw Hill Publisher
2. Printed circuit Board – Design & Technology by Walter C.Bosshard
3**.** ISTE Hand book on Printed Circuit Board Fabrication.

MICRO CONTROLLERS INTERFACING & SYSTEM DESIGN.

Course No	: 13EM 334	L – T – P: 3-0-0
Pre-requisite	: 11EC311	Credits: 3

OVERVIEW OF ARCHITECTURE AND MICROCONTROLLER RESOURCES: Architecture of microcontroller-Microcontroller resources-Resources in advanced and next generation microcontrollers-8051 microcontroller-Internal and External memories-Counters and Timers-Synchronous serial cum asynchronous serial communication-Interrupts.**8051 FAMILY MICROCONTROLLERS INSTRUCTION SET:** Basic assembly language programming-Data transfer instructions-Data and bit manipulation instructions-Arithmetic instructions-Instructions for logical operations on the bytes among the Registers, Internal RAM, and SFR's Program flow control instructions-Interrupt control flow. **SREAL TIME CONTROL: INTERRUPTS:** Interrupt handling structure of an MCU-Interrupt Latency and Interrupt deadline-Multiple sources of the interrupts - Non-maskable interrupt sources-Enabling of disabling of the sources-polling to determine the interrupt resources and assignment of the priorities among them-Interrupt structure in Intel 8051.TIMERS: Programmable Timers in MCU's-Free running counter and real time control-Interrupt interval and density constraints. **PIC MICROCONTROLLER:** Instruction, Architecture overview, memory organization Interrupts and reset, I/O ports, Timers. **SYSTEM DESIGN:** DIGITAL AND ANALOG INTERFACING METHODS: Switch, key and keyboard interfacing –LED and Array of LEDs-Keyboard-cum-Dislay controller (8279) - Alphanumeric Devices-Display Systems and its Interfaces. Interfacing with the Flash memory-Interfaces-Interfacing to High power Devices-Analog input Interfacing-Analog output Interfacing Optical motor Shaft Encoders- Industrial Control-Industrial process Control System-prototype MCU based Measuring Instruments-Robotics and embedded control.

TEXT BOOKS

1. D.V.Hall "Microprocessor and Interfacing", 2nd Edition Tata McGraw Hill Publishing Company, 2006.
2. A.K. Ray & K. M Bhurchandi, "Advanced Microprocessors & peripherals", Tata Mc Graw Hill Publishing Company 2002.
3. Rajkamal, "Microcontrollers - Architecture, Programming, Interfacing & System Design", 2nd edition, Pearson Education.
4. Mazidi & Mc Kinley "The 8051 Micro controller and Embedded systems: using assembles and C, 2nd edition.

ADVANCED EMBEDDED PROCESSOR ARCHITECTURES.

Course Code	: 13EM430	L – T – P: 3-0-0
Pre-requisite	: 13EC311	Credits: 3

ARM Processor as System-on-Chip: Acorn RISC Machine – Architecture inheritance – ARM programming model – ARM development tools – 3 and 5 stage pipeline ARM organization – ARM instruction execution and implementation – ARM Co-processor interface. **ARM Assembly Language Programming:** ARM instruction types – data transfer, data processing and control flow instructions – ARM instruction set – Co-processor instructions, Thumb Instruction set. **Architectural Support for System Development:** Advanced Microcontroller bus architecture – ARM memory interface – ARM reference peripheral specification – Hardware system prototyping tools – ARMulator – Debug architecture. **ARM Processor Cores:** ARM7TDMI, ARM8, ARM9TDMI, ARM10TDMI, The AMULET Asynchronous ARM Processors-AMULET1. **Embedded ARM Applications:** The VLSI Ruby II Advanced Communication Processor, The VLSI ISDN Subscriber Processor, The OneC™ VWS22100 GSM chip, The Ericssion-VLSI Bluetooth Baseband Controller, The ARM7500 and ARM7500FE

TEXT BOOKS (MAXIMUM 2)

1. ARM System on Chip Architecture – Steve Furber – 2nd ed., 2000,Addison Wesley Professional.
2. Design of System on a Chip: Devices and Components – Ricardo Reis, 1st ed., 2004, Springer

REFERENCE BOOKS

1. Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology) – Jason Andrews – Newnes, BK and CDROM

2. System on Chip Verification – Methodologies and Techniques –Prakash Rashinkar, Peter Paterson and Leena Singh L, 2001,Kluwer Academic Publishers.

HARDWARE SOFTWARE CO -DESIGN

Course Code	: 11 EM 432	L – T – P: 3-0-0
Pre-requisite	: 11 EC 311	Credits: 3

Co- Design Issues: Co- Design Models, Architectures, Languages, A Generic Co-design Methodology. **Co- Synthesis Algorithms:** Hardware software synthesis algorithms: hardware – software partitioning distributed system co-synthesis. **Prototyping and Emulation:** Prototyping and emulation techniques, prototyping and emulation environments, future developments in emulation and prototyping. **Target Architectures:** Architecture Specialization techniques, System Communication infrastructure, Target Architecture and Application System classes, Architecture for control dominated systems (8051-Architectures for High performance control), Architecture for Data dominated systems (ADSP21060, TMS320C60), Mixed Systems. **Compilation Techniques and Tools for Embedded Processor Architectures:**

Modern embedded architectures, embedded software development needs, compilation technologies practical consideration in a compiler development environment. **Design Specification and Verification:** Design, co-design, the co-design computational model, concurrency coordinating concurrent computations, interfacing components, design verification, implementation verification, verification tools, interface verification **Languages for System – Level Specification and Design-I** System – level specification, design representation for system level synthesis, system level specification languages. **Languages for System – Level Specification and Design-II** Heterogeneous specifications and multi-language co-simulation the cosyma system and lycos system.

TEXT BOOKS:

1. Hardware / software co- design Principles and Practice – Jorgen Staunstrup, Wayne Wolf – 2009, Springer.
2. Hardware / software co- design Principles and Practice, 2002, kluwer academic publishers

EMBEDDED NETWORKING

Course Code	: 13EM 336	L – T – P: 3-0-0
Pre-requisite	: 11EC311	Credits: 3

EMBEDDED COMMUNICATION PROTOCOLS: Embedded Networking: Introduction – Serial/Parallel Communication – Serial communication protocols -RS232 standard – RS485 – Synchronous Serial Protocols -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) – PC Parallel port programming -ISA/PCI Bus protocols – Firewire. **USB AND CAN BUS**: USB bus – Introduction – Speed Identification on the bus – USB States – USB bus communication: Packets – Data flow types –Enumeration –Descriptors –PIC 18 Microcontroller USB Interface – C Programs – CAN Bus – Introduction - Frames –Bit stuffing –Types of errors –Nominal Bit Timing – PIC microcontroller CAN Interface –A simple application with CAN. **ETHERNET BASICS:** Elements of a network – Inside Ethernet – Building a Network: Hardware options – Cables, Connections and network speed – Design choices: Selecting components –Ethernet Controllers – Using the internet in local and internet communications – Inside the Internet protocol. **EMBEDDED ETHERNET**: Exchanging messages using UDP and TCP – Serving web pages with Dynamic Data – Serving web pages that respond to user Input – Email for Embedded Systems – Using FTP – Keeping Devices and Network secure. **WIRELESS EMBEDDED NETWORKING**: Wireless sensor networks – Introduction – Applications – Network Topology – Localization –Time Synchronization - Energy efficient MAC protocols –SMAC – Energy efficient and robust routing – Data Centric routing

TEXT BOOKS

1. Frank Vahid, Givargis 'Embedded Systems Design: A Unified Hardware/Software Introduction', Wiley Publications
2. Jan Axelson, 'Parallel Port Complete', Penram publications
3. Dogan Ibrahim, 'Advanced PIC microcontroller projects in C', Elsevier 2008
4. Jan Axelson 'Embedded Ethernet and Internet Complete', Penram publications
5. Bhaskar Krishnamachari, 'Networking wireless sensors', Cambridge press 2005

WEB TECHNOLOGIES - STREAM
WEB PROGRAMMING

Course Code	: 13EM 331	L – T – P: 3-0-0
Pre-requisite	: 11EM301	Credits: 3

Introduction to HTML, Working with Text, Creating Tables and Working with Frames, **Cascading Style Sheets**: Working with Style Sheets. **Java Script**: Introduction, Simple program, obtaining user input with prompt dialogs, memory concepts, arithmetic, decision making, assignment operators, control structures – IF, IF…ELSE, WHILE, , FOR repetition statement, SWITCH multiple-selection statement, DO…WHILE repetition statement, logical operators. Java Script: Program modules in javascript, function definitions, scope rules, global functions, recursion, arrays, references and reference parameters, passing arrays to functions, sorting arrays, searching arrays, multi-dimensional arrays, math object, string object, date object, Boolean and number object, document object, window object, using cookies, using JSON to represent objects. **Document Object Model**: Introduction, Modeling a document, DOM Nodes and Trees, Traversing and modifying a DOM tree, DOM Collections, dynamic styles, summary of DOM objects and Collections, registering event handlers, onload, onmousemove, the event object, this, onmouseover, onmouseout, onfocus, onblur, onsubmit, onreset, event bubbling, more events. **PHP:** Introduction, PHP basics, string processing and regular expressions, form processing and business logic, connecting to database, using cookies, dynamic content, operator precedence. **Web Servers**: Microsoft Internet Information Services, Apatche Web Server, Active Server Pages.

Textbooks

1. Internet and World Wide Web: How to Program, Deitel and Deitel, 4th Edition, Prentice Hall, 2009.
2. HTML Black Book ,Steven Holzner ,Dream tech publications (2000).

Reference Books

1. N.P Gopalan, J.Akilandeswari Web Technology – A Developer's Perspective, PHI (2008).
2. Web Technologies –Uttam K Roy, Oxford Higher Education.
3. Chris Bates, Web Programming – Building Internet Applications Addison Wesley (2006).

VISUAL PROGRAMMING

Course Code	: 13EM 333	L – T – P: 3-0-0
Pre-requisite	: 11EM301	Credits: 3

The Philosophy of .NET Understanding the previous states affair, The .NET Solution, The building Block of the .NET platform (CLR,CTS,CLS), the role of the .NET base class libraries, what C# brings to the table, additional .NET – Aware programming Languages, An overview of .NET binaries (aka assemblies), The role of the common intermediate language, Compiling CIL to platform specific instruction, Understanding the common type system, Intrinsic CTS data types, Understanding the common languages specification, Understanding the common languages runtime, A tour of the .NET namespace, increasing your namespace nomenclature, Deploying the .NET runtime. **Building C# Applications** The role of the command line compiler (CSC.exe), Building C# application using csc.exe, Working with csc.exe response file, generating bug reports, Remaining C# compiler option, The command line debugger, using the visual studio. Net IDE, Other key aspects of the VS.Net IDE, Documenting your source code via XML, C# preprocessor directives, An interesting Aside: The System. Environment class, Building .Net application with other IDEs. **C# Language Fundamentals** : An Anatomy of a basic C# class, Creating objects: Constructor basic, the composition of a C# application, Default Assignment and variable scope, The C# member initialization syntax, Basic input and output with the console class, Understanding value types and reference types, The master node: System. Objects, The system Data type (And C# aliases), Converting between value type and reference type: Boxing and Unboxing, Defining program constraints, C# Iterations constructs, C# control flow constructs, The complete set C# operator, Defining Custom class methods, Understanding static methods, Method parameter modifiers, Array manipulation in C#, String manipulation in C#, C# Enumerations, Defining structures in C#, Defining custom namespaces. **Object Oriented Programming** with C# Formal definition of the C# class, Definition the "Default public interface" of a type, Recapping the pillars of OOP, The first pillar: C# Encapsulation services, Pseudo Encapsulation: Creating read only field, The second pillar: C#'s Inheritance supports keepingfamily secrets: The "Protected" keyword, The Nested type definitions, The third pillar: C#'s Polymorphic support casting between types, Generating class definitions using Visual Studio. Net. Exceptions and Objects Life Time Ode to errors, Bugs and exceptions, The role of .NET exceptions handling, The system. Exception base class throwing a generic exception catching exception, CLR system level exception (System. system exception),Custom application level exception (System. application exception), Handling multiple exception, The finally block, The last chance exception, dynamically identify application and system level exception, Debugging system exception using VS.Net, Understanding Object life time, The CIT of new, The basic of garbage collection, Finalizing a type, Finalization process, building and Ad hoc destruction method, garbage collection optimization, The system .GC type. **Interfaces and Collections** Defining interfaces using C#, Invoking interface member at the object level, Exercising the shape hierarchy, Understanding explicit interface implementation, Interfaces as Polymorphic agents, Building interface hierarchies, Implementing interface using VS.Net, Understanding the Iconvertible interface, Building a custom enumerator (I Enumerable and Ienumerator), Building cloneable objects (Icloneable), Building comparable objects (I Comparable), Exploring the system the collection namespace, Building a custom container (Retrofitting the carstype). **Understanding .Net Assembles Problems with classic COM Binaries**, An overview of .Net assembly, Building a simple file test assembly, A C# Client Application, A Visual Basic .Net Client application, Cross Language Inheritance, Exploring the Carlibrary's manifest, Exploring the Carlibrary's Types, Building the multi file assembly, Using the multi file assembly, Understanding private assemblies, Probing for private assemblies (The Basics), Private assemblies and XML Configuration files, Probing for private assemblies (The Details),Understanding Shared assembly, Understanding Shared Names, Building a Shared assembly, Understanding delay Signing, Installing/Removing shared assemblies, Using a Shared assembly.

Text Book:

1. Andrew Troelsen C# and The .Net platform, , Second edition,2003, Dream TECH Press,India.
2. Tom Archer Inside C#, , 2001,WP Publishers.

Reference Books

1. Joe duffy, Professional .NET Framework 2.0, Worx Publications, Willey India Edition, 2006 Edition
2. David S Platt, Introducing Microsoft .NET, Prentice Hall of India, Eastern Economy edition, 2nd Edition
3. Matthew Reynolds, Karli Watson, Bill Forgey, Brian Patterson, .NET

WEB MIDDLEWARE AND WEB SERVICES

Course Code : 13EM 335 L – T – P: 3-0-0
Pre-requisite : 11EM301 Credits: 3

Distributed Information systems – design, architecture and communication, Middleware – understanding middleware, RPC and related middleware, TP monitors, object brokers, message-oriented middleware. Enterprise Application Integration (EAI) – from middleware to application integration, EAI middleware **Workflow management systems**, Web technologies – exchanging information over the internet, web technologies for supporting remote clients, application servers and application integration. Web services and their approach to distributed computing, Web services technologies and web services architecture **Basic web services technology,** minimalistic infrastructure. SOAP, WSDL, UDDI, web services at work, interactions between specifications, related standards. Service coordination protocols, introduction, infrastructure for coordination protocols. **WS-coordination,** WS-transaction, RosettaNet, other standards, Service composition – basics, a new chance of success, service composition models, dependencies between coordination and composition. **BPEL, Outlook** – state of the art in web services, applicability of web services, web services as a problem and solution. Case studies - Web services: industry adoption, case studies: context setting, a proposed solution.

Textbooks

1. Web Services: Concepts, Architectures and Applications (Data-Centric Systems and Applications) – Gustavo Alonso, Fabio Casati, Harumi kuno and Vijay Machiraju, Springer pub, 2003
2. Web Services, An introduction, B.V. Kumar and S.V Subrahmanya, Tata Mcgraw Hill, 2004

References

1. Web Services Essentials Distributed Applications with XML-RPC, SOAP, UDDI & WSDL by Ethan Cerami, O'Reilly , First Edition, February 2002.
2. Programming Web Services with SOAP by James Snell, O'Reilly First Edition Dec 2001.
3. Web Services Theory & Practice by Anura Guruge, Digital Press, 2004.
4. Executive's Guide to Web Services by Eric A. Marks & Mark. J. Werrell, John Wiley & Sons, 2003.

ENTERPRISE PROGRAMMING

Course Code : 13EM431 L – T – P: 3-0-0
Pre-requisite : 11EM301 Credits: 3

Java EE Essentials, J2EE Multi-Tier Architecture, Advanced JSP topics, Java Server Faces, Working with Databases, Advanced topics in JDBC. EJB Fundamentals and Session Beans, EJB Entity Beans, Message Driven Beans, EJB Relationships, EJB QL, and JDBC. Design Patterns and EJB. J2EE Design patterns and Frameworks: Pattern Catalog- Handle-Forward pattern, Translator pattern, Distributor pattern, Broadcaster pattern, Zero sum pattern, Status Flag Pattern, Sequencer pattern, Behavior Separation pattern, Consolidator pattern, Simplicity pattern, Stealth Pattern. Web Services and JAX-WS. Java Mail API, Java Interface Definition Language and CORBA, Java Remote Method Invocation, Java Messaging Service, Java Naming and Directory Interface API.

TEXTBOOKS:

1. Kevin Mukhar, James L. Weaver, Jim Crume, Chris Zelenak, "Beginning Java EE 5 from Novice to Professional", Apress, 2005 Edition.
2. James Keogh, "J2EE: The Complete Reference", McGraw-hill Osborne Media: 1st Edition, 2002.

REFERENCES:

1. Jan Graba, "An Introduction to Network Programming with Java", Springer, 2nd edition, 2006.

2. Antonio Goncalves, “Beginning Java EE 6 Platform with GlassFish 3”, Apress, 2009.
3. Mark D Hansen, “SOA Using Java web services”, Pearson, 2007.
4. Dreamtech Software Team, “Java Server Programming J2EE: Black Book”, Wiley, 2007.

SEMANTIC WEB

Course Code : 13EM 433 L – T – P: 3-0-0
Pre-requisite : 11EM301 Credits: 3

INTRODUCTION Components – Types – Ontological Commitments – Ontological Categories – Philosophical Background -Sample - Knowledge Representation Ontologies – Top Level Ontologies – Linguistic Ontologies – Domain Ontologies – Semantic Web – Need – Foundation – Layers – Architecture. **LANGUAGES FOR SEMANTIC WEB AND ONTOLOGIES** Web Documents in XML – RDF - Schema – Web Resource Description using RDF- RDF Properties – Topic Maps and RDF – Overview – Syntax Structure – Semantics – Pragmatics - Traditional Ontology Languages – LOOM- OKBC – OCML - Flogic Ontology Markup Languages – SHOE – OIL - DAML + OIL- OWL **ONTOLOGY LEARNING FOR SEMANTIC WEB** Taxonomy for Ontology Learning – Layered Approach – Phases of Ontology Learning – Importing and Processing Ontologies and Documents – Ontology Learning Algorithms - Evaluation **ONTOLOGY MANAGEMENT AND TOOLS**
Overview – need for management – development process – target ontology – ontology mapping – skills management system – ontological class – constraints – issues. Evolution – Development of Tools and Tool Suites – Ontology Merge Tools – Ontology based Annotation Tools. **APPLICATIONS** Web Services – Semantic Web Services - Case Study for specific domain – Security issues – current trends.

TEXT BOOKS

1. Asuncion Gomez-Perez, Oscar Corcho, Mariano Fernandez-Lopez “Ontological Engineering: with examples from the areas of Knowledge Management, eCommerce and the Semantic Web” Springer, 2004.
2. Grigoris Antoniou, Frank van Harmelen, “A Semantic Web Primer (Cooperative Information Systems)”, The MIT Press, 2004.
3. Alexander Maedche, “Ontology Learning for the Semantic Web”, Springer; 1 edition, 2002

REFERENCES

1. John Davies, Dieter Fensel, Frank Van Harmelen, “Towards the Semantic Web: Ontology – Driven Knowledge Management”, John Wiley & Sons Ltd., 2003.
2. John Davies (Editor), Rudi Studer (Co-Editor), Paul Warren (Co-Editor) “Semantic Web Technologies: Trends and Research in Ontology-based Systems”Wiley Publications, Jul 2006
3. Dieter Fensel (Editor), Wolfgang Wahlster, Henry Lieberman, James Hendler, “Spinning the Semantic Web: Bringing the World Wide Web to Its Full Potential”, The MIT Press, 2002
4. Michael C. Daconta, Leo J. Obrst, Kevin T. Smith, “The Semantic Web: A Guide to the Future of XML, Web Services, and Knowledge Management”, Wiley, 2003

SMART GRID TECHNOLOGIES

Course Code : 13EE 330 L – T – P: 3-0-0
Pre-requisite : 11EE 203 Credits: 3

The smart grid: Introduction – Necessity of smart grid – Definition – Early smart grid initiatives – overview of the technologies required for the smart grid-Information and communication technologies, Sensing measurement, control and automation technologies, Power electronics and energy storage.

Data communication: Introduction – dedicated and shared communication channels – switching techniques – communication channels- layered architecture and protocols; **Communication technologies for the smart grid**: Introduction –communication technologies – standards for information exchange.

Information Security for the smart grid: Introduction – Encryption and Decryption: Symmetric Key encryption, Public key encryption - Authentication – Digital signature: Secret key signature, Public key signature, Message digest – cyber security standards.

Smart metering and demand side integration: Introduction – smart metering – smart meters – Communication infra structure and protocols for smart metering - Demand side integration**.**

Introduction to smart grid applications: Introduction – voltage and VAR control and optimization – fault detection, isolation and restoration (FDIR) – Demand response (DR) – Distributed energy resources (DERs) – wide area monitoring, control and protection (WAMCP)**.**

Text Books:

1. **"**Smart Grid: Technology and Applications" by Janaka Ekanayake , Kithsiri Liyanage , Jianzhong Wu , Nick Jenkins – John Wiley & sons Limited ; 2012 first Edition.
2. "Smart Grid: Applications, communication and security" by Lars T. Berger and Krzysztof Iniewski - John Wiley & sons Limited; 2012 first Edition.

Reference Books:

1. "Smart grid: Fundamental of Design and analysis" by James Momoh "John Wiley & sons Limited IEEE Press, 2012.

OPERATION OF RESTRUCTURED POWER SYSTEM

Course Code : 11EE334 L – T – P: 3-0-0

PRE-REQUISITE: 11EE205 CREDITS: 3

Need and conditions for deregulation. Introduction of Market structure, Market Architecture, Spot market, forward markets and settlements. Review of Concepts original cost of generation, least-cost operation, incremental cost of generation. Power System Operation: Old vs. New. **Electricity sector structures** and Ownership /management, the forms of Ownership and management. Different structure model like Monopoly model, Purchasing agency model, wholesale competition model, Retail competition model. **Pricing:** Framework and methods for the analysis of Bilateral and pool markets, LMP based markets, auction models and price formation, price based unit commitment, country practices. **Transmission network and market power**, Power wheeling transactions and marginal costing, transmission costing, Congestion management methods- market splitting, counter-trading; Effect of congestion on LMPs- country practices. **Ancillary Services and System Security in Deregulation**, Classifications and definitions, AS management in various markets- country practices. Technical, economic, & regulatory issues involved in the deregulation of the power industry.

Text Books:

1. K. Bhattacharya, M.H.J. Bollen and J.E. Daalder "Operation of restructured power systems", Kluwer's Power Electronics and Power Systems Series.
2. M. Shahidehpour, H. Yamin and Z. Li, "Market Operations in Electric Power Systems", John Wiley and Sons, March 2002.

Reference Books:

1. A.J.Wood and B.F.Wollenberg, "Power Generation Operation and Control", John Wiley and sons, New York, 1996.
2. Steven Stoft, "Power System Economics: Designing markets for electricity" IEEE Computer Society Press.
3. D Kirschen, G Strbac, "Fundamentals of Power System Economics", Wiley, 2004.

4. N. S. Rau, "Optimization principles: Practical Applications to the Operation and Markets of the Electric Power Industry"
5. Sally Hunt and Graham Shuttleworth, "Competition and Choice in Electricity"

DISTRIBUTION SYSTEM PLANNING AND AUTOMATION

COURSE NO : 11 - EE 338 L – T – P: 3-0-0
PRE-REQUISITE: 11 - EE 205 CREDITS: 3

Distribution System Planning and Load Characteristics: Planning and forecasting techniques, present and future role of computer, load forecasting definition, methods of forecasting, regression analysis, correlation analysis and time series analysis, load management, tariff and metering of energy. **Distribution Transformers, transmission line and Distribution Sub-Station:** Distribution Sub-Station, bus schemes, description and comparison of switching scheme, sub-station location and rating.Types of feeders, voltage levels, radial type feeders, 3-phase primary lines, copper loss, distribution feeder costs, loss reduction and voltage improvement in rural network. Capacitors in distribution systems and System protection: Effects of series and shunt capacitors, justification of capacitors, procedure to determine optimum capacitor size and location, basic definition and types of over current protection device, objective of distribution system protection. **Distribution system automation:** Reforms in power sector, methods of improvement, reconfiguration, reinforcement, automation, communication systems, sensors, automation systems architecture, software and open architecture, RTU and Data communication, SCADA requirement and application functions, GIS/GPS based mapping of distribution network, communication protocol for distribution systems, integrated substation, metering system, revenue improvement, issuing multi year tariff and availability based tariff.**Grounding System: Earth and safety, nature and size of earth electrodes, design of earthing schemes.**

Text Books:

1. Electrical Power Distribution Engineering by Turan Gonen, McGraw Hill.

Reference Books:

1. Electric Power Distribution by A S Pabla, TMH, 5th Ed., 2004.

POWER QUALITY

COURSE CODE : 11 – EE- 431 L – T – P: 3-0-0
PRE-REQUISITE: 11 – EE 303 CREDITS: 3

Introduction - Power or voltage quality, terms and definitions: short duration voltage variations, Interruptions – Voltage sag – Swell – Surges – Harmonics – Voltage fluctuations. Long duration voltage variations: Over voltage – Under voltage – Sustained interruptions, Transients: Impulse transients – Oscillatory transient, Power quality terms. **Long Interruptions** - Definition – Interruptions – Causes of long interruptions – Origin of interruptions – Limits for the interruptions frequency – Limits for the interruption duration. **Short Interruptions** - Definition, origin of short interruptions, basic principle, fuse saving, voltage magnitude events due to re-closing, voltage during the interruption, monitoring of short interruptions, difference between medium and low voltage systems. Multiple events, single phase tripping – voltage and current during fault period, voltage and current at post fault period, stochastic prediction of short interruptions. **Voltage sag analysis** - Voltage sag magnitude – Monitoring - Theoretical calculations – Examples - Sag magnitude in non-radial systems, Voltage calculation in meshed systems, Voltage sag duration, Fault clearing time – Magnitude duration plots- Measurement of sag duration, Magnitude and Phase angle jumps for three phase unbalanced sags – Phase to phase fault – Single phase faults – Two phase to ground faults – High impedance fault – Meshed systems. **Mitigation of**

Interruptions and Voltage Sags- Overview of mitigation methods – From fault to trip, Reducing the number of faults, Reducing the fault clearing time changing the power system, Installing mitigation equipment, Improving equipment immunity, Different events and mitigation methods. System equipment interface – Voltage source converter, series voltage controller with MATLAB, Shunt voltage controller with MATLAB, combined shunt and series controller with MATLAB simulation. Typical wiring and grounding problems.

Text Books:

1. Math H J Bollen, "Understanding Power Quality Problems: voltage sags and interruptions", Wiley-IEEE Press, 1999.
2. Roger C Dugan, Surya Santoso, Mark F. Mc Granaghan, H. Wayne Beaty, "Electrical power system squality", Third edition, 2012, TMH.

Reference Book:

1. Angelo Baggini, "Hand book of power quality", Wiley publications, 2008.
2. Power Quality in Power System and Electrical Machine by Edward F Fuchr, Mohammad A S Masoum, 1st Edition, Elsevier,2008

HVDC & FACTS

COURSE CODE: 11 – EE -435 **L – T – P: 3-0-0**
PRE-REQUISITE: 11 – EE -303 **CREDITS: 3**

General Considerations of AC And DC Systems: Introduction, Economic advantages of DC over AC transmission, types of DC links, technical advantages of DC over AC transmission, application of DC transmission system, Properties of converter circuits, different kinds of arrangements, choice of converter configuration, analysis of Graetz circuit. **Control of Converter And DC Link**: 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. **FACTS Concept and General System Considerations:** FACTS concepts, transmission inter connections, power flow in AC Systems. loading capability limits, dynamic stability considerations, Importance of controllable parameters, Basic types of FACTS controllers, benefits from FACTS controllers. **Static Shunt Compensators:** Objectives of shunt compensation, midpoint voltage regulation, voltage instability prevention, Improvement of transient stability, Power Oscillation damping, SVC & STATCOM. **Static Series Compensators:** Concept of series capacitive compensation, Improvement of transient stability, Power Oscillation damping, thyristor switched series capacitor (TSSC), thyristor controlled series capacitor (TCSC), Unified Power Flow Control (UPFC). **Harmonics And Filters:** Characteristic harmonics, calculation of AC Harmonics, Non-Characteristic harmonics, adverse effects of harmonics – Calculation of voltage & Current harmonics. Types of AC filters: Design of Single tuned filters.

Text Books:

1. K.R. Padiyar, "HVDC power transmissions systems: Technology and system interactions", New age International (P) Ltd., New Delhi, Eastern, Edition 2, 2011
2. N G Hingorani and L.Gyugyi, "Understanding FACTS devices", IEEE Press, 1999

Reference Books:

1. **HVDC Transmission, S.Kamakshiah, V.Kamaraju, Edition-1,Tata Mc Graw-**Hill Education, 2011
2. Song, Y.H and Johns, A.T, "Flexible A.C Transmission Systems (FACTS) IEEE Power Engineering Series 30, London, 1999

MACHINE MODELING AND ANALYSIS

COURSE CODE: 11 – EE 331 **L – T – P: 3-0-0**
PRE-REQUISITE: 13EE203 **CREDITS: 3**

Basic concepts of Modeling: Basic Two-pole Machine representation of Commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron's primitive Machine - voltage, current and Torque equations. **DC Machine Modeling:** Mathematical model of separately excited DC motor – Steady State analysis-Transient State analysis-Sudden application of Inertia Load-Torque equation - Mathematical model of DC Series motor, Shunt motor, Compound motor. Transfer function & Block diagram representation of Separately excited DC Machine State variable representation of separately excited dc machine. **Reference frame theory:** Linear transformation-Active transformation-Phase transformation - three phase to two phase transformation (abc to αβ0) and two phase to three phase transformation αβ0 to abc -Power equivalence. **Modeling of Three Phase Induction Machine:** Circuit model of a 3 phase Induction machine - Real time model of Two phase induction machine-Transformation to obtain constant matrices - Generalized model in arbitrary reference frame - stator reference frame model - rotor reference model - synchronously rotating reference model - Electromagnetic torque - derivation-State space model of Induction machine. **Modeling of Synchronous Machines:** Synchronous machine inductances – Circuit model of a 3ph Synchronous machine - Two axis representation of Synchronous machine. Voltage - current - Torque equation Synchronous machine.

Text Books:

1. R. Krishnan, "Electric Motor Drives - Modeling, Analysis & control", Pearson Publications, 1st edition, 2002.
2. P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff, "Analysis of Electrical Machinery and Drive systems", IEEE Press, Third Edition.

Reference Books:

1. P.S.Bimbhra, "Generalized Theory of Electrical Machines" Khanna publications, 5th edition.
2. Muhammed.H.Rashid, "Power Electronics- Circuits devices and applications" Pearson Publications, Third edition
3. Vedam Subrahmanyam "Thyristor Control of Electric Drives", Tata Mc Graw Hill .

ADVANCED POWER ELECTRONICS

COURSE CODE: 11 – EE 335 **L – T – P: 3-0-0**
PRE-REQUISITE: 11 – EE 303 **CREDITS: 3**

Advanced Power Semiconductor Devices: Power BJT, MOSFET, IGBT and GTO –construction, types, static and switching characteristics, steady state and dynamic models – Drivers, Thermal aspects, Snubber Circuit Design – ratings. **Advanced PWM Techniques:** SPM (Unipolar and Bipolar), Switch Utilization, Effect of blanking time, Third Harmonic Injected PWM, Selective Harmonic Elimination PWM, SVPWM. **Multilevel Inverters and Matrix Converters: Multilevel** concept – diode clamped – flying capacitor – cascade type multilevel inverters -Comparison of multilevel inverters - application of multilevel inverters. Matrix converters concept: Ac to Ac conversion with high quality input, output. **Resonant Pulse Inverters:** Resonant converter: Zero voltage, Zero current Switching advantages, series resonant inverter, Frequency response of Series Resonant Inverters, Parallel Resonant inverter, Voltage control Resonant Inverter Class E Resonant Inverter, Resonant DC-Link Inverter **Applications :**Industrial applications: fluorescent lighting, induction heating and electric welding. Domestic Applications: Space heating and Air

Conditioning, High frequency fluorescent lighting, Induction cooking Utility Systems: Interconnection of renewable energy sources and energy storage systems to the utility grid

Text Books:

1. Power Electronics Converters Applications and Design by Mohan, Undeland, Robbinds 3rd Edition, John Wiley and sons Publications,2003.
2. Power Electronics, circuits, devices and applications by M.H.Rashid, 3rd Edition , Prentice Hall(India) Publications, Aug., 2003.

Reference Books:

1. Power Electronics Essentials and Applications by L.Umanand by Wiley India Publications, 2009
2. Fundamental of Power Electronics. By Robert Erickson by Springer 2nd Edition,2001
3. Power Electronics by Daniel W. Hart by TMH Edition-2011

SWITCHED MODE POWER SUPPLIES

COURSE CODE: 11 – EE 339 **L – T – P: 3-0-0**
PRE-REQUISITE: 11 EE 303 **CREDITS: 3**

Non isolated DC –DC converters: Introduction to DC-DC Power supplies - Analysis and design of Buck, Boost , Buck-Boost, Cuk and SEPIC converters in continuous and Discontinuous conduction modes-Verification of theoretical analysisof converters using simulation tools. **Isolated DC –DC converters:** Introduction to DC-DC Power supplies with isolation- Analysis and design of Fly Back , Forward , Push Pull , Half Bridge and Full bridge converter in continuous conduction mode, Verification of theoretical analysis using simulation tools. **Resonant Converters:** Introduction to soft switching techniques, Analysis and design of Load resonant converters – Series Load Resonant Converter, Parallel Load Resonant Converter and Hybrid Resonant Converter, Resonant Switch Converter – Zero Current Switching, Zero Voltage Switching and Zero Voltage Switching with Clamped Voltage, Comparison of Resonant converter topologies. **Modeling of Non – isolated DC – DC converters:**Introduction to Small Signal Analysis – Small Signal Analysis of Buck, Boost, Buck-Boost converters in Continuous and Discontinuous conduction modes using Averaged switch models, Stability analysis of converters using Transfer Functions (open loop) derived from Small Signal Analysis. **Closed loop control of Converters:** Introduction to control of Switch mode DC Power supplies, Voltage Feedback, Voltage Feed Forward, Current Mode PWM Control of DC-DC converters, Power Supply protection and Electrical isolation in Feed back Loop.

Text Books:

1. Power Electronic Converters , Applications and design- Ned Mohan, Tore. M.Undeland, William P Robbins-John Willey &Sons Publications,2003
2. Power Electronics-Daniel W. Hart- McGraw-Hill Publications,2011

Reference Books:

1. Power – Switching Converters; Second Edition by Simon Ang & Alejandro Oliva, CRC Publications, 2005
2. Fundamentals of Power Electronics- R. W. Erickson and D. Maksimovic -Second Edition-Kluwer Academic Publishers, sixth printing-2004.
3. Power Electronics and Applications by L.Umanand Wiley India Publications 2009

CONTROL SYSTEMS - STREAM

STATE ESTIMATION & SYSTEM IDENTIFICATION

COURSE CODE: 11 – EE 332 L – T – P: 3-0-0
PRE-REQUISITE: 11 EE-304 CREDITS: 3

Elements of probability theory: definition of probability and random variable, probability functions, expected value, mean and covariance, independence and correlation, Gaussian distribution and its properties. **Stochastic processes and system models:** Elements of the theory of stochastic processes, mean value function and covariance kernel, independent and correlated stochastic processes, stationery and non sequence model, Gaussian white process. **Optimal prediction for discrete linear systems:** problem statement, optimal filtering for discrete systems **Optimal smoothing for discrete linear system**, classification of smooth estimates, fixed interval smoothing, fixed point smoothing, fixed lag smoothing, single and double stage optimal smoothing. **Optimal estimation for continuous linear systems:** problem formulation, optimal filtering and prediction, optimal fixed interval smoothing.

Text books:

1. Meditch, "Stochastic Optimal Linear Estimation and Control" Mc-Graw Hill Company,1969.
2. Dan Simon, "Optimal State Estimation", Wiley Intersience,2006.

DIGITAL CONTROL SYSTEMS

COURSE CODE: 11 – EE 336 L – T – P: 3-0-0
PRE-REQUISITE: 11 - EE 304 CREDITS: 3

Introduction: sampling process, signal re-construction difference equations, Z–Transforms, inverse Z transform, properties of Z Transform, Z transformer function. **Z transform analysis of sampled data control systems:** Z Transfer function of OH, closed loop transfer function of discrete systems, Response of linear discrete systems. The Z and s-domain relationship, Stability analysis of discrete systems using Jury's method. **Compensation techniques of discrete system:** Time domain technique of designing compensator. Frequency domain technique of designing compensator. Bilinear transformation: Root locus using bilinear transformation, Routh's criterion using bilinear transformation for discrete systems. **State variable methods in discrete time systems:** state description of digital systems. Conversion of state variable models to Z Transform function, Eigen values and eigenvectors, solution of state difference equations, controllability and observebility of discrete systems. Digital control systems with state feedback, state regulator design, design of state observers, reduced order observers, Compensator design by separation principle.

Text books:

1. M.Gopal, "Digital control and state variable methods", Tata McGraw Hill Publishers,2008.
2. B.C.Kuo, "Digital control systems" Oxford University Press, 2012, Second edition.
3. Digital Control of Dynamic Systems, Gene F. Franklin, J. David Powell and Michael Workman, Ellis-Kagle Press, 3rd Edition. 1997.

Reference books:

1. Digital Control System Analysis and Design, 3rd ed., Phillips and Nagle, Pearson Publishers, 1994.
2. Digital Control of Dynamic Systems, 3rd ed., Franklin and Powell, Ellis-Kagle Press, 2006.

NON LINEAR CONTROL SYSTEMS

COURSE CODE: 11 EE - 340 L – T – P: 3-0-0
PRE-REQUISITE: 11 EE - 304 CREDITS: 3

Introduction: Linear Versus Non Linear systems, Common Non linearity's in control systems, describing function for the non linear elements. Stability analysis by the describing function method. Construction of phase portraits, systems analysis on the phase plane, singular points, Limit cycles. Simple variable structures. Concept of stability: stability in the sense of Lyapunov and absolute stability, Zero - input and BIBO stability, Second (or direct) method of Lyapunov stability theory for continuous and discrete time systems, Aizerman's and Kalman's conjecture, Construction of Lyapunov function - Methods of Aizerman, Zubov, Variable gradient method, Lure problem. **Nonlinear control structures:** Feedback linearization Model, Nonlinear Control system identification and generalized predictive control in self tuning mode. **Fuzzy Logic:** Introduction – Fuzzy sets- basic Fuzzy set operations – Properties of Fuzzy sets - Membership function- features of membership function - Fuzzy Inference Systems - Methods of FIS – defuzzification methods – centroid method – weighted average method, applications to control systems – PID Control and water level control.

Text Books:

1. Hassan K. Khalil, Nonlinear Systems, Prentice Hall, 1996
2. Thimothy J Ross, “Fuzzy Logic with Engineering Applications”, 3rd Edition, John Willey Publications, 2010.

Reference Books:

1. Jean-Jacques Slotine, Weiping Li, “Applied Non Linear Control”, Prentice Hall India,1991.
2. Sankar Sastry, Nonlinear Systems Analysis, Stability and Control, Springer publication,1999.
3. M.Vidyasagar, Nonlinear Systems Analysis, Prentice - Hall International editions,1993.
4. M. Gopal,”Digital control and state variable methods” Tata Mc-Graw Hill Companies,2012.
5. M N Bandyopadhyay, “Control Engineering”, Prentice Hall of India,2009

OPTIMAL CONTROL SYSTEMS

COURSE CODE: **11 - EE 432** L – T – P: 3-0-0
PRE-REQUISITE: **11 - EE 304** CREDITS: 3

Introduction: Formation of optimal control problem, Minimum time, Minimum Energy, Minimum fuel, state regulator problem, output regulator problem, tracking problem. **Calculus of variations:** Minimization of functions, minimization of functional, Functional of a single function; Fixed end points problem, Terminal time t_1 specified, $x(t_1)$ Free, Terminal time t_1 free, $x(t_1)$ Specified. Both the terminal time t_1 and $x(t_1)$ free. Constrained minimization, formulation of variation calculus using Hamiltonian method. **Minimum principle**, Control variable inequality Constraints Control and state variable inequality constraints. **Dynamic Programming;** principle of invariant imbedding principle of optimality multistage decision process in continuous time. **Optimal feedback control**:, continuous time linear state regulator, Numerical solution of Riccati equation. Output regulator problem, tracking control scheme, proportional plus integral state feedback. **Sub Optimal Linear regulators**: Continuous time systems, Minimum time control linear invariant systems, stochastic optimal linear estimation and stochastic control Processes of linear systems. Response of linear continuous time systems to white noise,optimal estimation for linear continuous time systems. Time invariant linear state estimator.

Text Books:

1. M.Gopal “Modern Control System Theory”, New Age International Publishers,2005.
2. Anderson B.D.O and J.B Moore, ”Optimal Control Linear Quadratic Methods”, Prentice Hall Information and System Sciences Series,1989.

Reference Books:

1. A.P.Sage and C. C. White, III: Optimum Systems Control (2nd Ed.),Prentice Hall, 1977.
2. D.E.Kirk: Optimal Control Theory:An Introduction,Prentice Hall,1970

ADAPTIVE CONTROL SYSTEMS

COURSE CODE: 11 – EE 436 L – T – P: 3-0-0
PRE-REQUISITE: 11 EE 304 CREDITS: 3

Introduction: Basic approaches to adaptive control, applications of adaptive control. Gradient and least-squares algorithms: Linear error equation.Gradient and normalized gradient algorithms. Convergence properties. Least-squares and modified least-squares algorithms. **Identification:** Identification of linear time-invariant systems. Adaptive observers. Equation error and output error methods. **Indirect adaptive control:** Pole placement adaptive control. Model reference adaptive control. Adaptive inverse control. Predictive control. Singularity regions and methods to avoid them. **Direct adaptive control:** Filtered linear error equation. Gradient and pseudo-gradient algorithms. Strictly positive real transfer functions and Kalman-Yacubovitch-Popov lemma. Lyapunov redesign. Passivity theory. Direct model reference adaptive control. **Frequency-domain analysis and averaging approximations:** Averaging theory for one-time scale systems. Application to linear error equations. Sufficient richness condition for identification. Averaging analysis for mixed-time scale systems and application to adaptive control.

Text Books:

1. I.D. Landau, R. Lozano, and M. M'Saad, Adaptive Control, Springer Verlag, London, 1982.
2. K.J. Astrom and B. Wittenmark, Adaptive Control, Addison-Wesley, 2nd edition, 1995.
3. G.C. Goodwin and K.S. Sin, Adaptive Filtering, Prediction, and Control, Prentice-Hall, 1984.

Reference Books:

1. P. Ioannou & B. Fidan, Adaptive Control , SIAM, Philadelpia, PA, 2006.
2. P.A. Ioannou & J. Sun, Robust Adaptive Control, Prentice Hall, Upper Saddle River, NJ, 1996. The book is available (for free) in PDF form through the web page: http://www-bcf.usc.edu/~ioannou/RobustAdaptiveBook95pdf/Robust_Adaptive_Control.pdf.
3. K.S. Narendra and A.M. Annaswamy, Stable Adaptive Systems, Prentice-Hall, 1989.
4. S. Sastry and M. Bodson, Adaptive Control: Stability, Convergence, and Robustness, Prentice-Hall, 1989. The book is available (for free) in PDF form through the web page: http://www.ece.utah.edu/~bodson/acscr. Also republished by Dover Publications, 2011.
5. P.E. Wellstead & M.B. Zarrop, Self-Tuning Systems: Control and Signal Processing, J. Wiley & Sons, Chichester, England, 1991.

ENERGY SYSTEMS SPECILIZATION –STREAM
SOLAR ENERGY

COURSE CODE: 11EE333 L – T – P: 3-0-0
PRE-REQUISITE: 13AC 201 CREDITS: 3

Solar Resources : Passage through the atmosphere; global distribution; optimal system geometry, Insolation amount available on earth; Resource estimation; Solar data; Solar radiation spectrum; Seasonal and daily variation; Effect of Tilt Angle. **Solar Photovoltaics :** The Photo Voltaic effect; Spectral response; p-n junction; different types of photovoltaic cells; PV cell characteristics; Effect of variation of temperature; insolation level & tilt angle on the characteristics; equivalent circuits; temperature effects on conversion efficiency; Fabrication and costs of PV cell. **Solar Thermal**: Principles of applied heat transfer, solar thermal collectors: Glazing, evacuation, selective surfaces, concentrators. Solar thermal applications: water and space heating; solar ponds; dryers; distillation; solar cooker. Passive Solar design. **Solar Photovoltaic Systems**: Photovoltaic modules; module specifications; module hot spots; bypass diodes; PV arrays and PV systems; cabling;

earthling and lightning protection. Battery storage: Lead and Nickel cadmium batteries; Charge regulators; LVD circuit; Voltage and current Source Inverters. Tracking Systems; Maximum power point tracking. **System Applications :** Autonomous PV system; Grid Linked PV systems; Remote application of Photovoltaic's; System sizing; System Performance; Economics and future prospects.

Text Books:

1. Solar Energy: Principles of Thermal Collection and Storage by S.P.Sukhatme: TMH
2. Solar Energy Utilization Volume-1 &2 by G.D.Rai- Khanna Publishers ,

Reference Books:

1. Solar Electricity Handbook-2010 By Micheal Boxwell – Green Stream publishing
2. Non conventional Energy Sources by G.D.Rai- Khanna Publishers, Revised and Enlarged edition

WIND ENERGY

COURSE CODE: 11 – EE 337 L – T – P: 3-0-0
PRE-REQUISITE: 13AC 201 CREDITS: 3

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory-Power coefficient-Sabinin's theory-Aerodynamics of Wind turbine. HAWT-VAWT-Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations-Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control-stall control-Schemes for maximum power extraction. Generating Systems-Constant speed constant frequency systems-Choice of Generators-Deciding factors- Synchronous Generator-Squirrel Cage Induction Generator-Model of Wind Speed- Model wind turbine rotor - Drive Train model-Generator model for Steady state and Transient stability analysis. Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG-PMSG -Variable speed generators modeling - Variable speed variable frequency schemes. Stand alone and Grid Connected WECS system-Grid connection Issues-Machine side & Grid side controllers-WECS in various countries

Text Books:

1. L.L.Freris "Wind Energy conversion Systems", Prentice Hall, 1990
2. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.

Reference Books:

1. E.W.Golding "The generation of Electricity by wind power", Redwood burn Ltd., Trowbridge, 1976.
2. S.Heir "Grid Integration of WECS", Wiley 1998.

NUCLEAR ENERGY

COURSE CODE: 11 - EE 341 L – T – P: 3-0-0
PRE-REQUISITE: 13AC 201 CREDITS: 3

Introduction to Nuclear Power Systems: Thermal parameters - definitions and uses-Sources and distribution of thermal loads in nuclear power reactors-Conservation equations and their applications to nuclear power systems: power conversion cycles. **Basic Concepts In Nuclear Energy:** Nuclear constituents – charge, mass, shape, and size of nucleus, Binding energy, packing fraction, nuclear magnetic moment, saturation and short range nuclear forces, Radioactivity –

Laws of radioactive decay, half life, mean life, specific activity, Nuclear models. **Nuclear Reactors :**Types of reactor-Heat generation in fuel elements and temperature distributions. Heat removal, Reactor coolants. Single phase and two phase heat transfer. Boiling and flow regimes. Heat transfer and fluid flow correlations. **Nuclear Detectors And Accelerators :**Types of detectors, Geiger-Mueller counter, Scintillation counter, classification of accelerators, Cyclotron, Betatron. **Process Instrumentation And Control:** Basic concepts, sensing and transmission/receiving of temperature, flow, liquid level, pressure, force, viscosity, humidity-Nuclear Materials: fabrication and properties of metallic fuels, ceramic fuels, applications.

TEXT BOOK

1. John Lamarsh , "Introduction to Nuclear Engineering", Addison Wesley Publishing Company, Edition II,1983.
2. D.C.Tayal, Nuclear Physics, Himalayan Publication house, Bombay ,1980

REFERENCE BOOKS

1. Cecil Dudley,Gregg King, "Nuclear Power Systems : An Introductory Text" , Macmillan,1964.
2. Geoffrey F.Hewitt,John G Collier, " Introduction to Nuclear Power"II Edition,2000.
3. Irving Kaplan, "Nuclear Physics", Narosa Book Distributors, 2002.
4. R.D. Evans, "The atomic Nucleus", McGraw-Hill,1955.
5. D.C.Tayal, "Nuclear Physics", Himalayan Publication house, Bombay ,1980.
6. J.H.Horlock , "Combined Power Plants", Pergamon Press, 1992.

NANO MATERIALS FOR ENERGY AND ENVIRONMENT

COURSE CODE : **11 - EE 433** L – T – P: 3-0-0
PRE-REQUISITE: **13- ES 103** CREDITS: 3

Introduction: Importance of Nano-technology, Emergence of Nanotechnology, Bottom-up and Top-down approaches, challenges in Nano Technology. **Energy Overview:** Types of Energy and its utilization- Energy Characteristics, Energy Measures, Fundamentals of environment, Environmental aspects of energy utilization, Public health issues related to environmental pollution, Pollution Standards, environmental impact assessment **.Nanomaterials used in energy and environmental applications and their properties:** Evaluation of properties and performance of practical power systems that benefit from optimization of materials processing approaches. **Device applications:** sensors, power semiconductor chips, fuel cells, superconductors, solar cells, energy storage and other alternative power sources. Solar cells, Thin film Si solar cells, Chemical semiconductor solar cells, Dye sensitized solar cells, Polymer solar cells, Nano quantum dot solar cells, Hybrid nano-polymer solar Cells. **Fuel Cells:**principle of working, basic thermodynamics and electrochemical principle, Fuel cell classification, Fuel cell Electrodes and **Carbon nano tubes:** application of power and transportation.

Text Books:

1. W.F. Kenney: Energy Conservation in the Process Industries, Academic Press, 1984
2. Tetsuo Soga, Nanostructured Materials for Solar Energy Conversion, Elsevier

Reference Books:

1. Nano structures and Nano materials: Synthesis, properties and applications Guozhong Cao-Imperial College press
2. Robert K, Ian H, Mark G,Nanoscale Science and Technology, john Wiley & sons Ltd., 2005

ENERGY CONSERVATION & AUDIT

COURSE CODE : 11 – EE 437 L – T – P: 3-0-0
PRE-REQUISITE: 13AC 201 CREDITS: 3

System approach and End use approach to efficient use of Electricity; Electricity tariff types; Energy auditing; Types and objectives-audit instruments-ECO assessment and Economic methods-specific energy analysis-Minimum energy paths-consumption models- Energy auditing of a typical industrial unit-case study. Electric motors- Energy efficient controls and starting efficiency-Motor Efficiency and Load Analysis-Energy efficient/high efficient Motors-Case study; Load Matching and selection of motors. Variable speed drives; Pumps and Fans-Efficient Control strategies-optimal selection and sizing – Optimal operation and storage; Case study. Transformer Loading/Efficiency analysis, feeder/cable loss evaluation, case study. Reactive power management-Capacitor Sizing-Degree of Compensation-Capacitor losses-Location-placement-Maintenance, case study; Peak Demand controls- Methodologies-Types of Industrial loads-Optimal Load scheduling-case study. Lighting-Energy efficient light sources-Energy conservation in Lighting Schemes- Electronic ballast-Power quality issues-Luminaries, case study. Cogeneration-Types and Schemes-Optimal operation of cogeneration plants-case study; Electric loads of Air conditioning & Refrigeration-Energy conservation measures-Cold storage, Types –Optimal operation –case study; Electric water heating-Gysers-Power Consumption in Compressors, Energy conservation measures; Electrolytic Process; Computer Controls-softwares-EMS.

TEXT BOOKS:

1. Industrial Energy Management: Principles and Applications by Giovanni and Petrecca, The Kluwer international series-207 (1999)
2. Guide to Electric Load Management by Anthony J.Pansini, Kenneth D.Smalling, Pennwell pub (1988)

REFERENCE BOOKS:

1. Energy-Efficient Electric Motors and their applications by Howard E.Jordan, Plenum pub corp; 2nd ed. (1994)
2. Energy Management Hand book by Turner, Wayne C, Lilburn, The Fairmont press, 2001 3. Handbook of Energy Audits by Albert Thumann, Fairmont Pr; 5th edition (1998)
4. Recommended practice for Energy Conservation and cost effective planning in Industrial facilities by IEEE Bronze book, IEEE Inc, USA

DIGITAL SYSTEMS SPECILIZATION - STREAM

COMPUTER ARCHITECTURE

COURSE CODE : 13EE 501 L – T – P: 3-0-0
PRE-REQUISITE: 13EC203 CREDITS: 3

History of Calculation and Computer Architecture; Influence of Technology and Software on Instruction Sets: Up to the dawn of IBM 360; Complex Instruction Set Evolution in the Sixties: Stack and GPR Architectures; Microprogramming; Simple Instruction Pipelining; Pipeline Hazards. Multilevel Memories – Technology; Cache (Memory) Performance Optimization; Virtual Memory Basics; Virtual Memory: Part Deux.

Complex Pipelining; Out of Order Execution and Register Renaming; Branch Prediction and Speculative Execution; Advanced Superscalar Architectures; Microprocessor Evolution: 4004 to Pentium 4.

Synchronization and Sequential Consistency; Cache Coherence; Cache Coherence (Implementation); Snoopy Protocols; Relaxed Memory Models.

VLIW/EPIC: Statically Scheduled ILP; Vector Computers; Multithreaded Processors; Reliable Architectures; Virtual Machines.

Text books:

1. Hennessy, J. L., and D. A. Patterson. Computer Architecture: A Quantitative Approach, 3rd ed. San Mateo, CA: Morgan Kaufman, 2002. ISBN: 1558605967.

2. Patterson, D. A., and J. L. Hennessy. Computer Organization and Design: The Hardware/Software Interface, 3rd ed. San Mateo, CA: Morgan Kaufman, 2004. ISBN: 1558606041.

PLDs AND FPGAs

COURSE CODE : 13EE 502 L – T – P: 3-0-0
PRE-REQUISITE: 13EC 203 CREDITS: 3

Introduction: Full Custom Design; Semicustom Design; Programmable Logic Devices; Notations for Programmable Logic Devices; Design Methodology Using Programmable Logic Devices; Design Soft Ware; **Programmable Read Only Memory (PROM):** Mask programmed ROM; EPROM; EEPROM; Programmable Logic Element (PLE); Combinational Logic Design using PLEs; Sequential Circuit Realization using PLEs; **Programmable Logic Devices:** Programmable Logic Device (PLD); Sequential PLD; Complex PLD; Field Programmable Gate Array (FPGA); Xilinx SRAM-Based FPGA; Comparison between FPGA, ASIC and CPLD; FPGA based system design; **Field Programmable Gate Arrays:** Introduction; The Xilinx logic Cell Array; Advanced futures of the 4000 series; The Actel ACT; Technology Trends; **New generation Architectures of Programmable Logic Device:** Erasable Programmable Logic Devices; Reprogrammable Generic Logic Devices; Erasable Programmable Logic Array (EPLA); Generic Array Logic (GAL); Programmable Electrically Erasable Logic (PEEL);

TEXT BOOKS

1. Parag K. Lala, “Digital System Design Programmable Logic Devices”, B S Publications
2. Debaprasad Das, “VLSI Design”, Oxford.
3. Pak K. Chan, Samiha Mourad, “Digital Design Using Field Programmable Gate Array”, Pearson Education.

REFERENCE TEXT BOOKS

1. Bob Zeidman, “Designing with PFGAs and CPLDs”, CMP Books,
2. Stephen Brown Zvonko Vranesic “Fundamentals of Digital Logic with VHDL Design” McGraw-Hill, 2008

SIMULATION BOOK

1. Ian Grout,"Digital Systems Design with FPGAs and CPLDs",Newnes,
2. Scott Hauck,André Dehon,"Reconfigurable Computing: The Theory and Practice of FPGA-Based Computing" Elsevier Science,

VLSI DESIGN

COURSE CODE : 13EE 503 L – T – P: 3-0-0
PRE-REQUISITE: 13EC203 CREDITS: 3

Technology Introduction: Introduction to IC Technology – MOS, PMOS, NMOS, CMOS

MOS Theory Analysis: Basic Electrical Properties of MOS Circuits: **Ids-Vds** Relationships, , **gm**, **gds**, Figure of Merit **ωo**, Pass Transistor, Transmission Gate, NMOS Inverter, Various Pull-ups, CMOS Inverter Analysis and Design, Bi-CMOS Inverters, Latch up in CMOS Circuits.

CMOS Circuits and Logic Design Rules: MOS Layers, Stick Diagrams, Lambada Based rules
Scaling of CMOS Circuits.

CMOS Circuit Characterisation and Performance Estimation: Sheet Resistance **RS** and its Concept to MOS, Area Capacitance Units, Transistor Sizing, Power Dissipation.

CMOS Fault models: need for testing, manufacturing test principles.

TEXT BOOKS

1. Kamran Ehraghian, Dauglas A. Pucknell and Sholeh Eshraghiam, "Essentials of VLSI Circuits and Systems" – PHI, EEE, 2005 Edition.
2. Neil H. E. Weste and David. Harris Ayan Banerjee,, "CMOS VLSI Design" - Pearson Education, 1999.

REFERENCES

1. Sung-Mo Kang, Yusuf Leblebici,"CMOS Digital Integrated Circuits" TMH 2003
2. Jan M. Rabaey, "Digital Integrated Circuits" Pearson Education, 2003
3. Wayne Wolf, "Modern VLSI Design ", 2nd Edition, Prentice Hall, 1998.

SIMULATION TEXT BOOKS

1. Etienne Sicard, Sonia Delmas Bendhia, "Basics of CMOS Cell Design", TMH, EEE, 2005.

EMBEDDED SYSTEM DESIGN

COURSE CODE: 13EE-504 L – T – P: 3-0-0
PRE-REQUISITE: 13EC 203 CREDITS: 3

Introduction to Embedded System

Embedded system processor, hardware unit, soft ware embedded into a system, Example of an embedded system, Embedded Design life cycle, Embedded System modeling [flow graphs, FSM, Petri nets], Layers of Embedded Systems.

Processor and Memory Organization

Bus Organization, Memory Devices and their Characteristics, Instruction Set Architecture [RISC, CISC], Basic Embedded Processor/Microcontroller Architecture [8051, ARM, DSP, PIC], memory system architecture [cache, virtual, MMU and address translation], DMA, Co-processors and Hardware Accelerators, pipelining.

I/O Devices and Networks

I/O Devices[Timers, Counters, Interrupt Controllers, DMA Controllers, A/D and D/A Converters, Displays, Keyboards, Infrared devices], Memory Interfacing, I/O Device Interfacing
[GPIB, FIREWIRE, USB, IRDA], Networks for Embedded systems (CAN, I2C, SPI, USB, RS485, RS 232), Wireless Applications [Bluetooth, Zigbee].

Operating Systems

Basic Features of an Operating System, Kernel Features [polled loop system, interrupt driven system, multi rate system], Processes and Threads, Context Switching, Scheduling[RMA, EDF, fault tolerant scheduling], Inter-process Communication, real Time memory management [process stack management, dynamic allocation], I/O[synchronous and asynchronous I/O, Interrupts Handling, Device drivers], RTOS [VxWorks, RT-LINUX].

Embedded System Development

Design Methodologies[UML as Design tool, UML notation, Requirement Analysis and Use case Modeling], Design Examples [Telephone PBX, Inkjet Printer, PDA, Elevator Control System, ATM System], Fault-tolerance Techniques, Reliability Evaluation Techniques.

Reference Books

1. Wayne Wolf "Computers as components: Principles of Embedded Computing System. design" The Morgan Kaufmann Series in Computer Architecture and Design, 2008.
2. Jane W. S., Liu, "Real time systems", Pearson Education, 2000.
3. Raj Kamal, "Embedded systems Architecture, Programming and design", Second Edition, 2008.
4. Robert Ashby, "Designer's Guide to the Cypress PSoC" Newnes, 2005.
5. Microblaze processor Reference guide, Xilinx

DSP PROCESSORS

COURSE CODE : 13EE-505 L – T – P: 3-0-0
PRE-REQUISITE: 13EC203 CREDITS: 3

INTRODUCTION TO DIGITAL SIGNAL PROCESING: Introduction, A Digital Signal processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Analysis and Design tool for DSP Systems MATLAB, DSP using MATLAB.**NUMBERING SYSTEMS:** Floating, Integer and Fixed point Processors, IEEE-754 Floating-Point Format, Q-Format. **ARCHITECTURES FOR PROGRAMMABLE DSP DEVICES:** Architecture for two selected DSPs, Pipelining process of instructions, Read and write operations, Interrupts, Timers. **PROGRAMMING FOR SELECTED DSP(**TMS320F28335/F2812**):** Code composer studio, implementation of small programs like Digital I/O, PID control, Digital Filters, Timer and interrupts, PWM signal generation, Analog to Digital Conversion

TEXTBOOKS:

1. Digital Signal Processing by Sanjit K Mitra, Tata MCgraw Hill Publications.
2. Digital Signal Processing Principles, Algorithms, Applications by J G Proakis, D G Manolokis, PHI.
3. TMS320F28335 Manuals

REFERENCE BOOKS:

1. Discrete-Time Signal Processing by A V Oppenhiem, R W Schafer, Pearson Education.
2. DSP- A Practical Approach- Emmanuel C Ifeacher Barrie. W. Jervis, Pearson Education.
2. Modern spectral Estimation techniques by S. M .Kay, PHI, 1997

MECHANICAL GENERAL ELECTIVES

R & AC

COURSE CODE : 13ME-331 L – T – P: 3-0-0
PRE-REQUISITE: 13ME-202 CREDITS: 3

Introduction to Refrigeration: Necessity and applications, unit of refrigeration and COP, methods of refrigeration; **Air Refrigeration:** Reversed Carnot Cycle, Bell Coleman cycle, Advantages and disadvantages of air refrigeration, Open and Dense air systems, Actual air craft refrigeration system, different types; **Refrigerants:** Nomenclature, Desirable properties, common refrigerants used, Eco friendly refrigerants, ODP; **Vapour Compression Refrigeration:** Working principle, essential components of plant, simple vapour compression refrigeration cycle, Effect of condenser pressure, evaporator pressure, sub cooling and super heating. Multi pressure systems – multistage compression, multi evaporator system, use of p–h charts; **System Components:** Compressors-general classification, comparison, advantages and disadvantages, Condensers-classification and working, Expansion devices-classification and working, Evaporators-classification and working; **Vapour Absorption System:** Calculation of max COP, description and working of NH_3 - water system, Li - Br, H_2O system, principle of operation of three fluid absorption system and salient features problems; **Production of Low Temperature:** Cascade system, Production of Solid CO_2; **Steam Jet Refrigeration System:** Principle of working, application, merits and demerits. **Introduction to Air Conditioning:** Psychrometric properties and processes, sensible and latent heat loads, SHF, need for ventilation, infiltration, concept of human comfort and effective temperature, comfort air conditioning, industrial air conditioning and requirements, air conditioning load calculations; **Air Conditioning Systems:** classification, concepts of RSHF, ASHF, ESHF & ADP, filters, grills and registers, deodorants, fans and blowers.

TEXT BOOKS:

1. Refrigeration and Air conditioning by Stoecker & Jones.
2. Jordon and Priester, "Refrigeration and Air Conditioning", Prentice Hall of India Pvt. Ltd., New Delhi

REFERENCE BOOKS:

1. Principles of Refrigeration by Dossat. , Thomas J. Horan: Books.
2. Refrigeration and Air conditioning by C.P. Arora.
3. Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd.Pub.
4. Heating, Ventilating, Air-Conditioning and Refrigeration by Billy C. Langley, Prentice Hall

ALTERNATIVE ENERGIES

COURSE CODE : 13ME 332 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS: 3

INTRODUCTION: Renewable & Nonrenewable sources. Solar Radiation: - Solar constant, basic earth-sun angles. Spectral distribution of extra terrestrial radiations & its variation. Solar time, Direction of beam radiation, solar charts, measurements of diffuse & global & direct radiations, duration of sunshine hours, Attenuation of solar radiation by the atmosphere; **SOLAR ENERGY COLLECTION:** Flat plate collectors, concentrating collectors. Effects of various parameters on the performance Solar energy Utilization:- Application of solar energy in heating, cooling, pumping, power production, distillation, drying, solar cookers, solar pond, solar furnace. Solar Energy Storage Methods of storage such as sensible, latent heat & thermo chemical storage; **ENERGY FROM OCEAN**: Tidal Power:- types of tidal plants such as single and two basin plants, operation of tidal power plant and power generation, Ocean thermal energy conversion system., Open & Closed OTEC cycles, Wave energy: Wave energy conversion machines and recent advances; **WIND POWER**: Wind speed data, power in the wind, wind power development, types of wind mills, application for pumping and power generation; **BIOMASS ENERGY RESOURCES**:-Mechanism of green plant photo-synthesis, efficiency of conversion, solar energy plantation; **BIOGAS**: Types of biogas plants, factors affecting production rates, Pyrolysis, Gasifiers: Types & classification; **GEOTHERMAL ENERGY:** Resources, power generation methods like vapour dominated, water dominated, flash steam, binary fluid and total flow concept of power generation; Direct Energy Conversion:- **Photo voltaic cells**:- Principle, concept of energy conversion, Conversion efficiency, power output and performance, storage; **FUEL CELLS**: Principles types of fuel cells, conversion efficiency. Magneto hydrodynamic generators operating principle power output, analysis of MHD, seeding, power generation, **FISSION AND FUSION** : Introduction and power plant layout, hybrid power generation, advantages, disadvantages, Grid balancing.

TEXTBOOKS:

1) Rai G.D, "Non-Conventional energy Sources", Khanna Publishers.
2) Solar Energy: Principles of Thermal Collection and Storage-S. Sukhatme, J Nayak- MGH, 2004-3rd Edition
3) Renewable Energy Sources and Emerging Technologies- Kothari, Singal & Ranjan-PHI, 2008

4) Bansal Keemann, Meliss," Renewable energy sources and conversion technology", Tata Mc Graw
5) Renewable Energy Sources and their Environmental Impact- Abbasi & Abbasi- PHI, New Delhi,2009

REFERENCE BOOKS :

1. Solar Energy : Fundamentals and Applications-H Garg, J Prakash-1st RE

ENERGY MANAGEMENT

COURSE CODE : 13ME 333 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS: 3

General energy problem: Global and national energy scenario, primary energy sources, energy use patterns, Basic Principles, laws of Thermo dynamics. Irreversibility, entropy enthalpy, heat engine, refrigeration cycle, thermal efficiency and thermal exchange ratio. Critical and economic thickness of insulation. Optimum use of prime movers for power generation, cogeneration technology. Energy conservation methods in power plants, conservation of energy in energy intensive industries. **Maintenance engineering:** Friction, lubrication and tribological innovations, predictive and preventive maintenance, Energy audit, case studies. Heating, Lighting and Air conditioning of building and measures for conservation of electrical energy. Energy conservation in domestic gadgets. Industrial heating and energy conservation in electric and oil fired furnaces. Analyze Measures for reduction of losses in Transmission and distribution systems. Energy efficient electric drives, energy efficient motors, V.S.D. power factor improvement in power system. Energy conservation in transportation systems especially in electric vehicle. Load curve analysis and load managements, DSM, Energy storage for power systems, (Mechanical, Thermal, electrical and Magnetic) Restructuring of electric tariff from energy conservation considerations, payback period.

TEXT BOOK:

1. Energy Technology: S.Rao, Dr.B.B.Purulekhar, Khanna Publishers
2. Elect. Energy Utilization & Conservation: By - Dr. S.C.Tripathi, Tata Mc Graw Hill Publishers

REFERENCES:

1. Energy Efficiency Manual: for everyone who uses energy, pays for utilities, designs and builds, is interested in energy conservation and the environment , Donald R. Wulfinghoff (Author) – Energy Institute Press,Maryland,U.S.A.
2. Handbook of Energy Conservation, (Set 2 Volumes) ISBN: 9789810828288 (Set ISBN)- Alkem Company (S) Pvt Ltd, Singapore.

POWER PLANT ENGINEERING

COURSE CODE : 13- ME 334 L – T – P: 3-0-0

PRE-REQUISITE: 13ME-202 CREDITS: 3

Introduction, Energy sources, types of power plants. **Hydro Electric Power Plant:** Hydrology, Rainfall, Run off and their measurement, hydrograph, Flow duration curve, Mass curve and calculation of storage capacity, site selection of hydro plant, different types of hydro plants. **Diesel Power Plants:** Classification, main components of plant, plant layout, application and comparison with other plants. **Thermal Power Plant:** General layout, Fuels, Coal analysis, Coal handling, Burning of coal - stoker and pulverized Systems, Ash handling systems, ESP, cooling ponds and towers (wet and dry types), Deaerators. **Nuclear Power Plants:** Nuclear Fission, Nuclear Fuels, Components of Reactor, types of Nuclear Reactors, Breeding, Fast Breeder Reactor, Radiation shields, Nuclear waste disposal. **Power Plant Economics:** Various performance factors (load factor, diversity factor, use factor etc.). Fixed costs, operating costs, cost per kWh, comparison of fixed and operating costs of hydro, thermal, nuclear plants, power tariffs. **Non Conventional Energy Sources:** Solar Energy **-** Solar collectors, solar energy storage, solar ponds, solar energy utilization and applications. **Wind Power:** Basic principle, different types of wind mills, wind energy conversion systems, other applications. **Geothermal Power:** sources, energy conversion system. **OTEC:** ocean thermal energy conversion systems, introduction to tidal power. **Direct Energy Conversion Systems:** Fuel cells, MHD, Solar cell. **Pollution And Control:** Introduction, particulate and gaseous pollutants, thermal pollution and solid waste pollution, methods to control pollution - brief description. **Energy Management & Auditing:** Role of Energy Manager, Energy Audit-types, Sankeyiagram for Energy Audit, Principle of Energy Conservation, Energy Conservation Technologies.

TEXT BOOKS

1. Power Plant Technology, M.M. El-Wakil McGraw Hill
2. Power station Engineering and Economy by Bernhardt G.A.Skrotzki and William A. Vopat- Tata McGraw Hill

REFERENCES:

1. An introduction to power plant technology by G.D. Rai-Khanna Publishers, Delhi
2. Power Plant Engineering by P.K. Nag, Tata McGraw Hill
3. Power plant engineering by Nagpal, Khanna Publications,New Delhi.
4. Power Plant Engineering by culp.

ADVANCED STRENGTH OF MATERIALS

COURSE CODE: 13 ME 341 L – T – P: 3-0-0

PRE-REQUISITE: 13ME-205 CREDITS: 3

STATICALLY INDETERMINATE BEAMS: Statically indeterminate Beams, Analysis by the differential equations of the Deflection curve, Moment Area Method.

CONTINUOUS BEAMS: Clapeyron’s theorem of three moments, Beams with constant and varying moments of inertia.

CURVED BEAMS: Stresses in Beams of small and large initial curvature, The Winkler-Bach theory, Stresses in Crane Hook and C-Clamp with Rectangular, Circular and Trapezoidal cross-sections.

Unsymmetrical Bending: Shear Center, Examples of unsymmetrical bending, Simple problems on shear center.

CENTRIFUGAL STRESSES: Introduction, Rotating Ring, Rotating Disc, Rotating Disc of uniform strength.

Thick pressure vessels: Thick Cylinders: Lame’s theory, Radial Deflection, Compound Cylinder.

ENERGY METHODS: Introduction, Principles of virtual work, unit load, Method for calculating displacements, Strain energy & complementary energy, Strain Energy Methods

Text books:

1. Mechanics of Materials by Gere and Timoshenko, CBS publishers, 2nd edition.

Reference Books:

1. Pytel A H and Singer F L, “Strength of Materials”, Harper Collins, New Delhi.
2. Beer P F and Johston (Jr) E R, “Mechanics of Materials”, SI Version, McGraw Hill, NY.
3. Popov E P, “Engineering Mechanics of Solids”, SI Version, Prentice Hall, New Delhi.
4. Advanced Mechanics Of Solids by L. S. Srinath, 3rd edition Tata McGraw-Hill, 2009.

THEORY OF ELASTICITY & PLASTICITY

COURSE CODE: 13ME-342 L – T – P: 3-0-0

PRE-REQUISITE: 13ME-205 CREDITS: 3

ELASTICITY : Analysis of stress and strain, Equilibrium equations - Compatibility equations - stress strain relationship. Generalized Hooke's law. ELASTICITY SOLUTION : Plane stress and plane strain - Simple two dimensional problems in Cartesian and polar co-ordinates. TORSION OF NON-CIRCULAR SECTION :St.venant's approach - Prandtl's approach – Membrane analogy - Torsion of thin walled open and closed sections. ENERGY METHODS : Strain energy – Principle of virtual work – Energy theorems – Rayleigh Ritz method – Finite difference method – Application to elasticity problems.

PLASTICITY : Physical Assumptions – Yield criteria - Plastic stress strain relationship. Elastic plastic problems in bending – torsion and thick cylinder.

Text books:

1. Timoshenko, S. and Goodier J.N. "Theory of Elasticity", McGraw Hill Book Co., Newyork, 1988.
2. Slater R.A.C, "Engineering Plasticity", John Wiley and Son, New York, 1977

Reference Books:

1. Chou P.C. and Pagano, N.J. "Elasticity Tensor, Dyadic and Engineering Approaches", D.Van Nostrand Co., Inc., London, 1967.
2. Hearn , E.J. "Mechanics of Materials", Vol.2, Pergamon Press, Oxford, 1985
3. Irving H.Shames and James, M.Pitarresi, "Introduction to Solid Mechanics", Prentice Hall of India Pvt. Ltd., Newl Delhi -2002.
   Sadhu Singh, "Theory of Elasticity", Khanna Publishers, New Delhi 1988.

PRINCIPLES OF PRODUCT DESIGN

COURSE CODE: 13ME343 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS: 3

Design methodology and design philosophy- types of designs, design models, concurrent engineering, product life cycle. Design Teams - Organizations & product Planning. Need Analysis & Scope- mission statement, customer study, Kano diagram. Establishing Product Function-functional decomposition, FAST and SOP, function structure. Product Tear down reverse engineering. Product Specifications- QFD. Generation and evaluation of concepts – TRIZ, Decision matrix etc. Embodiment design- product architecture, configuration, parametric design, systems approach and other consideration of embodiment design, Industrial Design - aesthetics and ergonomic aspects of product design. Value Engineering. Failure mode and effects analysis.

Text Books:

1. Kevin Otto and Kristin Wood, " Product design"- Pearson, 2004
2. David G. Ullman, "The Mechanical Design Process" - McGraw Hill, 2003
3. George E. Dieter, " Engineering Design" - McGraw Hill, 2000
4. Karl T. Ulrich and Steven D. Eppinger," Product Design and Development" TataMcGraw Hill, 2007

Reference books:

1. Singleton W T "An Introduction to Ergonomics" WHO Generava 1978
2. McCormic E J and Sansers W "Human Factors in Engg" McGraw Hill 1993
3. Eirich and Robert "Human Computer Dialogue Design" New York Elsevier, 1986
4. Paul J G "Form, Function and Design" Dover Publication 1994
5. Kurt Rowland, "The Development of Shape" Ginn and Company 1994
6. James F Thorpe, "Mechanical Systems Components". Allyn and Bacon, Boston 1989

VIBRATIONS ENGINEERING

COURSE CODE: 13ME-344 L – T – P: 3-0-0
PRE-REQUISITE: 13ME-206 CREDITS: 3

Fundamentals of Vibration:- Introduction, Definitions, vector method of representing Harmonic motions, Addition of two simple Harmonic motion of the same frequency, Beats phenomenon. **Undamped Free Vibrations of single Degree of freedom systems**:- Introduction, Derivations of differential equations, solution of differential equation, Torsional vibrations, Equivalent stiffness of spring combinations, Energy method. **Damped free vibrations of single degree of freedom systems**:- Introduction, Different types of damping, Free vibrations with viscous damping, Logarithmic Decrement, Viscous dampers, Coulomb damping. **Forced vibrations of single degree of freedom systems**:- Introduction, Forced vibrations with constant Harmonic excitation, Forced vibration with rotating and reciprocating unbalance, forced vibrations due to excitation of the support,Vibration isolation and Transmissibility, Critical speed of a light shaft having a single disc without damping, Vibration measuring instruments. **Two Degrees of Freedom systems**:- Introduction, principal modes of vibration, other cases of simple two degrees of freedom systems, combined rectilinear and angular modes, undamped forced vibrations with harmonic excitation, undamped dynamic vibration absorber, centrifugal pendulum absorber. **Multi-Degree of freedom systems** – Exact analysis:- Introduction, Free vibrations – Equations of motion, co-ordinate coupling, Eigen values and Eigen vectors.

Text Books:

1. Leonard Meirovitch, Fundamentals Of Vibrations, 1st edition , TataMcGrawHill, 2001
2. G.K.Grover, Mechanical Vibrations, Neem Chand & Bros. 7th Edition

Reference Books:

1. W.T.Thomson Mechanical Vibrations, Pearson education ,2nd Edition
2. S.S.Rao , Mechanical Vibrations, Pearson education, 4th edition

J. P. Den Hartog, Mechanical Vibrations, 1st Edition, Dover Publications

ROBOTICS: SENSING AND CONTROL

COURSE CODE: 13ME-351 L – T – P: 3-0-0
PRE-REQUISITE: 13ME-206 CREDITS: 3

INTRODUCTION: Introduction to Robotics, Major components of a Robot, Classification of Robots - Classification by Coordinate System, by Power Drive and by Control Method, Specifications of Robots, Fixed versus flexible automation, Economic Analysis.

ROBOT END EFFECTORS: Introduction, Types of end effectors-Grippers and Tools, Gripper Mechanisms, Considerations in the selection and design of remote centered devices.

ROBOTIC SENSORY DEVICES: Objective, Non-Optical position sensors-Potentiometers, Synchros, inductosyn, optical position sensors-opto interrupters, Optical encoders (absolute & incremental).

PROXIMITY SENSORS: Contact type, non-contact type-reflected light scanning laser sensors.

TOUCH & SLIP SENSORS: Touch sensors – proximity Rod & Photo detector sensors, Slip sensors – Forced oscillation slip sensor, interrupted type slip sensors, force and torque sensors.

CONTROL SYSTEMS: Basic control systems concepts and Models – Mathematical Models, Transfer function, Block Diagrams- Configuration of a control system for a robot joint.

CONTROLLERS: On-off control, Proportional Control, Integral Control, Proportional plus Integral Control, Derivative control, Proportional plus Derivative control, PID Control, Control system Analysis.

PLC's, Microprocessors and Computer Control methods and their programming.

ROBOT APPLICATIONS: Industrial Applications – Material Transfer, material handling, Loading and unloading, processing, spot and continuous arc welding, spray painting, grinding, Assembly and Inspection and Non-Industrial Applications

DESIGN: Robotic systems Design based Case studies of problems derived from Domestic, Industry, Defense for example An Aerial Surveillance Robot, Automated Guided Vehicles, Multi Arm Industrial Robot, Underwater Vehicles, Medical and Surgical Robots etc.

Text Books:

1. Robotic engineering by Richard D. Klafter (PHI)
2. Industrial robotics by Mikell P.Groover, (MGH)
3. Robotics and Control by RK Mittal (MGH)

References:

1. Introduction to Robotics - John J. Craig (Pearson Education India)
2. Robotics Fundamental concepts and analysis: Ashitava Ghoshal (Oxford Higher Education).
3. Robotics – K.S. Fu, Gonzalez & Lee (MGH)
4. Robotics For Engineers by Yoram K koren (MGH)

MECHATRONICS PRODUCT DESIGN

COURSE CODE : 13ME-352 L – T – P: 3-0-0

PRE-REQUISITE: 13ME-204 CREDITS: 3

Introduction: Integrated Design issues in Mechatronics, Mechatronics Design process, Mechatronics Key Elements, Applications in Mechatronics.

Modeling and simulation of physical systems: Electrical systems, Mechanical systems-translational&rotational systems, fluid systems.

Sensors and Transducers: Introduction, sensor for motion and position measurement, force, torque and tactile sensors, vibration – Acceleration sensors, sensor for flow measurement, temperature sensing devices, sensor applications.

Actuating Devices:DC Motors, Stepper motors, fluid power Actuation, fluid power design elements, piezoelectric Actuators.

System Control – Logic Methods: Number Systems in Mechatronics, Binary Logic, Karnaugh Map Minimization, Programmable Logic Controllers.

Signal Conditioning and Real Time Interfacing: Elements of a Data Acquisition and Control System, Transducers and Signal Conditioning, Devices for Data Conversion, Data Conversion Process.

Case Studies

TEXT BOOKS:

1. DevdasShetty, Richard A.Kolk, "Mechatronics System Design", PWS Publishing Company, 1997.

2. Boltan, “Mechatronics-Electronic Control Systems in Mechanical and Electrical Engineering”, 2nd Edition, Addison Wesley Longman Ltd., 1999

REFERENCE BOOK:

1. D.A Bradley, D.Dawson, N.C Burd and A.J.Loader, “Mechatronics” CRC Press, 2010.

INDUSTRIAL AUTOMATION

COURSE CODE : 13ME-353 L – T – P: 3-0-0

PRE-REQUISITE: 13ME-302 CREDITS: 3

Automation: Introduction, automation principles and strategies, basic elements of advanced functions, levels modeling of manufacturing systems.

Material handling: Introduction, material handling systems, principles and design, material transport system: transfer mechanisms automated feed cut of components, performance analysis, uses of various types of handling systems including AGV and its various guiding technologies.

Storage system: Performance, location strategies, conventional storage methods and equipments, automated storage systems.

Automated manufacturing systems: Components, classification, overview, group technology and cellular manufacturing, parts classification and coding, product flow analysis, cellular manufacturing, application considerations in G.T.

FMS: Introduction, components, application, benefits, planning and implementation, transfer lines and fundamentals of automated production lines, application, analysis of transfer line without internal storage (numerical problems).

Inspection Technology: Introduction, contact and non-contact conventional measuring, gauging technique, CMM, surface measurement, machine vision, other optical inspection techniques, non-contact non-optical inspection technologies versus.

Manufacturing support system: Process planning and concurrent engineering- process planning, CAPP, CE and design for manufacturing, advanced manufacturing planning, production planning and control system, master production schedule, MRP.

Capacity planning, shop floor control, inventory control, MRP-II, J.I.T production systems. lean and agile manufacturing.

Text Books

1. M.P. Groover, Automation, “Production Systems and Computer Integrated manufacturing”, 2nd Edition, Pearson Education (2004).

References Books

2. Vajpayee, “Principles of CIM”, PHI, 1992.
3. Viswanathan and Narahari, “Performance Modeling of Automated Manufacturing Systems”, PHI, 2000.
4. R.S. Pressman, “Numerical Control and CAM, John Wiley , 1993.

INTELLIGENT VISUAL SURVEILLANCE

COURSE CODE: 13ME-354 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS: 3

Basics of Image Processing: Introduction to Image Processing methods, Image Transforms, Wavelet Transform, JPEG Image Compression, Image Formats, Color Spaces- RGB, CMY, HSI.

Video Compression Standards: H. 261, H. 263, H.264, MPEG-1, MPEG-2, MPEG-4, MPEG-7, and MPEG-21, Video shot boundary detection, motion modeling and segmentation techniques.

Object Detection and Classification- Shape based object classification, motion based object classification, Silhouette-Based Method for Object Classification, Viola Jones object detection framework, Multiclass classifier boosting.

Multi-Object Tracking- Classification of multiple interacting objects from video, Region-based Tracking, Contour-based Tracking, Feature-based Tracking, Model-based Tracking, Hybrid Tracking, Particle filter based object tracking, Mean Shift based tracking, Tracking of multiple interacting objects.

Human Activity Recognition- Template based activity recognition, Sequential recognition approaches using state models (Hidden Markov Models), Human Recognition Using Gait, HMM Framework for Gait Recognition, Description based approaches, Human interactions, group activities, Applications and challenges.

Camera Network Calibration - Types of CCTV (closed circuit television) camera- PTZ (pan-tilt zoom) camera, IR (Infrared) camera, IP (Internet Protocol) camera, wireless security camera, Multiple view geometry, camera network calibration, PTZ camera calibration, camera placement, smart imagers and smart cameras.

Text Books

1. Murat A. Tekalp, "Digital Video Processing", Prentice Hall, 1995. Y. Ma and G. Qian (Ed.), "Intelligent Video Surveillance: Systems and Technology", CRC Press, 2009.

REVERSE ENGINEERING & RAPID PROTOTYPING

COURSE CODE: 13ME-361 L – T – P: 3-0-0

PRE-REQUISITE: 13ME-361 CREDITS: 3

Introduction to reverse engineering (RE), Need for RE, Relation between rapid prototyping and reverse engineering, RE taxonomy-Active and Passive techniques, RE types-contact and non contact, Definition of Prototype and types, History of RP and Classification of RP, Data Processing for RP, Liquid based techniques, Solid based techniques, Powder based techniques, Rapid tooling and RP case studies, Applications and Case Studies of RP.

Text Books

1. Jian (John) Dong, Rapid response manufacturing-Contemporary Methodologies, Tools and technologies, Chapman&Hall, 1st edition, 1998.

2. C K Chua, K F Leong & C S Lim, Rapid Prototyping- Principles and Applications, World Scientific, 2nd Edition, 2005

Reference Books

1. Ali K Kamrani, Emad Abouel Nasr, Rapid Prototyping- Theory and Practice, Springer, 2006.
2. Kenneth G Cooper, Rapid Prototyping Technology- Selection and Application, Marcel Dekker, Inc
3. D.T.Pham and S.S. Dimov,Rapid manufacturing; the technologies and applications of rapid prototyping and rapid tooling

POWDER METALLURGY

COURSE CODE: 13ME-362 L – T – P: 3-0-0

PRE-REQUISITE: 13ME-203 CREDITS: 3

Characteristics and Testing of Metal Powders, Powder Manufacturing and Conditioning, Hot isostatic processing and techniques for producing high density powder metallurgy products, Powder Compaction, Sintering, Sintering Furnaces, Post sintering Operations, Applications of P/M Parts, Hot Isostatic process, Advantages and Limitations of Powder Metallurgy

Text Books:

1. Sinha A. K., "Powder Metallurgy", Dhanpat Rai & Sons. New Delhi, 1982.
2. Ramakrishnan, P.," Powder Metallurgy", New Age International Publishers,1st edition,2007

References:

1. ASM Handbook. Vol. 7, "Powder Metallurgy", Metals Park, Ohio, USA, 1990.
2. Animesh Bose., "Advances in Particulate Materials", Butterworth - Heinemann. New Delhi, 1995.
3. Kempton. H Roll., "Powder Metallurgy", Metallurgical Society of AMIE, 1988.
4. Ramakrishnan. P., "Powder Metallurgy Opportunities for Engineering Industries", Oxford and IBH Publishing Co., Pvt. Ltd, New Delhi, 1987
5. ~~Environmental Science and Engineering by J.Glynn Henry, Gary W.Heinke,(2004),Low Price Edition, Pearson Education Inc, Singapore.~~
6. ~~MoEF(2000) Municipal Waste Management and Handling Rules, Govt. of India.~~
7. ~~CPCB(2001) Criteria for Hazardous waste Landfill(HASWAMS/17/2000-01)~~
8. ~~Solid and hazardous waste management by M.N.Rao and Razia Sultana, BS Publications, Hyderabad.~~

NON-DESTRUCTIVE TESTING

COURSE CODE : 13ME-363 L – T – P: 3-0-0

PRE-REQUISITE: 13ME-204 CREDITS: 3

Radiographic Testing, Film Radiography, Radiographic Image Quality and Radiographic Techniques, Radiation Safety, Surface NDE Methods, Visual Testing, Liquid Penetrant Testing, Magnetic Particle Testing, Eddy Current Testing, Principles of Acoustics, Generation of ultrasonic waves, Ultrasonic Inspection Methods.

Test Books:

1. Non-Destructive Testing Hand Book: Radiography and Radiation Testing, Vol.3, 2nd" ed, Columbus, OH, American Society for Non-Destructive Testing, 1985.
2. Halmshaw. R, Industrial Radiography, Applied Science Publishers Inc. Englewood, NJ,1982.

References

1. American Metals Society, "Non-Destructive Examination and Quality Control", Metals Hand Book, Vol.17, 9th Ed, Metals Park, OH, 1989.
2. Krautkramer, Josef and Hebert Krautkramer, "Ultrasonic Testing of Materials", 3rd Ed, Newyork, Springer- Verlag, 1983.

CONCURRENT ENGINEERING

COURSE CODE : 13ME-364 L – T – P: 3-0-0

PRE-REQUISITE: 13ME-204 CREDITS: 3

Introduction, Definition of CE, CE design methodologies, Use of Information Technology, Expert Systems, Design Stage, Life Cycle design of products, Manufacturing Competitiveness, JIT System, Project Management Life Cycle Semi Realization, Evaluation of design for manufacturing cost, Engineering Design studies – Product Realization Taxanomy.

Text Books:

1. Anderson M M and Hein, L Berlin, Springer Verlog – ' Integrated Product Development'
2. Cleetus J Concurrent research center, Morgan Town – 'Design for Concurrent Engineering'

Reference Books:

1. "Concurrent Engineering: Automation Tols and Technology' Wiley, John and sons Inc., 1992.
2. "Concurrent Engineering fundamentals: Integrated Product Development" Prasad, Prentice Hall, 1996.

FACILITY LAYOUT & MATERIAL HANDLING

COURSE CODE: 13ME-371 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Facilities Planning definition, Significance and Objectives of Facilities Planning, Facilities Planning Process, Facilities Planning Strategies, **Product, Process and Schedule Design**: Product Design, Process Design, Schedule Design and Facilities Design, **Flow, Space and Activity Relationships**: Activity Relationships, Flow Patterns, Measuring Flow, **Personnel Requirements**: Office Facility Planning, Employee – Facility Interface

Facility Design for Various Facilities Functions

Warehouse Operations: Missions of a warehouse, functions, Receiving, Shipping and Storage Operations

Manufacturing Systems: Fixed Automation & Flexible Manufacturing Systems, JIT & Reduction of WIP

Facilities Systems: Enclosure, Atmospheric, Electrical, Life Safety, Automation and Sanitation Systems

Material Handling: Scope and Definitions, Material Handling Principles, Designing Material Handling Systems, Unit Load Design, Material Handling Equipment, Safety Considerations

Layout Planning Models: Basic Layout types, Layout Procedures, Developing Layout Alternatives, Computerized Layout techniques

Developing Alternatives – Quantitative Facilities Planning Models:

Facility Location, Machine Layout, Conventional Storage, Automated Storage and Retrieval Systems, Fixed Path Material Handling, Waiting Line, Simulation Models

Evaluating and Selecting Facilities Plan, Preparing, Presenting, Implementing and Maintaining the Facilities

Text Books:

1. Facilities Planning, John Wiley & Sons, 2003, James A. Tompkins, John A. White
2. Manufacturing Facilities: Location Planning and Design, PWS Publishing Co., 1994, Dileep R. Sule

Reference Books:

1. Manufacturing Facilities Design and Material Handling, Allyn & Bacon, 1999, Fred E. Meyers, Matthew P. Stephens
2. Facilities Design, CRC Pr I Llc, 2008, Sunderesh Heragu

WORK STUDY & ERGONOMICS

COURSE CODE: 13ME-372 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Productivity: Meaning and Importance of Productivity, Factors Affecting Productivity. Productivity and Living Standards, Productivity Measurements, Work Design and Productivity, **Operations Analysis**: Total Time for A Job Or Operation, Total Work Content And In-Effective Time, Methods And Motions, Graphic Tools. **Work Study**: Techniques of Work Study, Basic Procedure of Work Study. METHOD STUDY: Tools for Recording Techniques – Flow Process Chart, Flow Diagram, String Diagram, Multiple Activity Chart, Man-Machine Chart. MICRO MOTION STUDY: Therbligs, Motion Economy Principles, SIMO Chart. **Work Measurement**: Stopwatch Time Study Procedure - Breaking The Job Into Elements, Timing Methods, Number Of Cycles To Be Timed, Rating, Allowances, Setting Standard Time. **WORK SAMPLING**: Confidence Levels, Number Of Observations, Use Of Random Number Table. **Human Factors in Work system Design**: Human Factors Engineering/Ergonomics, Human Performance in Physical Work, Anthropometry, Design of Workstation, Design of Displays and Controls, Job Enrichment, Job Enlargement. **Types of Production Systems**: Mass Production, Batch Production, Job Order Production. Production Planning & Control Functions, **Facility Layout**: Types of Layout - Line Layout for Product Focused System, Functional Layout for Process Focused System, Fixed Position Layout, Introduction to

Computerized Layout Methods, **Material Handling**: Material Handling Objectives And Principles - Unit Load Concept. Factors Affecting Choice of Handling Equipment, Classification of Material Handling

Text Books

1. Introduction to Work study by I.L.O. Geneva.
2. Motion & time study by Barnes, R.M.

Reference Books

1. Industrial Management by Ahuja, vol.1 and 2.
2. Industrial Engineering & Management by Dr. R. Ravisankar

TOTAL QUALITY MANAGEMENT

COURSE CODE: 13ME-373 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Introduction, Quality and improvement, and evolution of TQM, Quality assurance, quality system, quality loss function, link between quality and productivity. Philosophy of Deming, Juran, Crossby. Seven tools of TQM - Control charts, check sheets, flow charts, graphs, histograms, pareto chart, cause-effect diagram, scatter diagram,

Quality function deployment – Introduction, benefits, process, quality circle, zero-defect programme .Quality control charts for variables, attributes, (X bar, R, p, c, np, U charts), Process capability,

Acceptance sampling – introduction, definition, objectives, benefits, different sampling plans, O.C.curve- construction, properties (for single sampling plan)

Bench marking, quality costs, total productive maintenance, ISO 9000- Introduction, series of standards, benefits, requirements, implementation, documentation, quality auditing.

Continuous process improvement – basic concepts of KAIZEN, 5S, POKAYOKE, JIT & KANBAN, PDSA cycle, Six sigma, Taguchi methods

Text Books:

1. D. Besterfield, Total Quality Management, 2007, Phi.
2. E. L. Grantt, Statistical Quality Control, 7th Edition, 2008, Tata Mc-Graw Hill.

Reference Books:

1. P.Charntimath, Total Quality Management, 2006, Pearson Education.
2. L.Suganthi, Anand A. Samuel, Total Quality Management, 2004, PHI.
3. D. Besterfield, Quality Control, 7th Edition, 2008, Pearson Education.
   D.C. Montgomery, Introduction to Statistical Quality Control, 4th Edition, 2008, Wiley India

OPERATIONS MANAGEMENT

COURSE CODE: 13ME-374 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Operations Management: definition, historical development, evolution, functions, **Forecasting**: definition, approaches, types, qualitative approach, judgmental methods, quantitative approach, time series, regression, multiple regression, forecasting error estimation techniques, Introduction to aggregate planning, **Production Management**: Types of production systems, Mass production, Batch production, Job order production. Productivity and factors influencing productivity, **Facility layout**: definition, types – product layout, process layout, fixed position layout, cellular layout, introduction to computerized layout, **Material handling**: definition, objectives, principles, unit load concept, factors affecting choice of MH equipment, classification, benefits, **Scheduling**: Introduction, concept of assembly line balancing, scheduling of batch production, scheduling of job order, loading, sequencing,- definition, sequencing of n jobs through one machine, n jobs through 2 machines, (Johnsons' algorithm), sequencing of n jobs through 3 machines, n jobs through m machines. **Inspection & Quality Control**: Concept and Types of Inspection, Quality Control Charts – SQC, Charts for variables and charts for attributes, application and construction of charts and problems. **Acceptance sampling**, Single and double sampling, OC curve, **Reliability**: definition, failure rate diagram, reliability computation, **Production planning & control**: Introduction, definition, functions of PPC. **Brief introduction to**: JIT, Lean manufacturing, Six sigma, Supply chain management.

Text Books:

1. Production & Operations Management -- G.J. Monks
2. Production & Operations Management -- Adam & Ebert

Reference Books:

1. Production & operations Management – S.N. Chari.
2. Production & operations Management -- Panner selvam.

SPECILIZATION - AUTOMOBILE ENGINEERING

AUTOMOBILE ENGINEERING

COURSE CODE: 13ME-335 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS: 3

Introduction to Automobiles: Classification of vehicles – applications, options of prime movers, Components, Requirements of Automobile Body; Vehicle Frame, Separate Body & Frame, Unitised Body, Car Body Styles, Bus Body & Commercial Vehicle Body Types; Front Engine Rear Drive & Front Engine Front Drive Vehicles, Four Wheel Drive Vehicles, Safety considerations; Safety features of latest vehicle; Future trends in automobiles. **Engine:** Engine Classification, types of combustion chambers for petrol and diesel engines, valves, valve arrangements and operating Mechanisms, pistons, piston rings, Firing order; Crankshafts, Flywheel. Fuel Supply systems for Petrol Engines, Fuel pumps. Mechanical and Electrical Diaphragm pumps, Carburetors, Electronic petrol injection**. Ignition Systems:** Energy requirement for ignition**,** Battery ignition system, Magneto ignition, modern systems, firing order, timing and engine parameters, **Cooling Systems:** Coolants, properties, Air and water cooling systems. **Lubrication System:** Lubricants, Properties, Splash, semi-pressure and full pressure Lubricating systems. **Chassis:** Components of an automobile, Layout, Specifications, Articulated and rigid vehicles, Front wheel drive, rear wheel drive, 4- wheel drive, frame, types, aerodynamic considerations, energy absorbing bumpers. **Emission:** Emission from automobiles-pollution standards, national and international-pollution control techniques. **Transmission:** Clutches: single and Multi-plate clutches, Centrifugal clutches, wet and dry type, actuating mechanisms, Gear Box - Four speed and Five Speed Sliding Mesh, Constant mesh & synchromesh type, selector mechanism, automatic transmission, overdrive, propeller shaft, differential - principle of working. **Suspension:** systems, springs, shock absorbers, axles – front and rear, different methods of floating rear axle, front axle and wheel alignment. **Vehicle Control:** steering mechanisms and power steering, types of brakes and brake actuation mechanisms (air and hydraulic).

Electronic systems: Typical engine management systems, position displacement and speed sensing, measurement of pressure, temperature and intake air flow, exhaust oxygen sensor.

TEXT BOOKS:

1. Automotive Mechanics – Crouse / Anglin, TMH.
2. Automotive Mechanics, Principles & Practices – Joseph Heitner, EWP.

REFERENCE BOOKS:

1. Motor Automotive Technology by Anthony E. Schwaller – Delmer Publishers, Inc.
2. The Motor Vehicle – Newton steeds Garrett, Butter Worths.

COMPUTER AIDED DESIGN

COURSE CODE: 13ME-345 L – T – P: 3-0-0

PRE-REQUISITE: 13ME-205 CREDITS: 3

INTRODUCTION: Fundamentals of CAD, Design process, Applications of computer for design, Benefits of CAD, Computer peripherals for CAD work station, Graphic terminal, CAD software, CAD database and structure.

DISPLAY DEVICES: Video display devices – Raster scan display, CRT , DVST,Inherent memory display devices, Random Scan Display, Raster scan systems – Video controller, Random scan systems – Graphic monitors and work station, Input devices.

PRIMITIVES: Points and Lines, Line drawing algorithms, DDA algorithm, Bresenham's line algorithm, Circle generation algorithm, Mid point circle algorithm.

GEOMETRIC MODELING: 2D wire frame modeling, 3D Wire frame modeling, Wire frame models , Entities and their definitions. Concept of Parametric and nonparametric representation of curve, Curve fitting techniques, Definitions of cubic splines.

SURFACE MODELING: Surface modeling and entities, Algebraic and geometric form, Parametric space of Surface, Blending functions, Reparametrisation of surface patch, Sub dividing cylindrical surface, Ruled surface, Surface of revolution, Spherical surface, Composite surface.

SOLID MODELING: Solid models, Solid entities, Solid representation, Sweep representation, Constructive solid geometry and Boundary representation, Solid modeling based applications.

GEOMETRIC TRANSFORMATIONS: Transformation Principles, Translation,Scaling, Rotation, Matrix Representations and Homogeneous Coordinates, Composite transformations and other transformations

WINDOWS and CLIPPING: Introduction, The Viewing Transformation, Viewing transformation implementation, Clipping operation.

TEXT BOOKS:

1. CAD/CAM by Mikel P.Groover and Emory W.Zimmers,Prentice Hall of India , Delhi
2. CAD/CAM by P.N.Rao, Tata McGrawhill , Delhi
3. CAD by Ibrahim Zeid, Tata McGrawhill,Delhi.

Principles of Interactive Computer Graphics by Newman and Sproull, McGrawhill

VEHICLE DYNAMICS

COURSE CODE: 13ME-346 L – T – P: 3-0-0

PRE-REQUISITE: 13ME-206 CREDITS: 3

Introduction to vehicle dynamics: Vehicle coordinate systems; loads on axles of a parked car and an accelerating car. Acceleration performance: Power-limited acceleration, traction-limitedacceleration.

Tire models: Tire construction and terminology; mechanics of force generation; rolling resistance; tractive effort and longitudinal slip; cornering properties of tire; slip angle; camber thrust;aligningmoments.

Aerodynamic effects on a vehicle: Mechanics of airflow around the vehicle, pressure distribution, aerodynamic forces; pitching, rolling and yawing moments; crosswind sensitivity.

Braking performance: Basic equations for braking for a vehicle with constant deceleration and deceleration with wind-resistance; braking forces: rolling resistance, aerodynamic drag, driveline drag, grade, tire-road friction; brakes, anti-lock braking system, traction control, brakingefficiency.

Steering systems and cornering: Geometry of steering linkage, steering geometry error; steering system models, neutral steer, under-steer, over-steer, steering ratio, effect of under-steer; steering system force and moments, low speed and high speed cornering; directional stability of the vehicle; influence of front-wheel drive.

Suspension and ride: Suspension types—solid axle suspensions, independent suspensions; suspension geometry; roll centre analysis; active suspension systems; excitation sources for vehicle rider; vehicle response properties, suspension stiffness and damping, suspension isolation, active control, suspension non-linearity, bounce and pitch motion.

Roll-over: Quasi-static roll-over of rigid vehicle and suspended vehicle; transient roll-over, yaw-roll model, tripping.

Multi-body systems: Review of Newtonian mechanics for rigid bodies and system of rigid bodies; coordinate transformation between two set of axes in relative motion between one another;

Euler angles; angular velocity, angular acceleration, angular momentum etc. in terms of Euler angle parameters; Newton-Euler equations of motion; elementary Lagrangian mechanics: generalised coordinates and constraints; principle of virtual work; Hamilton's principle; Lagrange's equation, generalized forces. Lagrange's equation with constraints, Lagrange's multiplier.

Text Books

1. T.D. Gillespie, "Fundamental of Vehicle Dynamics", SAE Press (1995)
2. J.Y. Wong, "Theory of Ground Vehicles", 4th Edition, John Wiley & Sons (2008).
3. Reza N. Jazar, "Vehicle Dynamics: Theory and Application", 1st Edition, 3rd Printing, Springer (2008).
4. R. Rajamani, "Vehicle Dynamics and Control", Springer (2006).
5. A.A. Shabanna, "Dynamics of Multibody Systems", 3rd Edition, Cambridge University Press (2005).

Reference Books

1. G. Genta, "Motor Vehicle Dynamics", World Scientific Pub. Co. Inc. (1997).
2. H.B. Pacejka, "Tyre and Vehicle Dynamics", SAE International and Elsevier
3. Dean Karnopp, "Vehicle Stability", Marcel Dekker (2004).
4. U. Kiencke and L. Nielsen, "Automotive Control System", Springer-Verlag, Berlin.
5. M. Abe and W. Manning, "Vehicle Handling Dynamics: Theory and Application", 1st Edition, Elsevier (2009).

AUTOMOBILE CHASSIS AND BODY ENGINEERING

COURSE CODE : 13ME-364 L – T – P: 3-0-0

PRE-REQUISITE: 13ME-106 CREDITS: 3

Vehicle Aerodynamics Vehicle drag and types – various types of forces and moments – effects of forces and moments–side wind – various body optimization techniques, Aerodynamic Aids for Optimisation of drag– wind tunnel, testing of scale model.Car Body Types, Regulations, Drivers seat design & dimensions parameters, drivers visibility, methods for improving visibility and space in cars, design for safety, safety requirements for car (with reference to Vehicle Body Engineering), car body construction. Crash Test and Roll over test regulations. Heating and ventilation systems. Dash boards, instrument panel and passenger compartment lighting, Audio – visual systems.Bus Body DetailsTypes: Mini bus, single decker & double decker, two level, split level andarticulated bus, bus body layout, floor height, engine location, entrance and exit locations, passenger seating dimensions , seat layout for RTO registration, constructional details, frame construction, double skin construction, types of metal sections used, conventional and integral coachtype construction. Bus body Code Regulations (ARAI). Pneumatic equipment for passenger door opening & closing. Air conditioning equipment selection and mounting.Commercial Vehicle DetailsTypes of body, flat platform, drop side, fixed side, tipper body, tanker body, light commercial vehicle body types. Dimensions of driver's seat in relation to controls, drivers cab design. Tipper body designs, volume/weight considerations, pay load and related regulationsBody LoadsIdealized structure, structural surface, shear panel method, symmetric and asymmetric vertical loads in a car, longitudinal load,different loading situations, chassis frame design. Construction of Doors, door apertures, windows.Spare wheel carrier construction and design for different types of vehicle and weight distribution criteria in relation to Spare wheel location.Sources of body noises testing and methods of elimination. Water leakage test.Body Materials Metal sheets (Steel, Aluminum etc.), plastics, timber, GRP, FRP, Insulating materials, adhesives and sealants. Wind screen, Back light & window Glasses and regulations for glasses. Difference between toughened glass, sheet glass & laminated glass. Composite materials, properties of materials, corrosion, anti-corrosion methods, selection of paint and painting process, body trim items, body mechanisms

Text Books

1."Automotive Chassis & Body", by P.L.Kohli, Papyrus Publishing House, NewDelhi.

2. "Automotive Chassis", by Crouse W.H.& Anglin D.L, McGraw - Hill Int. Book Co.

Reference Books

1."Body Engineering", by Sydney F. Page, Chapman & Hill Ltd., London.

2."Fundamentals of Vehicle Body work", by J. Fairbrother, Hutchinson, London.

3."Automotive Chassis", by P.M. Heldt, Chilton Co. NK

4.“Vehicle Body Layout & Analysis”, by John Fenton, Hutchinson, London.
5.“Vehicle Body Engineering”, by J. Powloski, Business Books Ltd., London.
6.“Body Construction and Design”, (Vol. 6), by J.G. Giles, Llefe Books/Butterworth & Co. London

ENERGY SYSTEMS & PERFORMANCE

COURSE CODE : 13ME-336 L – T – P: 3-0-0
PRE-REQUISITE: 13ES-201 CREDITS: 3

Working principles: constructional details; classification and application of different types of I.C Engines, Wankel and other rotary engines; Operation of the stirling Engine; Mixture preparation systems for SI and CI Engines; combustion chambers; Ignition, lubrication and cooling systems; speed governing systems; Intake and exhaust systems; Supercharging methods; Turbocharger matching; Aero-thermodynamics of compressors and turbines; Engine Testing performance; Effects of engine design and operating parameters on performance and emissions;

TEXT BOOKS:
1. Heinz Heisler, “Advanced Engine Technology,” SAE International Publications USA, 1998.
2. John B Heywood “Internal combustion Engine Fundamentals”. Tata Mcgraw-Hill, 1988

REFERENCE BOOKS
1. Ganesan V, “ Internal Combustion Engines, Third Ed. Tata Mcgraw –Hill, 2007
2. I.C.Engines – M.L Mathur and Sharma Dhanpat Rai & Sons.
3. Patterson D.J. and Henein NA “ Emissions from Combustion engines and their control’, Ann Arbor Science Publication Inc. USA, 1978
4. Gupta H.N. “ Fundamentals of Internal combustion Engines”, Prentice Hall of India 2006
5. Ultrich Adler “Automotive Electric /Electronic systems, Published by Robert Bosh GMBH, 1995

COMPUTATIONAL FLUID DYNAMICS

COURSE CODE : 13ME-337 L – T – P: 3-0-0
PRE-REQUISITE: 13ME-201 CREDITS: 3

Introduction: Conservation equation; mass; momentum and energy equations; convective forms of the equations and general description; **Classification and Overview of Numerical Methods:** Classification into various types of equation; parabolic elliptic and hyperbolic; boundary and initial conditions; over view of numerical methods; **Finite Difference Technique:** Finite difference and volume methods; Taylor series expansion; boundary layer treatment; **Methods of Solution:** Solution of finite difference equations; iterative methods; matrix inversion methods; ADI method; operator splitting; fast Fourier transform; **Time integration Methods:** Single and multilevel methods; Applications to transient conduction and advection-diffusion problems; **Numerical Grid Generation:** Numerical grid generation; basic ideas; transformation and mapping; **Navier-Stokes Equations:** Explicit and implicit methods; SIMPLE type methods; fractional step methods; **Turbulence modeling:** Reynolds averaged Navier-Stokes equations, RANS modeling, DNS and LES.
Software Package: ANSYS 13(Fluent/CFX)

TEXT BOOKS:
1. Numerical Computation of Internal and External Flows, C. Hirsch, Vols. I & II, John Wiley & Sons (2004)
2. An Introduction to Computational Fluid Dynamics, H. K. Versteeg & W. Malalasekera, Longman Scientific & Technical (1995)

REFERENCE BOOKS:
1. Computational Fluid Mechanics and Heat Transfer, J. C. Anderson, D. A. Tannehil and R. H. Pletcher, Taylor & Francis publications, USA (1997)

Fundamentals of CFD, T. K. Sengupta, Universities Press (2004)

ROTOR DYNAMICS

COURSE CODE : 13ME-347 L – T – P: 3-0-0
PRE-REQUISITE: 13ES-106 CREDITS: 3

Rotor-Bearing Interaction, Flexural Vibration, Critical Speeds of Shafts, Jeffcott Rotor Model, Unbalance Response, Effect of Damping, Campbell Diagram, Effects of Anisotropic Bearings, Unbalanced Response of an Asymmetric Shaft, Parametric Excitation, Gyroscopic Effects, Rotor with Non-central Disc, Rigid-rotor of Flexible Bearings, Stodola Model, Effect of Spin Speed on Natural Frequency, Forward and Backward Whirling Motion, Aerodynamic Effects, Rotor-shaft Continuum, Effect of Rotary Inertia and Shear-Deformation within the Shaft, Equivalent Discrete System, Finite Element model for Flexural Vibration, Torsional Vibration, Geared and Branched Systems, Transfer Matrix Model, Fluid Film Bearings: Steady State Characteristics of Bearings, Raynold's Equation, Oil-Whirl, Rigid And Flexible Rotor Balancing, Active Vibration Control of Rotor-Bearing System: Active Magnetic Bearing, Condition Monitoring of Rotating Machinery, Measurement Techniques

Texts:

- J. S. Rao, Rotor Dynamics, Third ed., New Age, New Delhi, 1996 (2009 reprint).
- M. J. Goodwin, Dynamics of Rotor-Bearing Systems, Unwin Hyman, Sydney, 1989.

References:

- E. Krämmer, Dynamics of Rotors and Foundation, Springer-Verlag, New York, 1993.
- G. Genta, Dynamics of Rotating Systems, Springer, New York, 2005.
- J.M. Vance, Rotordynamics of Turbomachinery, Wiley, New York, 1988.
- M.L. Adams, Rotating machinery vibration: from analysis to troubleshooting, Second ed., CRC Press, Boca Raton, 2010.
- J. Kicinski, Rotor dynamics, Tech. Book, New Delhi, 2010.
- D. Childs, Turbomachinery Rotordynamics: Phenomena, Modeling and Analysis, Wiley, New York, 1993.

AERO STRUCTURES

COURSE CODE : 13ME-348	L – T – P: 3-0-0
PRE-REQUISITE: 13ME-205	CREDITS: 3

Stresses, Strains, Material Properties, Plane Stress : Stress & Strains in 3D, Average Stresses & Component Design, Thin Wall Pressure Vessels,. Stress-Strain Material Laws. Plane Stress Transformations. **Torsion :**Torsion of Circular Cross Sections, Torsion of Open Thin Wall (OTW) Sections, Torsion of Closed Thin Wall (CTW) Sections. **Beam Deflections :** Beam deflections by 2nd Order Method, Beam deflections by 4th Order Method & Adl' Topics, Beam deflections by Discontinuity Functions. **Introduction to Finite Elements and the Direct Stiffness Method** : The Direct Stiffness Method I, The Direct Stiffness Method II, The Direct Stiffness Method III, FEM Analysis of Plane Beam Structure. **Introduction to Structural Dynamics and Vibrations : F**ree SDOF Oscillator, Harmonically Forced SDOF Oscillator, MDOF Dynamical Systems, Vibrations of beams. **Introduction to Structural Stability :** Stability of Structures: Basic Concepts, Discrete Models, Continuous Models, Additional Topics.

1. Mechanics of Materials, 8th edition, Gere and Goodno, 2006, Cengage
2. Hibbeler, R.C.; "Statics and Mechanics of Materials"; 2010; Pearson Prentice Hall ; 9780122166744
3. Leonard Meirovitch, Fundamentals Of Vibrations, 1st edition , TataMcGrawHill, 2001
4. G.K.Grover, Mechanical Vibrations, Neem Chand & Bros. 7th Edition

PROPULSION ENGINEERING

COURSE CODE: 13ME338	**L – T – P**: 3-0-0
PRE-REQUISITE: 13ME301	**CREDITS**: 3

Introduction: Propulsion, Jet and Duct Propulsion, Impulse, Force, universal law for gravitational force, Orbits, orbit velocities, Forces acting on vehicle, basic relation of motion, escape velocity, Rocket equation, Mass ratio of rocket, propulsion efficiency, Performance parameters of a rocket, staging and clustering, effect of propulsion system on vehicle performance; Nozzles: Flow through nozzles, Convergent divergent nozzle, choking, variation of parameters in nozzle, variation of parameters in nozzle, Expansion ratio of nozzles, Performance loss in nozzles, Under – expanded and over – expanded nozzles, flow separation, Real nozzles, efficiencies and thrust correction factor; Air – Breathing Engines: Thermodynamic cycles of jet engines, Thrust and efficiency, Turbojet engine Turbo engines, Turboprop engines, performance characteristics of engines, inlets, thrust chamber, nozzles; Solid Rocket Motor : Solid Propellants, ingredients, characteristics, motor configuration, liners, inhibitors and insulators, Ignition process. Burn rate, propellant grain, grain configuration, variation of burn rates with rocket size. Liquid Rocket Propulsion: Liquid Propellants and characteristics, Liquid rocket engine configurations, feed system, Thrust chamber, injector types, combustion chamber, Turbo-pumps, Complexity of liquid propellant rockets, determination of Performance; Advance Propulsion systems: Hybrid Rockets, Nuclear, tri-propellant and advanced propulsion, Ramjet.

TEXT BOOKS:

1. Hill, P.G. and Peterson, CR., Mechanics and thermodynamics of propulsion, 2nd ed.,: Addison Wesley Publishing Company, 2010.

REFERENCES:

1. Sutton, G.P. and Biblarj, O. Rocket Propulsion elements, 7th Ed., New York: Wiley Intescience Pulications, 2001.
2. Ronold D, Flack. Fundamentals of Jet Propulsion with Applications, Cambridge University Press, 2011.

MECHATRONICS SYSTEMS AND CONTROL

COURSE CODE: 13ME355 L – T – P: 3-0-0
PRE-REQUISITE: 13ME109 CREDITS: 3

Time response design: Routh-Hurwitz test, relative stability, Root locus design, construction of root loci, phase lead and phase-lag design, lag-lead design.

Frequency response design: Bode, polar, Nyquist, Nichols plot, lag, lead, lag-lead compensator, time delay, process plant response curve. PID controller design.

Modern control: Concept of states, state space model, different form, controllability, observability; pole placement by state feedback, observer design, Lunenburg observer, reduced order observer, observer based control.

Optimal control design: Solution-time criterion, control-area criterion, performance indices; zero steady state step error systems; modern control performance index: quadratic performance index, Ricatti equation.

Digital control: Sampling process, sample and hold, analog to digital converter, use of z-transform for closed loop transient response, stability analysis using bilinear transform and Jury method, digital control design using state feedback.

Non-Linear Control System: Common physical non-linear system, phase plane method, system analysis by phase plane method, stability of non-linear system, stability analysis by describing function method, Liapunov's stability criterion, Popov's stability criterion.

Text Books:

1. K. Ogata, "Modern Control Engineering", Prentice Hall India (2002).
2. Gene F. Franklin, J. D. Powell, A E Naeini, "Feedback Control of Dynamic Systems", Pearson (2008).
3. John Van De Vegte, "Feedback Control Systems", Prentice Hall (1993).
4. Thomas Kailath, "Linear Systems", Prentice Hall (1980).
5. Alok Sinha, "Linear Systems: Optimal and Robust Control", Taylor & Francis
6. Brian D. O. Anderson and John B. Moore, "Optimal Control: Linear Quadratic Methods", Dover Publications (2007).
7. K. Ogata, "Discrete-Time Control Systems", PHI Learning (2009).
8. H.K. Khalil, "Nonlinear Systems", Prentice Hall (2001).

FATIGUE, CREEP AND FRACTURE

COURSE CODE: 13 ME349 L – T – P: 3-0-0
PRE-REQUISITE: 13ME205 CREDITS: 3

Analysis of stresses and strains in three dimensions: Principal stresses and strains. Stress / Strain Invariants, Octahedral stresses, Theories of Failure, Various yield criteria. **Repeated stresses and fatigue in metals:** Fatigue tests, endurance limit. Fatigue under combined loadings. Fatigue design theory: Goodman, Gerber and Soderberg criteria. Factors **influencing**

fatigue behavior of metals: Frequency, temperature, size, form, surface conditions, residual stress, etc. Influence of stress concentration, Notch sensitivity. Various mechanical and metallurgical methods used for improving fatigue strength of metals. Effect of corrosion, Corrosion fatigue and fretting. Cumulative fatigue damage and life estimation of components.

Fracture mechanics: Basic modes of fracture. Griffith theory of brittle fracture and Orwon's modifications. **Linear Elastic fracture mechanics:** Stress field ahead of crack-tip, Stress Intensity factors, Critical SIF, Fracture toughness testing and evaluation of KIC. Elasto-plastic fracture mechanics: Plane stress and plane strain plastic zone sizes. J-Integral method. SERR computations and evaluation of structural integrity.

Creep behavior of metals: Creep–stress-time-temperature relations, creep testing methods. Mechanics of creep, creep in tension, bending and torsion. Strain-hardening effects on creep. Creep buckling, members subjected to combined stresses and creep.

Text Books:
1. Mechanical Metallurgy – George E. Dieter (McGraw-Hill)
2. Elementary Engineering Fracture Mechanics – David Broek (Springer)

References:
1. Engineering Fracture Mechanics – S. A. Meguid (Springer)
2. Fracture Mechanics – C. T. Sun and Z. H. Jin (Elsevier)
3. Elements of Fracture Mechanics – Prashant Kumar (Tata Mcgraw Hill)
4. Fundamentals of Fracture Mechanics – TribikramKundu (CRC Press)
5. Mechanical Behaviour of Materials – Norman E. Dowling (Prentice Hall)
6. Metal Fatigue in Engineering – R. I. Stephens and H. O. (Willey)

Creep of Engg. Materials – I. Finnie and W. R. Heller (Mc Graw Hill Book Co.)

FLEXIBLE MANUFACTURING SYSTEMS

COURSE CODE: 13 ME365 L – T – P: 3-0-0
PRE-REQUISITE: 13ME-204 CREDITS: 3

Automation: Types of automation, Automated assembly systems, Group Technology, Flexible Manufacturing Systems: Components of an FMS, Robotic technology, Robot programming: Types of programming, lead through programming, Robot applications: Characteristics of robot applications, robot cell design, types of robot applications: Material handling, processing operations, assembly and inspection.

Text Books:
1. Automation, Production Systems and Computer Integrated Manufacturing. Groover M.P, Prentice Hall of India.
2. CAD/CAM – Groover M.P, Zimmers E.W, Prentice Hall of India.

Reference Books:
1. Approach to Computer Integrated Design and Manufacturing Nanua Singh, John Wiley and Sons, 1998.
2. Production Management Systems: A CIM Perspective Browne J, Harhen J, Shivnan J, Addison Wesley, 2nd Ed. 1996.

MODERN MANUFACTURING PROCESSES

COURSE CODE: 13ME366 L – T – P: 3-0-0
PRE-REQUISITE: 13ME204 CREDITS: 3

Introduction, Need For Non Traditional Machining Methods, Classification of Modern Machining Processes, Considerations in process selection, materials and applications, Mechanical Energy Based Processes, Chemical Energy Based Processes, Electro – Chemical Energy Based Processes, Thermo Electric Energy Based Processes, Advanced Welding Techniques, High Velocity Forming

Process. Introduction, Selection, Comparison Of Conventional, Explosion Forming Process, Electro Hydraulic Forming, Magnetic Pulse Forming, Petro Forge Hammer.

Text Books:

1. Advanced machining processes / Jain V K / Allied Publishers, 2005
2. Welding and Welding Technology, Richard L. Little, McGraw Hill.Inc., U S,Ist Edition.

Reference Books:

1. Modern Machining Processes / Pandey P.C. and Shah H.S./ TMH, 1995
2. New Technology / Bhattacharya A/ The Institution of Engineers, India 1984
3. Production Technology -- H.M.T.
4. High velocity forming of metals -ASTME Prentice Hall

Non Conventional Machining by P K Mishra, Narosa Publications

CELLULAR MANUFACTURING

COURSE CODE : 13ME-367 L – T – P: 3-0-0

PRE-REQUISITE: 13ME-204 CREDITS: 3

: Introduction Concept of group machining, Terminologies associated with Cellular manufacturing, Comparison between tradition and Cellular Manufacturing System. Classification and coding systems, Cell Formation Techniques, Data Structures and its influence on solutions, Processing exceptional Components in Cellular Manufacturing, Evaluation of Cellular Manufacturing Solutions, Scheduling, Line Balancing and Inventory Control in cellular manufacturing, Implementation issues in Cellular Manufacturing, Case study on application of cellular manufacturing.

Text Books:

1. BS Nagendra Parashar (2009), Cellular Manufacturing Systems and Integrated Approach, PHI Publications, New Delhi)
2. Andreq Kusaik, "Intelligent Manufacturing System"

Reference Books:

1 Irani SA, "Cellular Manufacturing Systems"

2 Mikell.P.Groover "Automation, Production Systems and computer integrated manufacturing", Pearson Education, 2007

COMPUTER INTEGRATED MANUFACTURING

COURSE CODE: 13ME368 L – T – P: 3-0-0

PRE-REQUISITE: 13ME204 CREDITS: 3

Introduction, Scope of Computer Integrated Manufacturing, Group Technology, Benefits of G.T., FMS, Computer Aided Process Planning, Role of Process Planning, Integrative Manufacturing Planning and Control, Overview Of Production Control, Computer Aided Quality Control, Terminology in quality control, Computer Integrated Manufacturing systems, Computer networks for Manufacturing, The Future Automated Factory, Trends in Manufacturing.

Text Books:

1. David D.Bedworth, Mark R.Hendersan, Phillip M.Wolfe "Computer Integrated Design and Manufacturing", McGraw-Hill Inc.
2. Mikell.P.Groover and Emory Zimmers Jr., "CAD/CAM", Prentice Hall of India Pvt. Ltd., 2008.

Reference Books:

1. Mikell.P.Groover "Automation, Production Systems and computer integrated manufacturing", Pearson Education, 2007.
2. Yorem koren, "Computer Integrated Manufacturing System", McGraw-Hill, 1983.

MODELING & SIMULATION OF MECHATRONIC SYSTEMS

COURSE CODE: 13ME357 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS: 3

Physical Modelling: Mechanical and electrical systems, physical laws, continuity equations, compatibility equations, system engineering concept, system modelling with structured analysis, modelling paradigms for mechatronic system, block diagrams, mathematical models, systems of differential-algebraic equations, response analysis of electrical systems, thermal systems, fluid systems, mechanical rotational system, electrical-mechanical coupling.

Simulation Techniques: Solution of model equations and their interpretation, zeroth, first and second order system, solution of 2nd order electro-mechanical equation by finite element method, transfer function and frequency response, non-parametric methods, transient, correlation, frequency, Fourier and spectra analysis, design of identification experiments, choice of model structure, scaling, numeric methods, validation, methods of lumped element simulation, modelling of sensors and actuators, hardware in the loop simulation (HIL), rapid controller prototyping, coupling of simulation tools, simulation of systems in software (MATLAB, LabVIEW) environment.

Modelling and Simulation of Practical Problems:

- Pure mechanical models
- Models for electromagnetic actuators including the electrical drivers
- Models for DC-engines with different closed loop controllers using operational amplifiers
- Models for transistor amplifiers
- Models for vehicle system

Text Books:

1. L. Ljung, T. Glad, "Modeling of Dynamical Systems", Prentice Hall Inc. (1994).
2. D.C. Karnopp, D.L. Margolis and R.C. Rosenberg, "System Dynamics: A Unified Approach", 2nd Edition, Wiley-Interscience (1990).
3. G. Gordon, "System Simulation", 2nd Edition, PHI Learning (2009). V.
4. Giurgiutiu and S. E. Lyshevski, "Micromechatronics, Modeling, Analysis, and Design with MATLAB", 2nd Edition, CRC Press (2009).

SIGNAL PROCESSING IN MECHATRONIC SYSTEMS

COURSE CODE: 13ME358 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS: 3

Discrete- Time Signals: Sequences; representation of signals on orthogonal basis; Sampling and Reconstruction of signals

Discrete systems: Z-Transform, Analysis of LSI systems, Frequency Analysis, Inverse Systems, Discrete Fourier Transform (DFT), Fast Fourier Transform algorithm, Implementation of Discrete Time Systems.

Frequency selective filters: Ideal filter characteristics, lowpass, highpass, band pass and bandstop filters, Paley-Wiener criterion, digital resonators, notch filters, comb filters, all-pass filters, inverse systems, minimum phase, maximum phase and mixed phase systems.

Design of FIR and IIR filters: Design of FIR filters using windows, frequency sampling, Design of IIR filters using impulse invariance, bilinear transformation and frequency transformations, Butterworth, Chebyshev Filters.

Introduction to multi-rate signal processing: Decimation, interpolation, polyphase decomposition; digital filter banks: Nyquist filters, two channel quadrature mirror filter bank and perfect reconstruction filter banks, subband coding.

Introduction to DSP Processors: Introduction to various Texas processors such as TMS320C6713, TMS320C6416, DM6437 Digital Video Development Platform with Camera, DevKit8000 OMAP3530 Evaluation Kit.

Applications: Application of DSP to Speech and Radar signal processing, A few case studies of DSP applications in multimedia using TI DSP kits.

Text books:

1. S. K. Mitra, Digital Signal Processing: A computer-Based Approach, 3/e, TMcHl, 2006.
2. A. V. Oppenheim and R. W. Shafer, Discrete-Time Signal Processing, Prentice Hall India, 2/e, 2004.
3. J. G. Proakis and D. G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 4/e, Pearson Education, 2007.

References:

1. V.K. Ingle and J.G. Proakis, "Digital signal processing with MATLAB", Cengage, 2008.
2. T. Bose, Digital Signal and Image Processing, John Wiley and Sons, Inc., Singapore,04.
3. L. R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, PH, 2005.
4. A. Antoniou, Digital Filters: Analysis, Design and Applications, Tata McH, 2003.

FUZZY SETS AND ARTIFICIAL INTELLIGENCE

COURSE CODE: 13ME359 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS: 3

Basic Concepts of Fuzzy Sets, Fuzzy Logic, Zadeh's Extension Principle, Operations on Fuzzy Sets, Fuzzy Measures, Probability and Possibility Measures, Fuzzy Inference Methodologies, Fuzzy Relations, Applications of Fuzzy Sets in Management, Decision Making, Medicine and Computer Science.

Introduction to Artificial Intelligence, Production System and Artificial Intelligence, Problem Solving by Search, Predicate Calculus, Knowledge Representation, Semantics Nets, Frames, Conceptual Dependencies, Knowledge Bases and Expert Systems, Fuzzy Rule, Neuro Fuzzy Approaches, Case Studies in Various Domain.

Texts:

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 2nd Ed, Prentice Hall, 2003.
2. H.J.Zimmermann, Fuzzy Set Theory and Its Applications, 2nd Ed., Kluwer Academic Publishers, 1996.
3. D.Dubois and H. Prade, Fuzzy Sets and Systems: Theory and Applications, Academic Press, 1980.

References:

1. E. Charniak and D. McDermott, Introduction to Artificial Intelligence, Addison-Wesley, 1985.
2. E. Rich, Artificial Intelligence, McGraw-Hill, 1983.
3. P. H. Winston, Artificial Intelligence, Addison Wesley, 1993.
4. J.Yen and R.Langari, Fuzzy Logic Intelligence, Control, and Information, Pearson Education, 2005.
5. T.J.Ross, Fuzzy Logic with Engineering Applications, McGraw-Hill, 1997.
6. J.Kacprzyk, Multistage Fuzzy Control, Wiley, 1997.

ENGINEERING SMART MATERIALS FOR MECHATRONICS APPLICATIONS

COURSE CODE: 13 ME360 L – T – P: 3-0-0

PRE-REQUISITE: 13ME203 CREDITS: 3

Introduction: Smart materials and their application for sensing and actuation, Mechatronics aspects.**Piezoelectric materials:** Piezoelectricity and piezoelectric materials, Constitutive equations of piezoelectric materials, Piezoelectric actuator types, Control of piezoelectric actuators, Applications of piezoelectric actuators for precise positioning and scanning.

Shape memory alloys (SMA): Properties of shape memory alloys, Shape memory effects, Pseudo-elasticity in SMA, Design of shape memory actuator, selection of materials, Smart actuation and control, Applications of SMA in precision equipments for automobiles, trains and medical devices.

Electro-active polymers (EAPs): Ionic polymer metal composites (IPMC), Conductive polymers, Carbon nanotubes, Dielectric elastomers, Design & control issues for EAP actuators, Applications of EAP for biomemetic, tactile display and medical devices.

Magnetostrictive materials: Basics of magnetic properties of materials, magnetostriction: constitutive equations, types of magnetostrictive materials, Design & control of magnetostrictive actuators, Applications of magnetostrictive materials for active vibration control. **Summary, conclusion and future outlook:** Comparative analysis of different smart materials based actuators, Conclusions, Future research trend and applications trends of smart materials and smart materials based actuator technology.

Text books:

1. Jose L. Pons, Emerging Actuator Technologies, a Micromechatronics Approach, John Wiley & Sons Ltd, 2005. .
2. Ralph Smith, Smart Material Systems: Model Development, SIAM, Society for Industrial and Applied Mathematics, 2005. .
3. F. Carpi, D. De Rossi, R. Kornbluh, R. Pelrine, P. Sommer-Larsen, Dielectric Elastomers as Electromechanical Transducers, Elsevier, Hungry, 2008. .
4. Y. B. Cohen, Electroactive Polymer (EAP) Actuators as Artificial Muscles Reality, Potential and Challenges, SPIE press, USA, 2004.

B.TECH WITH HONOR'S DEGREE

BIOTECHNOLOGY

BIOCATALYSIS AND ENZYME MECHANISMS

COURSE CODE: 13BT547 L – T – P: 3-0-2
PRE-REQUISITE: 13BT201 CREDITS: 4

BIOCATALYSIS - Current Status, Advantages & disadvantages, Comparison with other Catalysts, Biocatalysts as a technology, Green Chemistry **.CHARACTERIZATION OF A BIOCATALYST**: Enzyme Kinetics, Basis of Enzyme Action, Theories of Enzyme Catalysis, Efficiency, Stability, Selectivity of Enzymes, Screening of New Enzyme Activity UNIT-III **BIOCATALYTIC ASYMMETRIC SYNHTHESIS**: Basic of stereochemistry; Enantiomerically pure amino acids, Hydroxy esters with carbonyl reductase, Alcohols with ADH, Penicillin G, Ephedrine, Chiral drugs, Anticholesterol drugs, Anti-infectives, Anti-AIDS drugs, Cardiovascular drugs, Applications of Lipases and Esterases in the Pharma industry, Steroids UNIT-IV **BIOCATALYSIS IN NON-CONVENTIONAL MEDIA**: Enzymes in organic solvents, Advantages of Biocatalysis in organic media, Role of water in Enzyme reactions in Organic solvents, Substrate as solvent, Ionic liquids and Supercritical Solvents for enzymatic reactions . **INDUSTRIAL ENZYMES**: Enzymes in the food industry, Cell-wall degrading enzymes, Lipases, Proteases, Amylases, Xylanases, Enzymes in brewing, Fat splitting, Enzymes in the paper and pulp industry, Enzymes in the textile industry, Enzymes for preservation, The future of enzyme applications

Text books:

1. Biocatalysis: Fundamentals & Applications by Andreas Sebastian Bommarius , Bettina R. Riebel, VCH.

2. 2. Biotransformations in Organic Chemistry by Kurt Faber, Springer Berlin.

Reference books:

1. Enzymes by Palmer,
2. Enzymes in Industry by Wolfgang Aehle, Wiley-VCH.

BIOREACTOR MODELING AND SIMULATION

COURSE CODE: 13BT507 L – T – P: 3-0-2

PRE-REQUISITE: 13BT305 CREDITS: 4

Fundamentals of Modeling: Different approaches towards modeling, (Empirical and Modeling approach), applications and advantages of modeling and simulations, general flow diagrams for model building, simulation tools (Berkeley-Madonna, Mat Lab- Simu Link) **Enzymes and growth kinetic models** Michaelis-Menten equation, graphical determination of Km and Vmax, Double Michaelis Menten kinetic model, inhibition models (Competitive, Non-Competitive, Uncompetitive, Deactivation Kinetics models) Monad growth kinetics model, equation for inhibition of growth, Product inhibition, , Teisser equation for growth, Contoin equation, Moses equation for growth models.**Modeling of batch cultures** Unstructured growth models, structural kinetic model, metabolic models for batch cultures.**Product formation Kinetics** Product formation kinetic models, unstructured models, chemically structured models, genetically structured models.**Case studies of simulations** Programme for simulation of Batch fermentation, continuous fermentation, steady state and fed batch fermentation.

Textbooks:

1. Biological reaction Engineering- J.J.Dunn, E.Heinzle, J.Ingham.
2. J.E.Presnosil Organic modeling fundamentals with simulation examples.
3. Biochemical Engineering fundamentals- James.E.Bailey and David.F.Ollis, Mc-Graw- Hill international Edition
4. Franks.R.G.E (1973), Modeling and simulation in chemical Engineering, Wiley, NewYork

Reference Books

1. Modeling and simulation in Biochemical Engineering. Adv, Biochemical Engineering, 3, 127-165
2. Hanm, B, Ruth. B (1997) Modeling dynamic biological systems, Springer-Verlag, New York.

PROTEIN ENGINEERING

COURSE CODE: 13BT530 L – T – P: 3-0-2

PRE-REQUISITE: 13BT302 CREDITS: 4

Protein Engineering Methods of protein isolation, purification, detection, quantitation and characterization. Study of protein structure and organization. Solid phase peptide synthesis, use of peptides in biology, examples of engineered proteins, protein design with examples. **Structure & Functional Relationship Of Proteins** Structural characteristics of DNA binding proteins, prokaryotic and Eukaryotic transcription factors, DNA polymerases, Bacteriorhodopsin, epidermal growth factors, insulin and PDGF receptors and their interaction effectors, protein phosphorylation, Immunoglobulins, nucleotide binding proteins, serine proteases, Ribonuclease, Lysozyme**.** **Protein Folding** haperons in protein folding, types of chaperons. Non-covalent forces in protein folding, Structural Dynamics of proteins, Protein folding models, Denaturation of proteins, Protein degradation and turn over; ATP dependent proteolysis, intracellular digestion of proteins in Lysosomes. **Protein Targeting** Introduction, Methods in targeting, translocation and transport. Signal sequences, Signal Recognition Particle, Protein export in bacteria, Protein modification and targeting. Protein targeting in Bacterial system. Protein targeting in Endoplasmic Reticulum, Mitochondria and Chloroplast. **Protein Techniques** Solution properties of proteins, Protein fragmentation, Peptide sequence determination, Protein hydration, Conformational stability of proteins, Recombinant protein, Fusion proteins, Modification of proteins, Protein labeling, Peptide mapping.

Text books:
1. L. Stryer by Biochemistry, 5th edition Freeman – Toppan publications.
2. TM Devlin, Textbook of Biochemistry with clinical correlations, 6th edition with human molecular genetics. John Wiley and Sons, Inc.

References:
1. Moody P C E and A J Wilkinson. Protein Engineering. IRL Press.
2. Creighton T E, Proteins. Freeman W H. Second edition 1993.

TRANSPORT PHENOMENON IN BIOPROCESS

COURSE CODE: 13BT535 L – T – P: 3-0-2
PRE-REQUISITE: 13BT401 CREDITS: 4

Introduction to transport phenomena
Three levels of transport process, conservation laws, Basic laws governing momentum, heat and mass transport, pressure and temperature dependence on viscosity, thermal conductivity and mass diffusivity, Molecular theories of viscosity, thermal conductivity and mass diffusivity under different condition, Introduction to convective transport process. **Shell balances for momentum, mass and energy**
Flow of a falling film, flow through a circular tube, flow through annulus, heat conduction with electrical, nuclear and chemical heat, heat conduction in a fin, diffusion through a stagnant gas film, diffusion with homogeneous and heterogeneous chemical reaction, diffusion and reaction in a porous catalyst, Forced convective momentum, heat and mass transport process. **Transport process under turbulent conditions**
Equations of change for isothermal and non-isothermal conditions, unsteady state momentum, heat and mass transport process, Velocity distribution in turbulent flow, time smoothed equation of change, turbulent flow in ducts, unsteady state heat conduction, temperature distribution for turbulent flow in tubes, jets and at large Prandtl number, concentration distribution in turbulent flow .**Interphase transport process**
Definition of friction factors, friction factors for flow in tubes and pressure drop calculations, heat transfer coefficients, heat transfer coefficient for free and forced convection, analytical calculations of heat transfer, mass transfer coefficient, mass transfer coefficient in single and two phase system, mass transfer with chemical reactions. **Macroscopic balances and other mechanisms of transport** Macroscopic balances for steady and unsteady state balances in momentum, heat and mass transport. Heat transfer by radiation, radiation between nonblack bodies at different temperatures, mass transport during centrifugation of proteins, diffusion of salts in aqueous solution, mass transport across permeable membranes, mass transport in porous media

Textbook:
1. R. B. Bird. W.E. Stewart and E.N. Lightfoor, Transport Phenomenoa Wiley II edition, India.

Reference books:
1. D.G.Rao, Introduction to Biochemical Engineering, Tata Mc Hill (2005).
2. Paul M. Doran, Bioprocess Engineering Principles Academic press (1995).
3. J E Bailey and D F Ollis, "Biochemical Engineering fundamentals "2nd edition Mc Graw-Hill (1986).
4. S Aiba, A E Humphrey and N Millis, "Biochemical Engineering" Prentice- Hall (1978).
5. Michaeln L shuler and F Kargi,Bio process Engineering : Basic concepts" 2nd ed., Prentice Hall of India (2003).

BIOMINING

COURSE CODE: 13BT536 L – T – P: 3-0-2
PRE-REQUISITE:13BT401 CREDITS: 4

Introduction to Data mining
Introduction to Data mining- methods- selection & sampling- Preprocessing and cleaning- Transformation & reduction- Data mining methods- Evaluation- visualization
Text mining Overview on text mining- Natural Language Processing -Text summarization –tools- Applications of Data Mining**Introduction to Genetic Algorithms**
Introduction to Genetic Algorithm, Genetic Operators and Parameters, Genetic Algorithmsin Problem Solving, Theoretical Foundations of Genetic Algorithms, Implementation issues.**Neural Network**Neural Model and Network Architectures, Perceptron Learning, Supervised HebbianLearning, Backpropagation, Associative Learning, Competitive Networks, Hopfield-Network, Computing with Neural Nets and Applications of Neural Network.**Introduction to Fuzzy Sets** Introduction to Fuzzy Sets, Operations on Fuzzy sets, Fuzzy Relations, Fuzzy Measures,Applications of Fuzzy Set Theory to different branches of Science and Engineering

Recommended textbooks:
1. Mitchell, M., 1998, an Introduction to Genetic Algorithms, Prentice-Hall.
2. Lau C., (Ed), 1992, Neural Networks, IEEE Press.

Reference textbooks:
1. Freeman, J. and Skapura, D., 1991 Neural Networks: Algorithms, Applications and Programming Techniques, Addison-Wesley.
2. Klir, G.J. and Folger, T.A., 1988, Fuzzy Sets, Uncertainty, and Information, PHI.

CIVIL ENGINEERING
THEORY OF ELASTICITY

COURSE CODE: **11CE 502** L – T – P: 3-2-0
PRE-REQUISITE: NIL CREDITS: 4

Two-dimensional problems in rectangular coordinates : Plane stress ; Plane strain; Differential equations of equilibrium; Boundary conditions; Compatibility equations; Stress function; Governing differential equation; Solution by Polynomials; End effects – Saint-Venant's Principle; Determination of displacements; Bending of a cantilever loaded at the end; Bending of a beam by uniform load

Two-dimensional problems in polar coordinates : General equations in polar coordinates; Stress distribution symmetrical about an axis; Effect of circular holes on stress distribution in plates; Concentrated force at a point of a straight boundary; Concentrated force acting on a beam; Stresses in a circular disc, general solutions of the two dimensional problem in polar coordinates, applications of the general solutions in polar coordinates.

Strain energy methods : Total strain energy; Principle of virtual work; Griffith's theory of rupture; Castigliano's theorem; Principle of least work (Stationary potential energy), applications of the principle of least workrectangular plates, shear lag

Analysis of stress and strain in three dimensions : Stress at a point – components of stress; Principal stresses; Stress ellipsoid and stress director surface; Determination of principal stresses; Stress invariants; Determination of maximum shear stresses; Octahedral shear stress; strain at a point – Components of strain; differential equations of equilibrium, the principle of superposition

Torsion
Torsion of straight bars – Saint Venant's theory; Elliptic cross section; Membrane analogy; Torsion of a bar of narrow rectangular cross-section; Torsion of rolled profile sections; Torsion of thin tubes

Text Books:
1. Theory of Elasticity by Timoshenko, S. and Goodier J.N., McGraw Hill Book Co., Newyork, 1988.

Reference Books

1. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, New Delhi 1988.
2. Hearn , E.J. "Mechanics of Materials", Vol.2, Pergamon Press, Oxford, 1985
3. Irving H.Shames and James, M.Pitarresi, "Introduction to Solid Mechanics", Prentice Hall of India Pvt. Ltd., Newl Delhi -2002.

ADVANCED PRESTRESSED CONCRETE

COURSE CODE: **11CE 504** L – T – P: 3-0-2

PRE-REQUISITE: NIL CREDITS: 4

Introduction, Prestressing Systems and Material Properties

Basic concepts of pre-stressing; Historical development; Advantages and Types of Pre-stressing, Pre-tensioning Systems and Devices, Post-tensioning Systems and Devices, Need for High strength steel and High strength concrete; **Losses Of Prestress:** Nature of losses of pre-stress; Loss due to elastic deformation of concrete, shrinkage of concrete, creep of concrete, relaxation of stress in steel, friction and anchorage slip; Total losses allowed for in design.

Analysis of Prestressed Member

Analysis of Members under Axial Load: Analysis at Transfer, Analysis at Service , Analysis for Ultimate Strength, Analysis of Member under Flexure:, Analysis at Transfer and at Service, Cracking Moment, Kern Point, Pressure Line, Analysis for Ultimate Strength, design loads and strength, Calculation of Crack Width, Variation of Stress in Steel, Analysis of a Rectangular Section, Analysis of a Flanged Section.

Deflections of Prestressed Concrete Members:

Importance of control of deflections; Factors influencing deflections; Short term deflections of uncracked members. Long term deflection of cracked member; **Transmission Of Pre-Stress:** Transmission of Pre-stressing force by bond; Transmission length; Bond stresses; Transverse tensile stresses; End zone reinforcement; Flexural bond stresses in pre –tensioned and post – tensioned grouted beams, stress distribution in end block, Anchorage zone reinforcements; **Shear And Torsion Resistance Of Prestressed Concrete Member:** Shear and Principal stresses; Ultimate shear resistance of pre-stressed concrete members; Design of shear reinforcement, pre-stressed concrete members in torsion, Design of reinforcements for torsion, shear and bending.

Design of Pre-Stressed Members

Design of sections for flexure, Design of Sections for Axial Tension, Design of Sections for compression and bending, design of pre-stressed section for shear and torsion, design of pre-stressed member for bond. Dimensioning of flexural member, design for pre-tensioning member, design of post-tensioning members.

Composite Construction of Prestressed Concrete

Composite structural member, types of composite construction, analysis of stresses, differential shrinkages, deflection of composite member, flexural strength of composite sections, shear strength of composite section; **Design of Continuous Prestressed Concrete Member:** Advantages of continuous members, ultimate load analysis of continuous pre-stressed member, design of continuous pre-stressed concrete beams.

Text Books: (supplemented with IS: 1343)

1. Prestressed Concrete by N. Krishna Raju; Tata Mc Graw - Hill Publishing Company Limited, New Delhi.3rd edition, 1995.
2. Design of Prestressed Concrete Structures by T.Y. Lin & Ned H. Burns; John Wiley & Sons, 3rd edition, 1981.

Reference Books

1. Prestressed concrete by N. Rajagopalan; Narosa Publishing House.2nd edition, 2005.
2. Design of Prestressed Concrete by A. Nilson; John Willey & Sons.2nd edition, 1987.

REPAIR & REHABILITATION OF STRUCTURES

COURSE CODE : **11CE 531** L – T – P: 3-0-2

PRE-REQUISITE: NIL CREDITS: 4

Introduction : Deterioration of structures with aging; Need for rehabilitation

Distress in concrete /steel structures : Types of damages; Sources or causes for damages; effects of damages; Case studies

Damage assessment and evaluation models : Damage testing methods; Non-destructive testing methods

Rehabilitation methods : Grouting; Detailing; Imbalance of structural stability; Case studies

Methods of Repair : Shortcreting; Grouting; Epoxy-cement mortar injection; Crack ceiling

Seismic Retrofitting of reinforced concrete buildings : Introduction; Considerations in retrofitting of structures; Source of weakness in RC frame building – Structural damage due to discontinuous load path; Structural damage due to lack of deformation; Quality of workmanship and materials; Classification of retrofitting techniques; Retrofitting strategies for RC buildings – Structural level (global) retrofit methods; Member level (local) retrofit methods; Comparative analysis of methods of retrofitting

Text Books:

1. Diagnosis and treatment of structures in distress by R.N.Raikar, Published by R&D Centre of Structural Designers & Consultants Pvt.Ltd., Mumbai, 1994.
2. Handbook on Repair and Rehabilitation of RCC buildings, Published by CPWD, Delhi, 2002.
3. Earthquake resistant design of structures by Pankaj Agarwal and Manish Shrikhande, Prentice-Hall of India, 2006.

FINITE ELEMENT ANALYSIS

COURSE CODE: **11CE 601** L – T – P: 3-0-2

PRE-REQUISITE: NIL CREDITS: 4

BASIC PRINCIPLES : **equilibrium equations; strain-displacement relations; linear constitutive relations; principle virtual work; principle of stationary potential energy**

Element Properties : Different Types Of Elements; Displacement Models; Relation Between Nodal Degrees Of Freedom And Generalized Coordinates; Convergence Requirements; Compatibility Requirement; Geometric Invariance; Natural Coordinate Systems; Shape Functions; Element Strains And Stresses; Element Stiffness Matrix; Element Nodal Load Vector. Isoparametric Elements – Definition, Two-Dimensional Isoparametric Elements – Jacobian Transformation, Numerical Integration

Direct Stiffness method and Solution Technique: Assemblage Of Elements–Obtaining Global Stiffness Matrix And Global Load Vector; Governing Equilibrium Equation For Static Problems; Storage Of Global Stiffness Matrix In Banded And Skyline Form; Incorporation Of Boundary Conditions; Solution To Resulting Simultaneous Equations By Gauss Elimination Method

Plane-stress and Plane-strain analysis : Solving Plane Stress And Plane-Strain Problems Using Constant Strain Triangle And Four Nodded Isoparametric Element

Analysis of plate bending : Basic Theory Of Plate Bending; Shear Deformation Plates; Plate Bending Analysis Using Four Noded Isoparametric Elements

Text Books:

1. Introduction to Finite Elements in Engineering by R.T. Chandrupatla and A.D. Belegundu, Prentice Hall of India, 1997.

Reference Books:

1. Finite Element Analysis by Abel and Desai, New Age Publishers, 2007.
2. Finite Element Analysis: Theory and Programming by C. S. Krishnamoorthy, Tata McGraw - Hill, 1995
3. Finite Element Procedures in Engineering Analysis by K. J. Bathe, Prentice Hall Inc., 1996.
4. The Finite Element Method by O.C. Zienkiewicz, and R.L.Taylor, McGraw – Hill, 1987.

SPECIAL CONCRETES

COURSE CODE: 14CT533 L – T – P: 3-0-2

PRE-REQUISITE: NIL CREDITS: 4

CONCRETE INGREDIENTS : Composition of OPC – Manufacture – Modified Portland Cements – Hydration Process of Portland Cements – Structure of Hydrated Cement Pastes Mineral Admixtures – Slags – Pozzolanas and Fillers – Chemical Admixtures –Solutes – Retarders – Air Entraining Agents – Water Proofing Compounds –Plasticizers and Super Plasticizers Aggregates – Properties and testing of fine and course aggregates – combining of aggregates – Substitute material for aggregates – recent advancements.

SPECIAL CONCRETES : Fibre Reinforced Concrete – Self Compacting Concrete – Polymer Concrete – High performance concrete – Sulphur concrete – pervious Concrete.

CONCRETE MIX DESIGN : Mix Proportioning – Mixes incorporating Fly ash, Silica fume, GGBS – Mixes for High Performance Concrete – High strength concrete – variations in concrete strength.

MECHANICAL PROPERTIES OF CONCRETE : Interfacial Transition Zone – Fracture Strength – Compressive strength – Tensile strength - Impact strength - Bond strength.

DURABILITY OF CONCRETE : Factors affecting durability – Chemical Attack – Permeability – chloride penetration –water absorption – creep – Shrinkage.

REFERENCES:

1. Santhakumar.A.R., Concrete Technology, Oxford University press, New Delhi. 2007.
2. Gambhir.M.L., Concrete Technology – Tata McGraw Hill Book Co. Ltd.,Delhi, 2004.
3. Neville, A.M., Properties of Concrete, Longman, 1995.
4. Metha P.K.and Montreio P.J.M., Concrete Structure Properties and Materials, Prentice Hall, 1998.
5. Gupta.B.L. and Amit Gupta, Concrete Technology, Standard Publishers Distributer, New Delhi, 2004.

OPTIMIZATION TECHNIQUES

Course code : 15-CS-5178 L – T – P: 3-0-2

Pre Requisite : NIL Credits: 4

Overview of the Operations Research Modeling Approach, Introduction to Linear Programming, The Simplex Method, Other Algorithms for Linear Programming, The Transportation and Assignment Problems, Network Optimization Models, Project Management with PERT/CPM, Dynamic Programming, Integer Programming, Nonlinear Programming, Game Theory, Decision Analysis, Markov Chains, Queueing Theory, The Application of Queueing Theory, Forecasting, Markov Decision Processes, Simulation, From A Priori to Online Stochastic Optimization 1,Online Stochastic Combinatorial Optimization ,Online Anticipatory Algorithms ,Online Stochastic Combinatorial Optimization in Context

Text Books:

1. Frederick S. Hillier, Gerald J. Lieberman, “Introduction to Operations Research”, 9TH Edition, Mc Graw Hill, (2014).
2. Pascal Van Hentenryck, Russell Bent-Online Stochastic Combinatorial Optimization-The MIT Press(2006)

Reference Books:

1. Kanti Swarup, Man Mohan and P.K.Gupta, “Introduction to Operations Research”, S.Chand & Co., (2006)
2. Wayne L. Winston, “Operations Research: Applications and Algorithms”, 4th Edition, Cengage,(2004)
3. H.A. Eiselt ,Carl-Louis Sandblom,” Operations Research: A Model-Based Approach”, 2nd Edition, Springer, (2012)

COMPUTATIONAL COMPLEXITY

Course code : 15-CS-5180 L – T – P: 3-0-2

Pre Requisite : NIL Credits:4

Multithreaded Algorithms, Matrix Operations, Linear Programming, Polynomials and the FFT, Number-Theoretic Algorithms, Computational Geometry, Approximation Algorithms,Randomized Algorithms, Introduction to Computability, Undecidability, Introduction to Complexity Theory, Basic Results of Complexity Theory, Nondeterminism and NP-Completeness, Relative Computability, Nonuniform Complexity, Parallelism, Probabilistic Complexity Classes, Introduction to Counting Classes, Interactive Proof Systems.

Text Book

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein”-Introduction to Algorithms” (Third Edition)-The MIT Press (2009)
2. Steven Homer, Alan L. Selman-“Computability and Complexity Theory”-Springer (2011)

DEVICE MANAGEMENT

Course code : 15-CS-5182 L – T – P: 3-0-2

Pre Requisite : NIL Credits:4

Rationale**,** the Traditional Approach to Teaching Computer Science,The Systems Approach Taken in This Book Process View,Communication View,Resource View, Architecture View,Distributed Systems, Kernel Facilities, Laying the Groundwork, Character Drivers, Serial Drivers, Input Drivers, The Inter-Integrated Circuit Protocol, PCMCIA and Compact Flash, Peripheral Component Interconnect, Universal Serial Bus, Video Drivers, Audio Drivers, Block Drivers,Network Interface Cards, Memory Technology Devices, Embedding Linux, Debugging Device Drivers, Maintenance and Delivery

Text Book.

1. Sreekrishnan Venkateswaran,” Essential Linux Device Drivers”, Prentice Hall,(2008)
2. Richard John Anthony,” Systems Programming Designing and Developing Distributed Applications”, Elsevier(2016).

MACHINE INTELLIGENCE

Course code : 15-CS-5280 L – T – P: 3-0-2

Pre Requisite : NIL Credits:4

Self adaptive systems for machine intelligence: Introduction, Logic foundation of artificial intelligence, constraint reasoning, qualitative reasoning, case based reasoning,probability reasoning, inductive learning, support vector machine, explanation based learning reinforcement learning, rough set,association rules, evolution computation,distributed intelligence, artificial life,Introduction to machine intelligence research,incremental learningImbalanced learning,ensemble learning,adaptive dynamic programming for machine intelligence, associative learning, sequence learning, hardware design for machine intelligence.

Text books:

1. Self adaptive system for machine intelligence, Haibo He Wiley Publications,2011
2. Advanced artificial intelligence, Zhongzhi SHI, Volume 1world scientific publishi ng, 2011

FORMAL_METHODS

Course code : 15-CS-5284 L – T – P: 3-0-2

Pre Requisite : NIL Credits:4

Discrete Mathematics for Software Engineering: A Lamda calculus, algebras, mathematical logic. Abstraction and Modeling: Introduction, atomic types and values in RSL, function definition in RSL, property and model oriented abstraction, sets in RSL, Cartesian in RSL, lists in RSL, Maps in RSL, Higher-order functions in RSL, types in RSL, applicative specification programming(lightly), Imperative specific programming(lightly), Parallel specification programming(lightly),etcetera. UML-ised Formal SE techniques: Introduction, modularization, class diagrams, State automation and machines, Petri Nets, message and live sequence charts, state charts.

Textbooks:

1. Software Engineering 1, The basic principles and techniques of abstraction and modeling. Vol 1,Springer,2007
2. Software Engineering 2 ,The basic principles and techniques of specifying systems and languages, Vol2, Springer, 2007
3. Software Engineering 3, The basic principles and techniques of overall software development,Vol 3, Springer, 2007

ELECTRONICS & COMMUNICATION ENGINEERING

ANTENNA MEASUREMENTS

COURSE CODE: 15EC5206 L – T – P: 3-0-2

PRE-REQUISITE: 13EC308 CREDITS: 4

Antenna Pattern Measurements: Basic Considerations, Pattern Formats, Fresnel Region Measurements, Modeling Techniques, Antenna Range Design and Evaluation: Introduction, Electromagnetic Design Consideration, Antenna Range Evaluation.

Antenna Testing: Introduction, Types of of Ranges: Elevated Ranges, Ground Ranges, Near Field Ranges, Radar Cross Section Ranges.

Far Field Range Design: Introduction, Designing the Range, Source Design, Receiving Site Design, Ground Ranges.

Far Field Antenna Tests: Introduction, Pattern Testing, Gain and Directivity, Polarization. Far Field Pattern Errors: Introduction, Error Estimates, Error Correction, Antenna Errors.

Compact Ranges: Introduction, Room Design, Feed Design, Reflector Design. Near Filed Testing: Introduction, Planar Near Field Ranges, Errors, Cylindrical and Spherical Scanning

TEXT BOOKS

1.Evans, Gray E," Antenna measurements techniques", Artech House, Inc

2.J S Hollis, T J Lyon, L Clayton," Microwave Antenna Measurements" , Scientific Atlants, Inc.

STATISTICAL SIGNAL PROCESSING

COURSE CODE: 15EC5216 L – T – P: 3-0-2

PRE-REQUISITE: 13ES205 CREDITS: 4

Review of random variables: Distribution and density functions, moments, independent, uncorrelated
and orthogonal random variables; Vector-space representation of Random variables, Schwarz Inequality
Orthogonality principle in estimation, Central Limit theorem, Random processes, wide-sense stationary
processes, autocorrelation and auto covariance functions, Spectral representation of random signals, Wiener Khinchin theorem Properties of power spectral density, Gaussian Process and White noise process, Linear System with random input, Spectral factorization theorem and its importance, innovation process and whitening filter, .Random signal modeling: MA(q), AR(p) , ARMA(p,q) models.

Parameter Estimation Theory: Principle of estimation and applications, Properties of estimates, unbiased and consistent estimators, Minimum Variance Unbiased Estimates (MVUE), Cramer Rao bound, Efficient estimators; Criteria of estimation: the methods of maximum likelihood and its properties ; Bayesian estimation : Mean square error and MMSE, Mean Absolute error, Hit and Miss cost function and MAP estimation.

Estimation of signal in presence of white Gaussian Noise: Linear Minimum Mean-Square Error (LMMSE)
Filtering: Wiener Hoff Equation, FIR Wiener filter, Causal IIR Wiener filter, Non causal I I R Wiener filter,
Wiener filter, Non causal I I R Wiener filter, Linear Prediction of Signals, Forward and Backward Predictions, Levinson Durbin Algorithm, Lattice filter realization of prediction error filters.

Spectral analysis: Estimated autocorrelation function, periodogram, Averaging the periodogram (Bartlett Method), Welch modification, Blackman and Tukey method of smoothing periodogram, Parametric method, AR(p) spectral estimation and detection of Harmonic signals, Burg, ESPRIT, MUSIC algorithm.

Kalman filtering: State-space model and the optimal state estimation problem, discrete Kalman filter,
continuous-time Kalman filter, extended Kalman filter.

Simulation Software: MATLAB® SSP Toolbox, Software for Filter Design, Signal Analysis, PDEs, and Applications to Signal Analysis.

Text Books:

1. M. Hays: Statistical Digital Signal Processing and Modelling, John Willey and Sons, 1996.
2. M.D. Srinath, P.K. Rajasekaran and R. Viswanathan: Statistical Signal Processing with Applications, PHI,

WAVELETS, FILTER BANKS AND APPLICATIONS

COURSE CODE: 15EC5109 L – T – P: 3-0-2

PRE-REQUISITE: 13ES205 CREDITS: 4

Integral wavelet transform, wavelet frames, orthogonal bases of Wavelets, Wavelet transform: Signal representation using basis function, ideal band pass wavelet, L2 -spaces, Basic properties of wavelet transform, Time frequency representation, Design of wavelet function.

Multi-rate Signal Processing: Filtering, Decimation, Poly-phase, Perfect Reconstruction and Aliasing Removal. Matrix Analysis: Toeplitz Matrices and Fast Algorithms.

Wavelet Transform: Pyramid and Cascade Algorithms, Haar wavelet basis, Daubechies Wavelets, Orthogonal and Biorthogonal Wavelets, Smoothness, Approximation, Boundary Filters and Wavelets, Time-Frequency and Time-Scale Analysis, Second-Generation Wavelets.

Spectral Factorization, Cosine-Modulated Filter Banks, Lattice Structure, Ladder Structure (Lifting.)

Going from piecewise linear to piecewise polynomial. The class of spline wavelets - a case for infinite impulse response (IIR) filter banks. Variants of the wavelet transform and its implementation structures, The wave packet transform, The lattice structure, The lifting scheme. Audio and Image Compression, Quantization Effects, Digital Communication and Multicarrier Modulation, Trans multiplexers, Text-Image Compression: Lossy and Lossless, Medical Imaging and Scientific Visualization, Edge Detection and Feature Extraction, Seismic Signal Analysis, Geometric Modelling, Matrix Preconditioning, Multi scale Methods for Partial Differential Equations and Integral Equations.

Simulation Software

MATLAB® Wavelet Toolbox, Software for Filter Design, Signal Analysis, Image Compression, PDEs, and Wavelet Transforms on Complex Geometrical Shapes.

Books:

1. Strang, and Nguyen. Wavelets and Filter Banks. Wellesley-Cambridge Press, 1997.
2. L. Debnath. Wavelet Transforms and Their Applications, Birkhauser Pub.
3. E. Mallat. A Wavelet Tour of Signal Processing, Elsevier, Indian Ed.
4. Yves Meyer.Wavelets and Operators, Cambridge Univ. Press.
5. G. Kaiser. A Friendly guide to Wavelets, Birkhauser.

REFERENCES

1. Howard L. Resnikoff, Raymond O. Wells, Wavelet Analysis: The Scalable Structure of Information, Springer, 1998.
2. Raghuveer M. Rao, Ajit S. Bopardikar, Introduction to Wavelet Transforms.
3. K. P. Soman, K. I. Ramachandran, Insight Into Wavelets - From Theory to Practice.
4. Michael W. Frazier, An Introduction to Wavelets Through Linear Algebra, Springer.
5. P. P. Vaidyanathan, Multi-rate Systems and Filter Banks, Pearson Education.

ADAPTIVE SIGNAL PROCESSING

COURSE CODE: 15EC5112	L – T – P: **3 – 0 – 2**
PRE-REQUISITE: 13ES205	CREDITS: 4

Introduction to Adaptive Filters: Adaptive filter structures, issues and examples, Applications of adaptive filters, Channel equalization, active noise control, Echo cancellation, beamforming. Discrete time random processes, Power spectral density – properties, Autocorrelation and covariance structures of discrete time random processes, Eigen-analysis of autocorrelation matrices.

Wiener filter, search methods and the LMS algorithm: Wiener FIR filter, Steepest descent search and the LMS algorithm, Extension of optimal filtering to complex valued input, The Complex LMS algorithm.

Convergence and Stability Analyses: Convergence analysis of the LMS algorithm, Learning curve and mean square error behavior, Weight error correlation matrix, Dynamics of the steady state mean square error (mse), Misadjustment and stability of excess mse.

Variants of the LMS Algorithm: The sign-LMS and the normalized LMS algorithm, Block LMS, Review of circular convolution, Overlap and save method, circular correlation, FFT based implementation of the block LMS Algorithm.

Vector space framework for optimal filtering: Axioms of a vector space, examples, subspace, Linear independence, basis, dimension, direct sum of subspaces, Linear transformation, examples, Range space and null space, rank and nullity of a linear operator, Inner product space, orthogonality, Gram-Schmidt orthogonalization.
Simulation Software: MATLAB® Signal Processing Toolbox.

Text Books:

1. "Adaptive Filter Theory" by S. Haykin, Prentice Hall, Englewood Cliffs, NJ, 1991 (end Ed.).
2. "Adaptive Filters: Theory and Applications", by B. Farhang-Boroujeny, John Wiley and Sons, 1999.

VLSI SYSTEM DESIGN

COURSE CODE : 15EC5234 L – T – P: 3-2-0
PRE-REQUISITE : 13EC206 CREDITS: 4

Design Methodology: Structured design techniques; Programmable logic; Gate array and sea of gates design; cell based design; full custom design; Design flow; Design Economics. **Data path Subsystems:** Adders; One/zero Detectors; Comparators; Counters; Shifters; Multipliers; Power and Speed Trade-off.
Memory and Array Subsystems: SRAM, DRAM, ROM, Serial access memories; CAM, PLAs; Array yield, reliability; Power dissipation in Memories. **Special-purpose Subsystems:** Packaging; power distribution;
I/O pads; **Interconnect:** Interconnect parameters; Electrical wire models, capacitive parasitics; Resistive
parasitics; Inductive parasitic; Crosstalk; Advanced Interconnect Techniques. **Timing Issues:** Timing classification; Synchronous design; Self-timed circuit design; **Clock Synthesis and Synchronization:** Synchronizers; Arbiters; Clock Synthesis; PLLs; Clock generation; Clock distribution; Synchronous Vs Asynchronous Design.

TEXT BOOKS

1.Neil H. E. Weste, David. Harris and Ayan Banerjee,, "CMOS VLSI Design" - Pearson Education, Third
Edition, 2004.
2.Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuits" Pearson Education, Second Edition.

REFERENCES

1.Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits" TMH, Third Edition, 2003
2. Wayne Wolf, "Modern VLSI Design ", 2nd Edition, Prentice Hall,1998.

SIMULATION BOOKS

1. Etienne Sicard, Sonia Delmas Bendhia, "Basics of CMOS Cell Design", TMH, EEE, 2005.

ELECTRONICS & COMPUTER ENGINEERING

MICRO CONTROLLERS FOR EMBEDDED SYSTEM DESIGN

COURSE CODE: **11EM501** L – T – P: 3-0-2
PRE-REQUISITE: NIL CREDITS: 4

Introduction to Embedded Systems

Overview of Embedded Systems, Processor Embedded into a system, Embedded Hardware Units and Devices in system, Embedded Software, Complex System Design, Design Process in Embedded System, Formalization of System Design, Classification of Embedded Systems.

Microcontrollers and Processor Architecture & Interfacing

8051 Architecture. Real world interfacing, Introduction to advanced architectures, processor & memory organization, Instruction-level parallelism, and performance metrics.

PIC Microcontroller Hardware

Introduction, Architectural overview, Memory organization, interrupts and reset, I/O ports, Timers

Device Drivers & Interrupt service Mechanism

Programmed-I/O Busy-wait approach without ISM,ISR concept, Interrupt sources, Interrupt service mechanism, Multiple Interrupts, context and the periods for context switching, Interrupt latency and deadline, Classification of processors ISM from context-saving angle, Direct Memory Access, Device driver programming

Devices &Communication Buses for Devices Network

IO Types and examples, Serial communication Devices, Parallel Device ports, Networked Embedded systems, Serial Bus communication protocols

Text Books:

1. Embedded Systems - Architecture Programming and Design – Raj Kamal, 2nd ed., 2008, TMH.
2. Embedded C Programming and the Microchip PIC-Richard Barnett, O" Cull, Cox, 2009,Cengage Learning.

Reference Books:

1. Embedded Microcomputer Systems, Real Time Interfacing – Jonathan W. Valvano – Brookes Cole, 1999, Thomas Learning

REAL TIME CONCEPTS FOR EMBEDDED SYSTEMS

COURSE CODE : 12EM-502 L – T – P: 3-1-0

PRE-REQUISITE: NIL CREDITS: 4

Introduction: Examples of Embedded Systems, Definition of Embedded Systems, Architecture of Embedded Systems, Real- Time Embedded Systems , Design Issues and Current Trends for Embedded Systems

Hard versus soft Real- Time Systems: Jobs and Processes, Release Times, Deadlines and Timing Constraints, Hard and Soft Timing Constraints, Hard Real Time Systems, Soft Real Time Systems

A Reference Model of Real – Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency, Functional Parameters- preemptivity of jobs, criticality of jobs, Resource Parameters of Jobs and Parameters of Resources, Scheduling Hierarchy- Scheduler and Schedules, Feasibility, Optimality and Performance Measures.

Classification of Real Time Scheduling Approaches: Clock- Driven Approach, Weighted Round-Robin Approach, Priority- Driven Approach, Dynamic versus Static Systems, Effective Release Times and Deadlines, optimality of the EDF and LST algorithms, Non optimality of the EDF and LST algorithms, Challenges in validating timing constraints in priority –driven systems Off-line versus On-line Scheduling

Clock-Driven Scheduling : Notations and Assumptions, Static, Timer -Driven Scheduler, General Structure of Cyclic Schedules, Cyclic Executives, Improving the Average Response Time of Aperiodic Jobs, Scheduling Sporadic Jobs-Acceptance test ,EDF Scheduling of accepted jobs and implementation, Pros and Cons of Clock Driven Scheduling,

Priority-Driven Scheduling of Periodic Tasks: Static Assumption, Fixed Priority v/s Dynamic Priority Algorithms, schedulability test for the EDF algorithm, a schedulability test for fixed priority tasks with short response times-time demand analysis, schedulability test for fixed priority tasks with arbitrary response times: busy intervals, general schedulability test, sufficient schedulability conditions for RM & DM algorithms: schedulable utilization of the RM algorithm for tasks with Di=pi, schedulable utilization of fixed priority tasks with arbitrary relative deadlines

Scheduling Aperiodic and Sporadic Jobs in Priority-Driven Systems: Assumptions and Approaches, Deferrable Servers- Operations of Deferrable Servers, Constant utilization server Scheduling of sporadic jobs-a simple acceptance test in deadline driven systems, a simple acceptance test in fixed- priority driven systems

Resources and Resource Access control: Assumptions on Resources and Their Usage, Effects of Resource Contention and Resource Access Control, Non-preemptive Critical Sections, Basic Priority Inheritance Protocol, Basic Priority Ceiling Protocol- Definition, computation of blocking time, controlling accesses to Multiple Unit Resources

Real-Time Operating Systems: Overview- Threads and Tasks, The Kernel, Time Services and Scheduling Mechanisms- Time Services, Scheduling Mechanisms, Other Basic Operating System Functions- Communication and Synchronization, Event Notification and Software Interrupt, Memory Management, I/O and Networking

TEXT BOOKS:

1. Real Time Systems – By Jane W.S.Liu -Low Price Edition , Pearson Education Asia
2. Real-Time Concepts for Embedded Systems - Qing Li with Caroline Yao published by CMP Books

DIGITAL SIGNAL PROCESSORS AND ARCHITECTURES

COURSE CODE: **13EM 602** L – T – P: 3-10-0

PRE-REQUISITE: NIL CREDITS: 4

Introduction To Digital Signal Processing: Introduction, A Digital signal-processing system, The sampling process, Discrete time sequences. DiscreteFourier Transform (DFT) and Fast Fourier Transform (FFT), linear time-invariant systems, Digital filters, Decimation and interpolation.

Computational Accuracy in DSP Implementations: Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of errorin DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors, Compensating filter.

Architectures for Programmable DSP Devices: Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Features for External interfacing.

Programmable Digital Signal Processors: Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.

Analog Devices Family of DSP Devices: Analog Devices Family of DSP Devices- ALU and MAC block diagram, Shifter Instruction, Base Architecture of ADSP2100, ADSP-2181 high performance Processor.

Introduction to Blackfin Processor – The Blackfin Processor, Introduction to Micro Signal Architecture, Overview of Hardware Processing Units and Register files, Address Arithmetic Unit, Control Unit, Bus Architecture and Memory, Basic Peripherals.

Interfacing Memory And I/O Peripherals To Programmable DSP Devices: Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA).

Text Books

1. Digital Signal Processing – Avtar Singh and S. Srinivasan, Thomson Publications, 2004.

2. A Practical Approach to Digital Signal Processing – K Padmanabhan, R. Vijayarajeswaran, Ananthi.S, New Age International, 2006/2009.
3. Embedded Signal Processing with the Micro Signal Architecture Publisher: Woon-Seng Gan, Sen M. Kuo, Wiley-IEEE Press, 2007.

References

1. Digital Signal Processors, Architecture, Programming and Applications – B. Venkataramani and M. Bhaskar, 2002, TMH.
2. Digital Signal Processing – Jonatham Stein, 2005, John Wiley.
3. DSP Processor Fundamentals, Architecture & Features- Lapsley et al. 2000, S. Chand & Co.
4. Digital Signal Processing Applications Using the ADSP-2100 Family by The Applications Enguneering Staff of Analog Devices, DSP Division, Edited by Amy Mar, PHI.
5. The Scientist and Engineering's Guide to Digital Signal Processing by Steven W. Smith, Ph.D., California Technical Publishing, ISBN 0-9660176-3-3, 1997.
6. Embedded Media Processing by David J. Katz and Rick Gentile of Analog Devices, Newnes, ISBN 0750679123, 2005.

SENSORS AND SENSING PRINCIPLES

COURSE CODE: 13EM513 L – T – P: 3-1-0

PRE-REQUISITE: NIL CREDITS: 4

Sensor Fundamentals:

Basic sensor technology -sensor characteristics –static and dynamic –Principles of sensing-capacitance- magnetic and electromagnetic induction –resistance piezoelectric effect – Pyroelectric effect -Hall effect- See beck and Pettier effect-heat transfer-light. **Sensor Characteristics:** Analysis of experimental data: causes and types of experimental errors – statistical analysis of experimental data –method of least squares –correlation coefficient, multivariable regression – graphical analysis and curve fitting.

Physical /Chemical sensors: Position, Displacement and Level sensors, Velocity and Acceleration sensors,Force, Strain, Tactile and pressure sensors. Classification of chemical sensing Mechanism, Potentiometric sensors, Conduct metric Sensors, Amperometric Sensors, Enhanced Catalytic gas Sensors.

Optical Sensors: Optical Radiation- Electromagnetic Spectrum, Snell's Law and Total internal reflection, Diffraction principles, Optical Detectors and Sources-Photo diodes and transistors, Photo-darling ton pairs, Photoconductive sensors, CCD sensors, Fiber optic sensors. Solid state light sources- LED , Diode lasers, Semiconductor laser optical cavity resonator.

Bio sensors Origin and Transmission of bioelectrical Signals, The Electromyogram (EMG) & the Electrocardiogram (ECG) The Electroencephalogram (EEG) & Blood pressure measurement, Catalytic biosensors, mono-enzyme electrodes, bi-enzyme electrodes. cell based biosensors, biochips and biosensor arrays, problems and limitations.

Text books:

1. Biosensor Principles and Applications, Edited by Loïc J.Blum, Pierre R. Coulet Agarwal, Govind P, "fiber Optic Communication Systems", 2nd edition, Wiley, NewYork,1997
2. Principles of Biochemistry Albert L.Lehninger, David Lee Nelson,Michael M. 2005, Fourth Edition.
3. Sensors and Transducers D. Patranabis Prentice-Hall of India Pvt.Ltd August 15, 2004
4. Jacob Fraden, " Hand Book of Modern Sensors: physics, Designs and Applications", 3rd ed.,Springer, 2003.

COMMUNICATION PROTOCOLS AND STANDARDS

COURSE CODE: 13EM516 L – T – P: 3-0-2

PRE-REQUISITE: NIL CREDITS: 4

Networks in process automation

Networks in process automation: Information flow requirements, Hierarchical communication model, Data Communication basics, OSI reference model, Industry Network, Network Topologies.

Communication Protocols:

Communication Protocols: Communication Basics, Basics, Network Classification, Device Networks, Control Networks, Enterprise Networking, Network selection. Proprietary and open networks: Network Architectures, Building blocks

Wired Communication:

Wired: Wired Communication: Industry open protocols (RS-232C, RS- 422, RS-485), CAN bus, I2C, SPI, Ethernet,USB ,OFC, Modbus, Modbus Plus, Data Highway Plus, Advantages and Limitations of Open networks.

Fieldbus Trends

Fieldbus: Fieldbus Trends, Hardware selection, Fieldbus design, Installation, Documentation, Fieldbus advantages and limitations, Automotive Most bus, Hot standby router protocol(HSRP) and Hot 255 modem, Dial up modem, Physical media -Cabling types and noise level conditions, leased line modems.

WPAN

Wireless: WPAN, Wi-Fi, Bluetooth, Zig-Bee, Z-wave, GPRS, GSM. Infrared communication: Routers, Hubs, Bridges, Ethernet switches, Different type of converters - Serial to Ethernet, Ethernet to OFC, Serial to OFC, RS232 to RS485

Outcomes: After completion of these course students should able to, Build sensor networks and Communicate through various media

Text Books:

1. TCIP/IP protocol suite , Behrouz A. Forouzen, III Edition
2. Data communications, computer networks, open systems, Prakash C. Guptha, V Edition

ELECTRICAL & ELECTRONICS ENGINEERING

POWER ELECTRONIC CONTROL OF DRIVES

COURSE CODE : 15 EE601 L – T – P: 3-1-0

PRE-REQUISITE: 11EE307 CREDITS: 4

Control of induction motor, Review of steady-state operation of Induction motor, Equivalent circuit analysis, torque-speed characteristics. VSI Fed Induction motor drives &CSI Fed Induction motor drives. Control of induction by Slip power recovery schemes. **Vector control of Induction Motor**: Principles of vector control, Direct vector control, derivation of indirect vector control, implementation – block diagram; estimation of flux, flux weakening operation. **Control of Synchronous motor drives**: Synchronous motor and its characteristics- Control strategies- Constant torque angle control- power factor control, constant flux control, flux weakening operation, Load commutated inverter fed synchronous motor drive. PMSM and BLDC control of Drives, control of Variable Reluctance Motor Drive .**Speed control of dc Motors**-Different types of speed control techniques by using single phase& three phase ac systems .Closed loop control of phase controlled DC motor Drives. Open loop Transfer function of DC Motor drive - Closed loop Transfer function of DC Motor drive –Phase-Locked loop control.**Closed loop control of chopper fed DC motor Drives**, Speed controlled drive system – current control loop – pulse width modulated current controller – hysteresis current controller – modeling of current controller – design of current controller .

TE**XT BOOKS:**

1. Modern Power Electronics and AC Drives –B. K. Bose-Pearson Publications- 2005
2. Electric Motor Drives- R.Krishanan- Prentice Hall, Indian Edition-2008

REFERENCE BOOKS:

1. Power Electronics and Motor Control – Shepherd, Hulley, Liang – II Edition, Cambridge University Press ,2004.

2. Power Electronic Circuits, Devices and Applications – M. H. Rashid – PHI,3 rd edition,2003.
2. Fundamentals of Electrical Drives by GK Dubey, Narosa Publishers,2 nd edition,2002.

OPTIMIZATION TECHNIQUES

COURSE CODE: 15EE602 L – T – P: 3-1-0
PRE-REQUISITE: NIL CREDITS: 4

Linear Programming: Standard form of Linear programming problem; Simplex method two phase simplex method; Duality in Linear programming, Decomposition Principle .Some simple numerical problems**. Non-Linear Programming:** Fibonacci method, Univariate method, Pattern directions, Golden section method, Powell's method, Newton's method, Quasi Newton method.Some simple numerical problems. **Transportation Problem:** Definition of transportation problem, transportation algorithm, North-West corner method, Vogel approximation method, Least cost method, Unbalanced & Transportation Problems. Hungarian method for assignment. Unbalanced Assignment, problems. **Project planning through Networks:** Arrow diagram representation; Rules for constructing an arrow diagram. PERT and CPM, critical path calculations, Earliest start and latest completion times; Determination of floats. Some simple numerical problems. **Dynamic Programming:** Multistage decision processes; Types of multistage decision problems, concept of sub-optimization and the principle of sub-optimality computational procedure in dynamic programming. Some simple numerical problems.

TEXT BOOKS:

1. Engineering optimization theory and practice by S.S. Rao. New Age International Publications. A Wiley Interscience publication,1996
2. Operations Research, An introduction by Hamdy A. Taha. PHI learning private Ltd. New Delhi,2010.

REFERENCE BOOKS:

1. Operations Research by S.D. Sharma, Kedarnath & Ramnath Publishers, Delhi.
2. Introduction to operations research by Hiller and Liberman,McGrawHill Eduction Pvt Ltd, 2010.

DESIGN OF POWER CONVERTERS

COURSE CODE: 15EE603 L – T – P: 3-0-2
PRE-REQUISITE: 11EE303 CREDITS: 4

DESIGN OF SNUBBER CIRCUITS: Design of snubber circuits for diode, transistor and thyristor- snubbers for bridge circuit configuration- GTO snubber circuit design considerations- Problems. **DESIGN OF GATE AND BASE DRIVE CIRCUITS**: Preliminary design considerations- DC-coupled drive cuircuits- electrically isolated drive circuits- cascaded connected drive circuits- thyristor drive circuits- power device protection in drive circuits- Problems. **DESIGN ASPECTS OF HEAT SINKS:** control of semiconductor device temperature- Heat transfer by conduction, convection and radiation- Heat sink design-Problems. **DESIGN OF MAGNETIC COMPONETS:** Analysis of a specific inductor design- Inductor design procedure- Analysis of a specific transformer design- transformer design procedure- comparison of transformer and inductor sizes- Problems. **DESIGN OF DC-DC CONVERTERS**- Design considerations of DC-DC converters- Current Mode Control- Controller Design- Problems

Text Books

1. Ned Mohan, T.M. Undeland and William P. Robbins "Power Electronics: Converters, Applications and Design", 3rd Edition, John Wiley & Sons, 2009.
   M.H. Rashid "Power Electronics-circuits, Devices and Applications", 3rd Edition, PHI, 2005.
2. Bimal K.Bose "Modern Power Electronics and AC Drives", Pearson Education, Second Edition, 2003.

Reference Books

1. Jai P.Agrawal, "Power Electronics Systems", Pearson Education, Second Edition, 2002.
2. P.T. Krein, Elements of Power Electronics, Oxford University Press, 1998.

POWER SYSTEM DYNAMICS & STABILITY

COURSE CODE: 15EE604 — L – T – P: 3-1-0
PRE-REQUISITE: 11EE302 — CREDITS: 4

POWER SYSTEM STABILITY: Introduction, General basic concept of Power System Stability, swing equations, power angle equations, natural frequencies of oscillations, single machine infinite bus system- equal area criterion- classical model of a multi machines systems. **SMALL SIGNAL STABILITY:** Small signal stability of a single machine infinite bus system, Effects of excitation systems, Power system stabilizers **SYNCHRONOUS MACHINE MODELING:** Modeling of Synchronous Machine, Park's Transformation, Analysis of Steady State Performance, P. U. Quantities, Equivalent Circuit of Synchronous Machine, Vector diagrams in steady state and transient state, power angles curves of a salient pole machine **EXCITATION SYSTEMS:** Typical Excitations configurations and excitation (Automatic) Voltage regulators, Effect of excitation on (a) Power limits, (b) Transient stability, (c) Dynamic stability, **VOLTAGE STABILITY:** Basic Concepts Related to Voltage Stability – Voltage Collapse – Voltage Stability Analysis – Prevention of Voltage Collapse.

TEXT BOOKS:

1. Power System Stability and Control – Prabha Kundur, TATA McGRAW – HILL, 2006.
2. Power System Control and Stability – P. M. Anderson & A.A. Fouad , 2nd Edition, Wiley IEEE press-2002.

REFERENCE BOOKS:

1. Power System Dynamics Stability & Control – K.R.Padiyar, 2nd Edition, B.S. Publication 2002.
2. Power System Stability by Kimbark, Vol- I, II & III – 1968, Dover Publication Inc, Newyork-1968.

REAL TIME CONTROL OF POWER SYSTEMS

COURSE CODE: **15EE605** — L – T – P: 3-0-2
PRE-REQUISITE: 11EE302 — CREDITS: 4

Unit Commitment Problem-Introductions to UCP, Economic Dispatch- characteristics of thermal, nuclear and hydro-generator units, **Economic dispatch problem**- The Lambda iteration method, first order gradient method, base point and participation factors**, Load frequency control**- single area control, block diagram representation, steady state analysis, dynamic response, AGC multi area system, static and dynamic response, Load frequency control of 2-area system, **Computer control of power systems**- Energy Control Centre, various levels, SCADA system, data acquisition and controls, EMS system, expert system applications for power system operation, **Security control**- Security analysis and monitoring, generator and line outages by linear sensitivity factors, **State estimation**- Power system state estimation, Weighted least square state estimation, state estimation of AC network, Treatment of bad data – network observability and pseudo measurements.

TEXT BOOKS:

1. Allen J. Wood and Bruce F. Wollenberg "Power Generation, Operation & Control" 2nd edition, John Wiley and Sons, 1996.
2. I.J. Nagarath & D. P. Kothari , "Modern power system analysis" 3rd Edition, TMH, New Delhi, 2003.

REFERENCE BOOKS:

1. I. Elgard , "Electric Energy Systems Theory – An Introduction" TMH, 1983.
2. Abhijit Chakrabarti & Sunita Halder " Power System Analysis operation and Control " 1st edition, PHI, 2006.
3. Mahalanabis A.K., Kothari D.P. and Ahson S.I., "Computer aided power system analysis and control", 4th Edition, 2011, TMH.
4. J.J.Grainger, W.D.Stevenson JR, Power system analysis, Tata McGraw Hill N.D. 2007.
5. Handschin and E. Petroiaenu," Energy Management Systems, Operations and Control of Electric Energy Transmission Systems", Springer-Verlag, Berlin, Heidelberg, 1991

MECHANICAL ENGINEERING

HEAT EXCHANGER DESIGN

COURSE CODE: 13TE531 L – T – P: 3-0-0
PRE-REQUISITE: **13ME-401** CREDITS: 3

Heat Exchangers-Introduction, C1assfication, and Selection. Heat Exchanger Thermo-Hydraulic Fundamentals. Heat Exchanger Design. Compact Heat Exchangers. Shell and Tube Heat Exchanger Design. Regenerators. Plate Heat Exchangers and Spiral Plate Heat Exchangers. Heat-Transfer Augmentation. Fouling; Flow-Induced Vibration of Shell and Tube Heat Exchangers. Mechanical Design of Shell and Tube Heat Exchangers. Corrosion; Material Selection and Fabrication. Quality Control and Quality Assurance and Nondestructive Testing. Heat Exchanger Fabrication.

TEXT BOOKS

1. Heat Exchanges: Selection, Design and Construction, E. A. Saunders, Longman Scientific and Technical (1988)
2. Fundamentals of Heat Exchanger Design, Ramesh K. Shah, Dusan P. Sekulic, Wiley (2002)

REFERENCES

1. Heat Transfer, J. P. Holman, McGraw Hill, New York (1989)
2. Process Heat Transfer, CRC Press, G.F. Hewitt, G.L. Shires, T.R. Bott (1994)
3. Fluid Dynamics and Heat Transfer, J.G. Knudsen and D.L. Katz, McGraw Hill, New York (1958)
4. Heat Exchanger Design Handbook, K. Thulukkanam, CRC Press (2013)
5. Heat Exchangers: Selection, Rating and Thermal Design, S. Kakaç and H. Liu, CRC Press (2002)
6. Fluid Mechanics and Transfer Processes, Cambridge University Press, J. M. Kay, and R. M. Nedderman (1985)
7. Heat exchanger design handbook, Hemisphere publishing corp., (1981)

COMPUTATIONAL FLUID DYNAMICS

COURSE CODE: 13TE602 L – T – P: 3-0-0
PRE-REQUISITE: **13ME201** CREDITS: 3

Introduction: Conservation equation; mass; momentum and energy equations; convective forms of the equations and general description, Classification and Overview of Numerical Methods: Classification into various types of equation; parabolic elliptic and hyperbolic; boundary and initial conditions; over view of numerical methods, Finite Difference Technique: Finite difference methods; different means for formulating finite difference equation; Taylor series expansion, integration over element, local function method; treatment of boundary conditions; boundary layer treatment; variable property; interface and free surface treatment; accuracy of FD method, Finite Volume Technique: Finite volume methods; different types of finite volume grids; approximation of surface and volume integrals; interpolation methods; central, upwind and hybrid formulations and comparison for convection-diffusion problem, Finite Element Methods: Finite element methods; Rayleigh-Ritz, Galerkin and Least square methods; interpolation functions; one and two dimensional elements; applications, Methods of Solution: Solution of finite difference equations; iterative methods; matrix inversion methods; ADI method; operator splitting; fast Fourier transform, Time integration Methods: Single and multilevel methods; predictor-corrector methods; stability analysis; Applications to transient conduction and advection-diffusion problems, Numerical Grid Generation: Numerical grid generation; basic ideas; transformation and mapping, Navier-Stokes Equations: Explicit and implicit methods; SIMPLE type methods; fractional step methods, Turbulence modeling: Reynolds averaged Navier-Stokes equations, RANS modeling, DNS and LES.

TEXT BOOKS:

3. Numerical Computation of Internal and External Flows, C. Hirsch, Vols. I & II, John Wiley & Sons (2004)
4. An Introduction to Computational Fluid Dynamics, H. K. Versteeg & W. Malalasekera, Longman Scientific & Technical (1995)

REFERENCE BOOKS:

9. Computational Fluid Mechanics and Heat Transfer, J. C. Anderson, D. A. Tannehil and R. H. Pletcher, Taylor & Francis publications, USA (1997)
10. Fundamentals of CFD, T. K. Sengupta, Universities Press (2004)
11. Computational Fluid Dynamics, T. J. Chung, Cambridge University Press (2002)
12. Computational Methods for Fluid Dynamics, J. H. Ferziger and M. Peric, Springer (1997)
13. Computational Techniques for Fluid Dynamics, C. A. J. Fletcher, Vols. I & II, Springer-Verlag (1996)

RENEWABLE ENERGY TECHNOLOGY

COURSE CODE: 13TE642 L – T – P: 3-0-0

PRE-REQUISITE: **13ME202** CREDITS: 3

Sources: Renewable Energy Sources in India - Potential sites, availability. Solar Energy: Measurement and collection, flat plate collectors, concentrating collectors, solar ponds, photovoltaic conversion, Thermal energy storage. Ocean Energy: Principles of OTEC; wave energy, tidal energy, energy conversion systems. Wind Energy: Principle, potential and status; Wind Characteristics; National Wind Atlas; Theory of wind turbine blades; Types of wind turbines and their characteristics. Biofuels: Sources and potential, properties and characterization; Biogas generation through aerobic and anaerobic digestion; Thermochemical methods of biofuel utilization: Combustion and gasification; Status of biofuel technology. Geothermal Energy-Nature, types and utilization. Applications: Applications of renewable energy sources - Typical examples.

TEXT BOOKS

1. Renewable Energy Resources, Twidell & Wier, CRC Press
2. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 1996.

REFERENCE BOOKS:

1. L.L. Freris, Wind Energy Conversion systems, Prentice Hall, UK, 1990
2. Renewable energy resources - Tiwari and Ghosal - Narosa.
3. Renewable Energy Technologies - Ramesh & Kumar - Narosa
4. Non-Conventional Energy Systems / K Mittal /Wheeler
5. Renewable energy sources and emerging technologies by D.P.Kothari,K.C.Singhal, P.H.I
6. Non-Conventional EnergySources - G.D.Rai, KhannaPublishers

SYSTEM DYNAMICS

COURSE CODE: 11ME547 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS: 3

Introduction System concepts, examples on system modeling Mathematical models, classification.Laplace Transformation, Properties of Laplace transformation, Inverse Laplace transformation using partial fraction expansion, Final value theoremSolution of ODE's via Laplace transformation.

Transfer Functions and Block Diagrams, Modeling of Physical Systems, Electrical, mechanical, thermal, & fluid flow problems. Examples on how to interconnect different physical systems.

Linearization of Nonlinear Systems, Concept of equilibrium and operating point, Taylor series expansion, State space formulation of ODE, Linearization of non-linear state equations, Response of linear models to test signals, Stability of Linear Time Invariant systems.

Characteristic equation, s-plane stability regions, Routh's test, Time domain analysis of control systems, Performance specifications in time domain.

Introduction to automatic control system design in time domain, P, PD, PID control system, design according to the performance specifications, Frequency response of Linear Time Invariant Systems, Asymptotic Bode Plot, Mathematical models from frequency response data

REFERENCE BOOKS:

1. Ogata, K., Modern Control Engineering, Prentice Hall, 4rd edition, 2002.
2. Beachley, N.H., Harrison, H.L., Introduction to Dynamic System Analysis, Harper and Row Publishers, 1978.
3. Cochin, I., Plass, H.J., Jr., Analysis and Design of Dynamic Systems, 2nd ed., Harper Collins Publishers, 1990.
4. Dorf, R.C, Bishop, R.H., Modern Control Systems, 10th ed., Pearson Prentice Hall, NJ, 2005.
5. Kuo, B., Automatic Control Systems, Prentice Hall, 1991.
6. Nise, N.S., Control Systems Engineering, 4th ed., Wiley International Edition, 2004.
7. Ogata, K., System Dynamics, 2nd ed., Prentice Hall, 1992.

FATIGUE, CREEP AND FRACTURE MECHANICS

COURSE CODE: 13ME349 L – T – P: 3-0-0

PRE-REQUISITE: **13ME205** CREDITS: 3

Introduction: Prediction of mechanical failure. Macroscopic failure modes; brittle and ductile behaviour. Fracture in brittle and ductile materials – characteristics of fracture surfaces; inter-granular and intragranular failure, cleavage and micro-ductility, growth of fatigue cracks, the ductile/brittle fracture transition temperature for notched and unnotched components. Fracture at elevated temperature.

Griffith's analysis: Concept of energy release rate, G, and fracture energy, R. Modification for ductile materials, loading conditions. Concept of R curves.

Linear Elastic Fracture Mechanics (LEFM): Three loading modes and the state of stress ahead of the crack tip, stress concentration factor, stress intensity factor and the material parameter the critical stress intensity factor, crack tip plasticity, effect of thickness on fractureToughness.

Elastic-Plastic Fracture Mechanics (EPFM): The definition of alternative failure prediction parameters, Crack Tip Opening Displacement, and the J integral. Measurement of parameters and examples of use.

Fatigue: definition of terms used to describe fatigue cycles, High Cycle Fatigue, Low Cycle Fatigue, mean stress R ratio, strain and load control. S-N curves. Goodmans rule and Miners rule. Micromechanisms of fatigue damage, fatigue limits and initiation and propagation control, leading to a consideration of factors enhancing fatigue resistance. Total life and damage tolerant approaches to life prediction.

Creep deformation: the evolution of creep damage, primary, secondary and tertiary creep. Micro-mechanisms of creep in materials and the role of diffusion. Ashby creep deformation maps. Stress dependence of creep – power law dependence. Comparison of creep performance under different conditions – extrapolation and the use of Larson-Miller parameters. Creep-fatigue interactions. Examples.

REFERENCE BOOKS:

1. T.L. Anderson, Fracture Mechanics Fundamentals and Applications, 2nd Ed. CRC press, (1995)
2. B. Lawn, Fracture of Brittle Solids, Cambridge Solid State Science Series 2nd ed1993.
3. J.F. Knott, Fundamentals of Fracture Mechanics, Butterworths (1973)
4. J.F. Knott, P Withey, Worked examples in Fracture Mechanics, Institute of Materials.
5. H.L.Ewald and R.J.H. Wanhill Fracture Mechanics, Edward Arnold, (1984).
6. S. Suresh, Fatigue of Materials, Cambridge University Press, (1998)
7. L.B. Freund and S. Suresh, Thin Film Materials Cambridge University Press,(2003).
8. G. E. Dieter, Mechanical Metallurgy, McGraw Hill, (1988)
9. D.C. Stouffer and L.T. Dame, Inelastic Deformation of Metals, Wiley (1996)
10. F.R.N. Nabarro, H.L. deVilliers, The Physics of Creep, Taylor and Francis, (1995)

UPSTREAM SPECIALIZATION

WELL INTERVENTION & STIMULATION TECHNIQUES

COURSE CODE: **14 PE331** L – T – P: 3-0-0

PRE-REQUISITE: **14 PE 206** CREDITS: 3

Work-over operations, Work over fluids. Scraping, well circulation, Water and gas Shut-off, Squeeze cementing. Handling water and gas coning.

Production packers, Packers calculation, Well activation. Repair of wells, Paraffin and scale removal. Planning and evaluation of workover jobs. Corrosion, Bacteria & Scale control

Sand-control, Screens, Gravel packs.

Reservoir Stimulation in Petroleum Production: Inflow performance, Tubing performance and NODAL analysis, Decision process for well stimulation, Reservoir engineering considerations for optimal production enhancement strategies, Stimulation execution.

Hydraulic Fracturing: Introduction, In-situ stress, Mechanics of Hydraulic Fracturing, Fracturing Fluid Chemistry and Proppants, Fracture Treatment Design.

Matrix Treatments: Introduction, Acid–Rock Interaction, Sandstone Acidizing Design, Carbonate Acidizing Design. Thermal stimulation techniques. Down-hole heaters. Horizontal well related development on the subject

Text Books:

1. Thomas O Allen , Alan P. Roberts, "Production Operations: Well Completions, Workover, and Stimulation", (Volume 1 and 2), Oil & Gas Consultants International, (1978).
2. Michael J. Economides Kenneth G. Nolte, "Reservoir stimulation", John Wiley & Sons, 3rd ed, (2000).

Reference Books:

1. Heriot Watt, "Production Engineering Handbook"
2. A. Daniel Hill, Christine Ehlig-Economides, Ding Zhu, Michael J. Economides, "Petroleum Production Systems", 2^{nd} Ed., Prentice Hall, (2012).
3. Boyun Guo, William C. Lyons, Ali Ghalambor, "Petroleum Production Engineering: A computer assisted approach" Elsevier Science and Technology Books, (2007).

RESERVOIR MODELLING AND SIMULATION

COURSE CODE: **14 PE 332** L – T – P: 3-0-0
PRE-REQUISITE: **14 PE 302** CREDITS: 3

Introduction & Overview: Organization, Design, Testing, Forecasting, Special processes, Economics, Credibility, decision making, Performance Monitoring, beneficial application, Planning a simulation study, Study Approach, Model design, Programming, History Matching, Predicting & Analyzing results, reporting.

Modeling Concepts: The concept of Grid blocks & Time steps, Representation of wells, Mobility Weighting, Numerical Dispersion, Grid Orientation effects, Explicit & Implicit functions, Treatment of Vertical saturation & Pressure distributions, Well functions, History Matching, Well Management, Solution methods.

Designing the reservoir model: Checklist for model design, Selecting the number of dimensions, Tank models, 1D, 2D (Areal, cross-sectional, radial), Multilayer, 3D, Simplification of complex problems, Pseudo-relative permeability & Capillary pressure functions, VE pseudo functions, Windowed models, Naturally fractured reservoirs, Representation of reservoir fluids, Representation of reservoir rock, Well models.

Selecting reservoir rock and fluid properties data: Data for model construction, Sensitivity of results to data accuracy, Porosity & Permeability: Sources of data, developing reservoir description, rock property distribution, Thickness and depth, Capillary pressure and relative permeability: Selection and assignment of data Fluid properties, Establishing Initial pressure and saturation distribution.

Selecting Grid & Time-step sizes: Selection of grid block size example grids, Selection of time-steps, Numerical dispersion, Grid orientation, Cost considerations.

Selecting the Numerical solution method: Terminology, Formulating the equations, Material Balance & pressure equations, Formulating options, Numerical Dispersion, Choosing the formulation option, Matrix Equations, Solution methods, Selecting the Equation-solving technique.

Well Management: Designing & Controlling Production Parameters.

History Matching: Validity of the Reservoir Model, Strategy & Plans, Adjustment of parameters, Pressures, Pressure gradients, GOR-WOR behavior Automatic History Matching.

Forecasting Future Performance: Planning prediction cases, Preparation of input data, smooth transition from history to predictions, Review & Analysis of predicted performance, Evaluating & Monitoring predicted performance.

Simulating Special Processes: Compositional Simulation, Miscible displacement, Chemical & polymer flooding, Steam simulation and steam drive, In-Situ combustion, Special Data requirements.

Text Books:

1. Jamal H. Abou Kasem, S. M. Fariuq Ali, M. Rafiq Islam, "Petroleum Reservoir Simulation: A Basic Approach", Gulf Publishing Company, (2006).
2. John R. Fanchi, "Principles of Applied Reservoir Simulation", Elsevier, (2005).

Reference Books:

1. Heriot Watt, "Reservoir Simulation Handbook"
2. M.R. Carlson, "Practical Reservoir Simulation", PennWell, (2003).
3. Zhangxin Chen, "Reservoir Simulation: Mathematical Techniques in Oil Recovery", Cambridge University Press, (2008).
4. Richard E. Ewing, "Mathematics of Reservoir Simulation", Society for Industrial and Applied Mathematics (SIAM), (1983).

ENHANCED OIL RECOVERY

COURSE CODE: 14 PE 333 **L – T – P: 3-0-0**
PRE-REQUISITE: 14 PE 302 **CREDITS: 3**

Introduction: Historical background and review of primary and secondary recovery, injection rate and pressures in secondary recovery.

Flood Patterns and Coverage: Basic flooding networks, directional permeabilities, off pattern wells, natural and induced fractures.

Microscopic displacement of fluids in a reservoir: Capillary forces, viscus forces, phase trapping, mobilization of trapped phases.

Macroscopic displacement of fluids in a reservoir: Areal sweep efficiency, vertical sweep efficiency, displacement efficiency, mobility ratio, well spacing.

Flow of immiscible fluids through porous media: continuity equation, equation of motion, solution methods Water flooding, Fractional flow equation, Frontal advance theory. Recovery efficiency, permeability heterogeneity.

Immiscible displacement processes:

Water flooding performance calculations: Frontal advance method, viscous fingering method, Stiles method, Dykstra-Parsons Method, Water for water flooding.

Gas Injection-Immiscible Displacement: Dispersed gas injection, external gas cap gas injection, and foam drive process for oil recovery.

Miscible Displacement Processes: Mechanism of miscible displacement, phase behavior related to miscibility, fluid properties in miscible displacement, design procedure and criteria, high pressure gas injection, enriched gas injection, LPG flooding, Carbon dioxide flooding, alcohol flooding. Microbial oil recovery

Thermal Recovery Processes: mechanism of thermal flooding, hot water flooding, cyclic steam injection, estimation of oil recovery from steam drive, in-situ combustion, air requirement for in-situ combustion.

Surface facilities for EOR processes: Treatment of water for reservoir compatibility. Design consideration for water handling and injection system. Pumps types & sizing, Infectivity problems. Gas compression for injection, gas compressors. Design consideration for gas collection and distribution system for injection

EOR Project Evaluation.

Text Books:

1. E. C. Donaldson, G. V. Chilingarian, T. F. Yew, "Enhanced Oil Recovery: Processes and Operations", Elsevier, (1998).
2. Larry W. Lake, "Enhanced Oil Recovery", Prentice Hall, (1998).

Reference Books:

1. H. R. Van Pollew and Associates, "Fundamentals of Enhanced Oil Recovery", PennWell, (1980)
2. Enhanced Oil Recovery, Teknica, Teknica Petroleum Services Ltd.,(2001).

3. Modern Chemical Enhanced Oil Recovery: Theory and Practice, Gulf Professional Publishing, (2011)
4. Aural Carcoane, “Applied Enhanced Oil Recovery”, Prentice Hall, (1992).
5. IstvanLaktos, “Recent Advances in Enhanced Oil and Gas Recovery”, Academy Kiado, (2001).
6. Don W. Greew, G. Paul Willfite, “Enhanced Oil Recovery”, Society of Petroleum Engineers, (1998).
7. Vladmir Alvarado, Eduardo Marriglee, “Enhanced Oil Recovery: Field Planning and Development Strategies”, Gulf Professional Publishing, (2010).

COAL BED METHANE-GAS HYDRATES-SHALE GAS

COURSE CODE: 14 PE 334 **L – T – P: 3-0-0**
PRE-REQUISITE: NIL **CREDITS: 3**

Coal Bed Methane: Present status of coal bed methane. Formation and properties of coal bed methane. Thermodynamics of coal bed methane. Exploration & Evaluation of CBM, logging of coal bed methane wells. Drilling and completion of coal bed methane wells. Hydro-fracturing of coal seam, Activation of well. Production installation and surface facilities. Well operation and production equipment. Treating and disposing produced water. Testing of coal bed methane wells.

Gas Hydrates: Introduction & present status of gas hydrates. Formation and properties of gas hydrates. Thermodynamics of gas hydrates. Exploration & evaluation of gas hydrates. Phase behavior of gas hydrates, Kinetics of gas hydrates. Drilling and completion of gas hydrate wells. Prevention & control of gas hydrates. Gas hydrates accumulation in porous medium. Gas extraction from gas hydrates. Uses and application of gas hydrates.

Shale Gas: History of shale gas production, Extraction methods: development of current practices. Location and size of production areas: estimated reserves and economics.

Text Books:

1. R. E. Rogers, “Coal Bed Methane: Principles and Practice”, 3rd Ed, Prentice Hall, (1994).
2. E. Dendy Sloan, Jr., C. Koh, “Clathrate Hydrates of Natural Gases”, 3rd Ed, CRC Press, (2007).
3. Amber L tuft, “Unconventional Oil & Shale Gas”, Nova Publishers, New York, (2015).

Reference Books:

1. Coal Bed Methane, Society of Petroleum, (1992).
2. John Seidle, “Fundamentals of Coal Bed Methane Reservoir Engineering”, Pennwell Corp., (2011).
3. John J. Carroll, “Natural Gas Hydrates: A Guide for Engineers”, Gulf Professional Publishers, (2003).
4. Natural Gas Hydrates in Flow Assurance, E. Dendy Sloan, C. Koh, A. K. Sum, A. L. Ballard, J. Creek, M. Eaton, N. McMullen, T. Palermo, G. Shoup and L. Talley, Elsevier, 2010.

DIRECTIONAL DRILLING & OFFSHORE STRUCTURES

COURSE CODE: 14 PE 335 **L – T – P: 3-0-0**
PRE-REQUISITE: 14 PE 206 **CREDITS: 3**

Directional Drilling: Objectives, Types of deflection tools, tool orientation, Directional well profiles, Well path deflection & correction.

Down Hole Motors: Positive displacement motors and Turbo-drills - motor description, Power calculation and applications; Auto-track and verti-track system; Rotary Steerable motors, Geo-steering tools.

Horizontal Well Drilling: Horizontal well objectives and selection, Different profiles, Drilling techniques, Mud requirements & characteristics, casing and drill string requirements and completion programs.

Slant Hole Drilling: Objectives and selections, Well profiles and applications.

Down the Hole Well Surveying: Well surveying objectives, surveying methods, Surveying Analysis methods and calculations for well coordinates.

Measurements While Drilling: Objectives of MWD/ LWD, SWD, MWD tools, Telemetry system and data interpretation.

Directional drilling problems and their remedies. Introduction to offshore oil and gas operations.

Offshore Fixed Platforms: Types, description and operations.

Offshore Mobile Units: Types, description and installation; Station keeping methods like conventional mooring & dynamic positioning system.

Offshore Drilling: Difference in drilling from land, from fixed platform, jackup, ships and semi submersibles; Use of conductors and risers; Deep sea drilling.

Offshore Well Completion: Platforms and subsea completions, Deep water applications of subsea technology.

Offshore Production: Oil processing platforms, gas processing platforms, water injection platforms, storage, SPM and SBM, transportation and utilities.

Divers and Safety: Principles of diving use of decompression chambers, life boats.

Offshore Environmental Pollution and Remedial Measures.

Text Books:

1.T. A. Inglis, “Directional Drilling”, “Petroleum Engineering and Development Studies”

2.“The Technology of Offshore 'Drilling, Completion and Production”, ETA Offshore Seminars, Inc. Penn WellPublishing Company.

3.S. Chakrabarti, “Handbook of Offshore Engineering”, Volume 1 & 2, Elsevier, (2005)

Reference Books:

1.Bill Mitchill, “Advanced oil well drilling engineering, hand book and computer programs” SPE.

PETROLEUM PRODUCTION SYSTEM DESIGN

COURSE CODE: 14 PE 336 **L – T – P: 3-0-0**

PRE-REQUISITE: NIL **CREDITS: 3**

Petroleum production system: Introduction

Gathering and collection of oil and gas: GGS, CTF and GCS - layout, sequential treatment, and safety features on installations

Well Tubing design: Introduction, Strength of Tubing, Tubing design

Metering and Measurements: Metering of oil & gas, Sampling and Testing of crude oil. Gauging equipment and methods. Water and sediment determination. Orifice and other metering devices and their characteristics.

Design of oil-gas separators: Principles of phase separators**,** Sizing of vertical & horizontal two phase and three phase separators, Optimum pressure, Design of single and multistage flash vaporization equipment.

Dehydration systems: Process design of glycol and solid bed dehydration systems.

Design of crude oil Treaters: Sizing horizontal and vertical treaters, Design of LTX units and line treaters

Design of crude desalting equipment.

Design of produced water treatment and disposal.

Design of acid gas treating system design: Design of iron sponge units, Design of H_2S and CO_2 absorbers and strippers using amine solutions.

Design of pressure vessels: Design considerations, Design temperature and pressure, Maximum allowable stress values, Determination of wall thickness, Corrosion allowance Sizing of different type of storage tanks.

Text Books:

1.Boyun Guo, William C. Lyons, Ali Ghalambor, "Petroleum Production Engineering: A computer assisted approach" Elsevier Science And Technology Books, (2007).

2.Ken Arnold, Maurice Stewart, Butterworth Heinemann, "Surface Production Operations", Vol 1 & 2, (1989).

Reference Books:

1.H.K. Abdel- Aal, Mohamed Aggour, M.A. Fahim, "Petroleum and Gas Field processing", Marcel Dekkar Inc., (2003).

2.A. Daniel Hill, Christine Ehlig-Economides, Ding Zhu, Michael J. Economides, "Petroleum Production Systems", 2nd Ed., Prentice Hall, (2012).

3.Engineering Data Book, 12th Edition (Electronic), FPS Version, Volume I & II, Gas Processers Suppliers Association (GPSA), (2005).

DOWNSTREAM SPECIALIZATION
MASS TRANSFER

COURSE CODE: 14 PE 337 **L – T – P: 3-0-0**

PRE-REQUISITE: NIL **CREDITS: 3**

Diffusion and mass transfer – Mass transfer operations & their applications. Molecular diffusion – Fick's law, steady state molecular diffusion in binary mixtures of gases, liquids and solids, diffusivity in gases and liquids, correlations; Mass transfer theories – Film mass transfer coefficients for the cases of equimolar counter diffusion and diffusion of one component (A) in stagnant component (B).

Interphase mass transfer – overall mass transfer coefficients. Equipment for gas – liquid contact - continuous and stage wise contact equipment, packed columns – Liquid distribution -Mass transfer coefficients in packed columns – Flooding in packed and plate columns – Ideal-plate – Murphree, point, plate and column efficiency – Comparison of packed and plate columns.

Absorption and Stripping – counter current and co-current isothermal absorption and stripping of single component – Operating Lines – Minimum flow rates – Determination of number of transfer units and height of a continuous contact absorbers. Multistage absorption and determination of number plates – absorption factor – Kremser – Brown equation.

Drying and Crystallization: Principles, Mechanisms and equipment

Distillation - Raoult's Law, Ideal Solution, X-Y and T-X-Y, P-X-Y Diagrams, Flash Vaporization and Condensation, Differential Distillation, Steam Distillation, Binary Distillation, McCable Thiele and Ponchon-Savarit Method, Total Reflux, Minimum and Optimum Reflux ratios, Design of Distillation Columns with Open Steam, Multiple Feeds, Side Streams and Partial Condensers, Approximate and Plate to Plate Calculations for Multi Component Distillation.

Solvent extraction - Liquid-Liquid Extraction, Extraction Equipment, Equilibrium Diagram, Choice of Solvent, Single Stage and Multiphase Countercurrent Extraction With/Without Reflux, Continuous Contact Extractors.

Leaching – Principles, Leaching Equipment and Equilibrium, Single and Multistage Cross Current and Counter Current Leaching

Adsorption and Desorption – Principle and mechanism

Text Books:

1. Robert E. Treybal, “Mass Transfer Operations” McGraw-Hill Education India Pvt.Ltd - New Delhi
2. E. L. Cussler**,** “Diffusion: Mass Transfer in Fluid Systems”**,** Cambridge University Press

Reference Books:

1. Binay K. Dutta, “Principles of Mass Transfer and Separation Processes” by PHI Learing Publisher
2. Incropera and DeWitt, “Fundamentals of Heat and Mass Transfer”, John Wiley & Sons

PETROLEUM REFINING & PETROCHEMICAL TECHNOLOGY

COURSE CODE: 14 PE 338 **L – T – P: 3-0-0**

PRE-REQUISITE: NIL **CREDITS: 3**

Primary Processing Of Crude Oil: Classification of crude oil, Atmospheric distillation, Vacuum distillation of residue, Products - Specifications, Properties & Test Methods

Secondary Processing Of Crude Oil: Thermal and Catalytic Cracking, Reforming, Alkylation, Isomerization, Hydro-Processing, Cracking, Visbreaking, coking, Bitumen Production. - Lube Oil Base Stock Production, Classification and Characterization of Propane Deasphalting, Dewaxing, Hydro-Finishing; polymerization.

Treatment Techniques: Treatment techniques for removal of objectionable gases, Odors, to improve performance, Storage stability, Extraction of aromatics, Olefins and recovery operations from petroleum products. Specialty products - Carbon Black, Petroleum Coke and Waxes

Petrochemicals: Chemicals from methane and synthetic gas: Ammonia, Methanol and Hydrogen Cyanide, Chemicals from olefins: Ethylene derivatives, Propylene derivatives and Butylenes derivatives, Aromatics, intermediates for synthetic fibres, Plastics and rubber.

Environmental and Safety Aspects in Refinery and Petrochemicals: Waste water and effluent gases treatment from alkylation units and petrochemical units, safety aspects in the above industries.

Text Books:

1.W.L. Nelson, “Petroleum Refinery Engineering”, 4th Ed, McGraw Hill, New York, (1985).

2.B. K. Bhaskara Rao, "Modern Petroleum Refining Processes", 2nd Ed, Oxford and IBH Publishing Company, New Delhi, (1990.)

3.Uttam Ray Chaudhuri, “Fundamentals of Petroleum and Petrochemical Engineering” CRC Press

Reference Books:

1.Surinder Parkash, “Refining Processes Handbook”, Gulf Professional Publishing

2.Robert A. Meyers, “Handbook of Petroleum Refining Processes” Mcgraw-Hill, (1996).

3.James G. Speight, “Handbook of Petroleum Analysis” Wiley-Interscience, (2001).

4.G. D. Hobson and W. Pohl., "Modern Petroleum Technology", Gulf Publishers, 2nd Ed, (1990).

REFINING PROCESS, MODELING & SIMULATION

COURSE CODE: 14 PE 339 **L – T – P: 3-0-0**

PRE-REQUISITE: NIL **CREDITS: 3**

Process Synthesis and details, Process Flow Sheeting, Strategy of Process Calculations

Characterization, physical and thermodynamic properties of oil fractions

Atmospheric distillation unit – introduction, process overview, model development, feed characterization, data requirements and validation, representative atmospheric distillation unit building the model in Aspen HYSYS

Vacuum distillation unit - process description, data reconciliation, model implementation
Predictive modeling of the fluid catalytic cracking (FCC) process, continuous catalyst regeneration (CCR) reforming process, Hydro-processing units

Text Books:

1.Refinery Engineering: Integrated Process Modeling and Optimization by Ai-Fu Chang, Kiran Pashikanti and Y. A. Liu, Wiley-VCH

2.Chemical Process Modeling and Computer Simulation by Jana Amiya K, PHI Publications, (2011).

Reference Books:

1.Robert A. Meyers, "Handbook of Petroleum Refining Processes", Mcgraw-Hill, (1996).

2.William L. Luybean, "Process Modeling, Simulation and Control for Chemical Engineers", McGraw-Hill Companies, (1989)

POLYMER SCIENCE & TECHNOLOGY

COURSE CODE: 14 PE 340 **L – T – P: 3-0-0**

PRE-REQUISITE: NIL **CREDITS: 3**

Introduction and Fundamentals: Definitions and concepts of plastics and polymers, Comer, Co-monomer, Mesomer, Co – polymer, functionality, visco-elasticity classification of polymers Methods determining molecular weights of polymers: Based on colligative properties, Sedimentation equilibrium method. Gel chromatography. Natural polymers: rubber, shellac, rosin, cellulose, and lignin's, Proteins.

Chemistry of Polymerization: Concepts of addition polymerization condensation polymerization and Co – polymerization, glass transition temperature of polymers, Degradation of polymers of following types: Mechanical, Hydrolytic thermal, back bone effects.

Methods of Polymerization: Mass, solution, emulsion, suspension Role of following additives for polymers: Initiators, catalyst inhibitors, solvents, fillers, reinforcing agents, stabilizers plasticizers, lubricants, blowing agents, coupling agents, flame retardants photo-degradants.

Methods of Manufacture, Properties, uses of following addition compounds: Polyethylene (LDPE & HDPE), Polypropylene, PVC and its copolymers, Acetals, PTFE;

Condensation compounds: polyester –PMMA, PET, Alkyd, Epoxy resins, Polyurethanes, Silicones, PF, UF, MF resins.

Description of Following Processing Methods: With principles involved and equipment used mixing and compounding, extrusion, Calendring, laminating, Moulding – compression, transfer, injection and blow moulding.

Text Books:

1. Bill Meyer, "Text Book of Polymer Science", 3rd Ed., John Wiley and Sons, (1984).
2. J.A Bryson Newness – Butterwarths, "Plastic Materials", London, (1989).

Reference Books:

1.J.H. Briston and C.C.Gosselin, "Introduction to Plastics", Newnes, London, (1968).

2.C.C Winding and G.D.Haitt, "Polymeric Materials", Mc Graw Hill Book, (1961).

3.M.S. Bhatnagar, "A Text Book of Polymers", 1st Ed., S. Chand and Company, New Delhi, (2007).

PETROCHEMICAL PROCESSES

COURSE CODE: 14 PE 341 **L – T – P: 3-0-0**

PRE-REQUISITE: NIL **CREDITS: 3**

Introduction to Petrochemicals and Petrochemical Industry in India - Reaction Mechanism and Kinetics in Petrochemical Production : Cracking, Polymerization, Alkylation, Reforming. -

Petrochemicals from Different Feed Stocks - Synthesis Gas : Ammonia, Urea - Methanol Derivations : Acetic Acid, Methyl Methacrylate, Dimethyl Terephthalate, Chloro Methanes. - N-Paraffin Derivatives - Propylene and Higher Olefins Production and Derivatives - Aromatics Production and Derivatives - Thermosetting and Engineering Resins, Synthetic Fibers, Synthetic Rubber - Integration of Petrochemical Production with Refinery Operations. - PRACTICAL

TEXT BOOKS:

1. Chemistry of Petrochemical Processes by Sami Matar and Lewis F. Hatch, 2nd Edn, Gulf Professional Publishing
2. Petrochemical processes by Alain Chauvel and Gilles Lefebvre, Editions Technip

REFERENCE BOOKS:

1. Handbook of Petroleum Processing by David S. J. Jones and Peter P. Pujadó, Springer, 2006

CHEMICAL PROCESS EQUIPMENT DESIGN AND DRAWING

COURSE CODE: 14 PE 342 **L – T – P: 3-0-0**

PRE-REQUISITE: NIL **CREDITS: 3**

Basic design procedure of heat transfer equipment, overall heat transfer coefficient and dirt factors, shell and tube heat exchangers - construction details, selection algorithm, design codes, mean temperature difference, general design considerations, tube-side heat transfer coefficient and pressure drop, shell-side heat transfer coefficient and pressure drop.

Design of condensers for single vapors, heat transfer coefficient correlations for condensation inside and outside of tubes of the vertical and horizontal condensers, pressure drop in condensers.

Reboilers, vaporizers and evaporators - Pool boiling, convective boiling, selection of reboilers, and vaporizers, design of reboilers, vaporizers and evaporators, drawing of evaporators.

Design of distillation column, degree of freedom analysis, various design methods of distillation column, general design consideration of multicomponent distillation, plate efficiency, tray hydraulics of sieve and valve - trays.

Design of pressure vessel; Introduction of codes for pressure vessel design; design of cylindrical and spherical shells under internal and external pressure, selection and design of closures, Selection of gaskets, selection of standard flanges, optimum selection of bolts for flanges, design of flanges. Design of lug support and saddle support including bearing plates and anchor bolts.

Text Books:

1. Sinnott R. K.; "Coulson and Richardson's Chemical Engineering Series", Vol. VI, 4th Ed., Butterworth-Heinemann.
2. Seader J. D. and Henley E. J., "Separation Process Principles", 2nd Ed., Wiley-India.
3. Bhattacharya B. C., "Introduction of Chemical Equipment Design", CBS Publisher.

Reference Books:

1. Hewitt G.F., Shires G. L. and Bott T. R., "Process Heat Transfer", Begell House.
2. Serth R.W., "Process Heat Transfer: Principles and Applications", Academic Press.
3. Brownell L. E. and Young H. E., "Process Equipment Design", John Wiley.
4. I.S.; 4503 - 1967, Indian Standard Specification for Shell and Tube Type Heat Exchangers.

OPEN ELECTIVES

IPR & PATENT LAWS

COURSE CODE: 11OE408 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Intellectual Property Rights; Patents and intellectual property rights (IPR): Definition,History of intellectual property; Types of intellectual property rights, copy rights, trade marks, geographical indication, Industrial design rights, patents. Sources of patent information, patent application procedures. **Principles, Scope And Functions Of GATT&WTO;** GATT- Historical perspective, objectives and fundamental principles, impact on developing countries. WTO-Objectives, scope, functions, structure, status, membership and withdrawal, dispute settlement, impact on globalization, India-tasks and challenges. **Regulatory Affairs;** Indian contest-requirements and guidelines of GMP, understanding of Drugs and cosmetic act 1940 and rules 1945 with reference schedule M,U & Y. Related quality systems-objectives and guidelines of USFDA,WHO & ICH; Introduction to ISO series. **Documentation and Protocols;** Documentation:Types related to pharmaceuticals industry, protocols, harmonizing formulation development for global fillings, NDA, ANDA, CTD, Dealing with post approval changes-SUPAC, handling andmaintenance including electronic documentation. **Case Studies on Patents;** Case Studies on - Patents (Basmati rice, turmeric, Neem, and related medicinal plants and byproducts)

Textbooks:

1. S. H. Willig, Good manufacturing practices for Pharmaceuticals, Informa Healthcare (Oct 2000).

Reference books:

1. Industrial Property Rights: Vol. III-4, Kogan Pate, Kogan Pate, Kogan Page (May 1998)

REGULATORY AFFAIRS AND CLINICAL TRAILS

COURSE CODE: 11OE411 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Investigational new drug development • New drug development • Abbreviated New Drug Development Phase 0 studies • Phase I and subtype studies (single ascending, multiple ascending, dose escalation, methods, food effect studies, drug – drug interaction, PK end points • Phase II studies (proof of concept or principle studies to establish efficacy) • Phase III studies (Multi ethnicity, multinational, registration studies) • Phase IV studies (Post marketing authorization studies; pits and practices? Good clinical practice (ICH GCP E6) • Clinical trial materials (Documentation, Investigational drugs, logistical materials) Ethics committees, constitution and practices • Declaration of Helsinki and Informed consent process • Liability and indemnity in clinical trials (Insurance and Indemnity: roles and responsibility) • Misconduct and Fraud in clinical research • Ethics and clinical trials in special population. Adverse event and serious adverse event reporting in clinical trials; emphasis on SUSARs, managing and reporting of events. Clinical study reports – structure and content • Critical appraisal of clinical study report • Reporting clinical trials in common technical document • Electronic reporting in clinical trials. Quality control, assurance and types of audits • Clinical study audit – conduct and reporting • Regulatory inspections in clinical research. ICH –GCP guidelines, • Clinical Research regulations in India – CDSCO guidelines, • Clinical trial application requirements in India- IND, ANDA, AADA and NDA. • USFDA regulations to conduct drug studies.

RECOMMENDED BOOKS:

1. Handbook of clinical research. Julia Lloyd and Ann Raven Ed. Churchill Livingstone
2. Principles of Clinical Research edited by Giovanna di Ignazio, Di Giovanna and Haynes.
3. Central Drugs Standard Control Organization. Good Clinical Practices-Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health; 2001.

BIO-SAFETY & BIOETHICS

COURSE CODE: 13OE432 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Biosafety Concepts and Issues Introduction to Biosafety, International dimensions in Biosafety, Cartagena protocol on biosafety, Rational Vs Subjective perceptions of risks and benefits, Relationship between risk, hazard, exposure and safeguards, Bioterrorism and conventions on biological weapons. **Biosafety in the Laboratory; Biotechnology and** biosafety concerns at the level of individuals, institutions, society, region, country and the world. Laboratory associated infections and other hazards, assessment of biological hazards and levels of biosafety, prudent biosafety practices in the laboratory institution. ; **Biosafety Regulations, Food Safety and Assessment** Biosafety regulations in the handling of recombinant DNA processes and products in institutions and industries, Biosafety assessment procedures in India and abroad. The GM-food and biosafety assessment procedures for biotech foods & related products, including transgenic food crops, case studies of relevance (e.g.-cotton).Biosafety assessment of biotech pharmaceuticals products such as drugs/vaccines etc.; **Biotechnology and Society** Introduction to science, technology and society, biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs private funding, biotechnology in international relations, globalization and development divide.; **Biotechnology and Bioethics ;** Ethics from biomedical practices to biotechnology, ethical conflicts in biotechnology-interference with nature, fear of unknown, unequal distribution of risks and benefits of biotechnology, bioethics vs business ethics, ethical dimensions of IPR, technology and other global biotech issues.

Recommended Textbooks:

1. Biotechnology & Safety Assessment (3 rd Ed)- Thomas J.A, Fuch R.L(2002) – Academic Press.
2. Biotechnology Safety Principles & Practices (3 rd Ed)-FlemingD.A, Hunt D.L(2000)– Academic Press.

Reference books:

1. Encyclopedia of Bioethics.-S.K.Ghosh-Global Publishing House.

ENVIRONMENTAL BIOTECHNOLOGY

COURSE CODE: 13OE433 L- T- P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Environmental Pollution; Types, Environmental pollution (water, soil, air), Noise & Thermal pollution, sources, and control. Reduction of environmental impact of industrial effluents, chemical herbicides and fertilizers. Biotechnology for hazardous waste management, persistent organic pollutants, Xenobiotics, biological detoxification of pH. Removal of oil spills. Environmental monitoring. Bioremediation – solid & liquid waste treatment. ; **: Water Pollution ;** Water Quality modeling for streams. Water pollution and its control, wastewater treatment – Biological processes for Industrial and domestic effluents treatments, Aerobic and non-aerobic Biological treatment. Role of Biotechnology in water purification systems. (Primary, secondary and tertiary treatments); **: Air Pollution;** Source of air, water and solid wastes. Micrometeorology and dispersion of pollutants in Environment.

Centrifugal collectors, Electrostatics, precipitator, bag filters and wet scrubbers. Design and efficiencies. Combustion generated pollution mine drainages, vehicle emission control. Case studies – Bio techniques for Air pollution control. ; **Microbe-Metal Interaction ;** Heavy metal pollution and impact on environment Bioleaching Microbial systems for heavy metal accumulation, Biosorption, molecular mechanism of heavy metal tolerance, role of microbes in synthesis of nanoparticles.; **Environment & Energy ;** Renewable sources of energy – Biogas, waste material, energy crops, cellulose. Bio-fuels & Bio diesel using microorganisms. Global Environmental problems. Ozone depletion, UV-B, Green house effect. National policy on environment.

Recommended textbooks:

1. T. Srinivas, Environmental Biotechnology, New-Age Publications, New Delhi (2008)
2. Bru E. Rittmann and Perry L.Mc Carty, Environmental Biotechnology: Principles and Applications, Mc Graw Hill Company (2001)

Reference textbooks:

1. Howard S. Peavy, Donal R. Rowe and George Tchobanoglous, Environmental Engineering, Mc Graw Hill Company (1985)

PRODUCT VALIDATION AND QUALITY CONTROL

COURSE CODE: 13OE434 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Process validation and cGMP Validations – Methods of validation, Types of validations, Documentation, Development of validation protocol, Standard operating procedures. Quality Assurance, Quality control, Quality management, Good laboratory practices, Good manufacturing practices, cGMP, GMP of industries. Guidelines and regulation of FDA and ICH for GLP, Documentation of GMP, Compliance of GMP. Clean room, Class A, B (USFDA), Bacterial counts in clean room, Waste disposal in laboratories. Introduction to ISO series. **: clinical trials and regulatory affairs;** What is clinical trail - Need, Types and phases of preclinical and clinical trails, Benefits and Risks in clinical trails, Research methodology, Primary and secondary outcomes: Subgroup analysis, Design configuration, Multicenter trails, Clinical trail regulation, Essential standards for performing clinical trails, Indian/USA/EU ethics approval system. Good clinical practice, Institutional ethics committee, General ethical principles. Basic components of clinical trails budgets, Clinical trail Industry, Economic challenges faced by Pharmaceutical companies.**: IPR and Patent laws ;** Patents and intellectual property rights (IPR): Definition, History of intellectual property; Types of intellectual property rights, copy rights, trade marks, geographical indication, Industrial design rights, patents. Sources of patent information, patent application procedures. GATT-objectives and fundamental principles. WTO-Objectives, scope, functions, structure, status, membership and withdrawal, dispute settlement, impact on globalization, India-tasks and challenges.; **Marketing and Management ;**Indian and foreign prospective of biotechnology, current challenges for the biotechnology based products. Role of Research and development, Develop process, success rates and costs, creating and marketing the image of the biotechnology company. Art of negotiation and effective communication, price, place of price in marketing strategy, multistage price determination process, breakeven analysis and pricing, pricing, policies.

Textbooks:

1. Biotechnology Safety Principles & Practices (3 rd Ed)-FlemingD.A, HuntD.L– Academic Press. (2000)
2. International Clinical Trail, Volume 1 & 2 Dominique P.brunier and Nahler, Interpham press, Denver, Colorado.

Reference books:

1. Joseph G Monk. Operations Management. Macmillan/McGraw-hill School (1988-11).
2. Samuel Eilon, Production, Planning and Control, Universal Publishing Corporation (1991).

REMOTE SENSING AND GIS

COURSE CODE: 11OE309 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Remote sensing basic definition and process, Passive and active remote sensing. Electromagnetic Spectrum, Resolution, Characteristics of Various sensors and satellites, Fundamentals of Image Processing. Map as a model, Spatial elements and terminology, Map scale, Spatial referencing system, Computers in map production, General software's in map production. Types of data products; Image interpretation strategy, Levels of interpretation keys; Topography, Types of Drainage Pattern and Texture, Erosion, ; Basic elements of image interpretation. Overview on visual image interpretation equipment. A brief history of GIS, GIS architecture, Components of a GIS, GIS workflow, Theoretical models of GIS: Functional elements, Fundamental operations, Theoretical framework, GIS categories, Levels/scales of measurement. The data stream, Data input methods: Keyboard entry, Manual digitizing, Scanning and automatic digitizing. Stages of GIS data modeling; Raster and Vector data representation, Spatial data models; Data editing, Detecting and correcting errors, Data reduction and generalization Edge matching and Rubber sheeting, Components of data quality, Sources of error in GIS. Land use /Land cover studies, slope mapping, preparation of structures map, Ground water prospects mapping, Watershed management and Action plan, Water quality modeling, Salt Water intrusion models, pipeline alignment studies, Solid and hazardous waste disposal site selection, Landslides mapping, Urban planning and Management, GPS applications.

TEXT BOOKS:

1. Remote Sensing and Image Interpretation- 5th Edition by Lillesand, Kiefer and Chipman, Published by John Wiley and Sons, Inc, New York, 2007**2.** Text book of Remote sensing and GIS – 3rd Edition by M. Anji Reddy, BS Publications, Hyderabad, 2010.

Reference Books:

1. Geoinformatics for Environmental management" by M. Anji Reddy, B.S Publications, Hyderabad

2. Remote Sensing and GIS- by B. Bhatia Published by Oxford University Press, 2009

ENVIRONMENTAL POLLUTION CONTROL METHODS

COURSE CODE: 11OE310 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Sources, Types and Effects of Water pollutants. Measurement of pollution loads: DO, BOD, COD, TOC - Water quality and Effluent discharge standards. Role of Microorganisms in wastewater treatment. Bacterial population dynamics- growth kinetics. Pre treatment, primary treatment, secondary and tertiary treatment of wastewater. Low cost treatment unit processes. Sources, Types, and effects and Fate of air pollutants. Meteorological factors and their impacts on pollutants dispersal. Sampling and measurement of air pollutants. Air quality standards. Air pollution control methods for particulates and gaseous pollutants. Emission Control equipments for particulate and gaseous matter Sources and types of Solid wastes – Disposal methods: Land filling - Composting - Incineration – Pyrolysis . Reclamation of polluted and degraded soil byBioremediation- Phyto-remediation. Human acoustics, Sound and its general features- Noise and its measurement - Noise pollution hazards -Control methods

Text Books

1. C.S.Rao (2006), Environmental Pollution Control Engineering, New Age International (P) Limited Publishers, New Delhi.
2. Howard S. Peavy, Donald R. Rowe and George Tchobanoglous(1985), Environmental Engineering, Mc Graw-Hill International Editions, NewYork.

ReferenceBooks

1. S.K. Garg,(2010),Sewage Disposal And Air pollution Engineering, Khanna publishers, New Delhi
2. M.N Rao and A.K Dutta,(2000) Waste water Engineering, Oxford & IBH PublishingCo.Ltd.
3. M.N Rao and H.V.N Rao,(2000), Air Pollution, Tata McGraw- Hill PublishingCompany Limited, New Delhi
4. Davis Cornvel,(2000),Environmental Engineering, McGraw Hill Book Co., New York
5. Met Calf &Eddy(2006), Waste Water Engineering, McGraw Hill Book Co., New York

SPATIAL DATA ANALYSIS AND MODELLING

COURSE CODE: 11OE311 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

History and basic components of Remote Sensing, Electromagnetic Remote sensing process, Passive and active remote sensing. Electromagnetic Spectrum, Resolution, Characteristics of Various sensors and satellites: IRS, Fundamentals of Image Processing. Fundamentals of GIS: Map – scale, projection and symbolism. Data structures, data models, GIS data, acquisition, input, storage, output generation. Data preprocessing, database management, integrated analysis of spatial and attribute data. Spatial Analysis and Measurement, Classification, Neighborhood functions, Polygonal neighborhoods, Buffers. Statistical Surfaces, Digital Elevation Model (DEM). Interpolation- linear and non-linear, uses and problems. Terrain reclassification, Discrete surfaces - dot distribution maps, choropleth maps. Spatial Arrangement: Spatial Arrangement, Directionality of Linear and Areal objects, Connectivity of Linear objects, Routing and allocation. Overlay Analysis, Cartographic overlay, Automating point-in-polygon and line-in-polygon procedures in Raster, Automating Polygon overlay in Raster, Automating vector overlay, types of overlay. Data Modelling, Cartographic Modeling, Scope of GIS and relationship to environmental modeling, data models and data quality. Hydrological Modeling - Land-surface-subsurface Process Modeling, solid and hazardous waste disposal site selection, zoning atlas for industrial siting, environmental information system development, risk and hazard modelling.

TEXT BOOKS:

1. Fundamentals of GIS by MICHAEL N DEMERS. Published By john Wiley & Sons Inc.
2. M. Anji Reddy , Text book of Remote sensing and GIS by, BSP Publications, Hyderabad, 2001

Reference Books:

1. Environmental Modelling with GIS, Michael F. Goodchild, Bradley O. Parks, Louis T. Steyaert
2. M.Anji Reddy, Geoinfomatics for Environmental Management, BS Publications, 2004.
3. Introduction to Geographic Information Systems By Kang-Tsung Chang (TATA McGRAW-HILL EDITION).

DISASTER MANAGEMENT

COURSE CODE: 11OE414 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Introduction and Concept of disasters and hazards related to Earthquakes, Tsunami, Volcanic eruption, Cyclones, Floods, Drought, Landslides, Forest fires, Avalanches and Pest infestation. Prediction and perception of hazards and adjustments to hazardous activities; Rates of natural cycles and residence time. Landslide: causes, prevention and correction. Landslide hazard mitigation. Earthquakes: intensity and magnitude of earthquakes; geographic distribution of earthquake zones; precursors to the earthquakes, seismic waves, travel-time and location of epicentre; nature of destruction; ground subsidence; protection from earthquake hazards; do's and don'ts during earthquake; Tsunamis causes and consequences. Floods: Causes, nature and frequency of flooding: nature and extent of flood hazard; urban floods, environmental effects of flooding; flood mitigation methods. Tropical cyclone- formation and consequences. Coastal erosion; sea level changes and its impact on coastal areas. Drought: Nature and effect on plant and animal systems. Study of pattern and mitigation of forest fires. Geological and environmental investigations for the construction of dams, bridges, highways and tunnels. Impact of major geotechnical projects on the environment. Disaster Management: Capability-Vulnerability- risk-preparedness and mitigation- Disaster management cycle; Disaster Risk Reduction and Resilience; Disaster Management Act and Policy. Disaster Management case studies.

Text books:

1. Smith, K. (1992) Environmental Hazards, Routledge, London.
2. Bell, F.G. (1999) Geological Hazards, Routledge, London.

Reference books:

1. Krynine, D.S. and Judd, W.R. (1998) Principles of Engineering Geology, CBS, New Delhi.
2. Bryant, E. (1985) Natural Hazards, Cambridge University Press. London.
3. Nagarajan, R. (2001) Lanslide Disaster – Assessment and Monitoring, Anmol Publications,New Delhi.
4. Cutter, Susan L. (1999) Environmental risks and hazards, Prentice Hall of India, New Delhi.
5. Bill Mc Juire, Ian Mason and C. Killburn (2002) Natural hazards and Environmental change,Oxford University Press, New York.
6. Gupta, Harsh K. (2003) Disaster Management, Universities Press (India) Pvt. Ltd
7. Coppola, Damon P. (2006) Introduction to International Disaster Management, Butterworth-Heinemann
8. Jha, Madan Kumar (2010) Natural and Anthropogenic Disasters: Vulnerability, Preparedness and Mitigation, Springer
9. Glade, Thomas, Malcolm G. Anderson, Michael J. Crozier (2005) Landslide Hazard and Risk, edited Springer
10. Singh, Surendra, Leszek Starkel, Hiambok Jones Syiemlieh (2008) Environmental Changesand Geomorphic Hazards, Bookwell.

IMAGE INTERPRETATION USING REMOTE SENSING

COURSE CODE: 11OE415 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Introduction and Physics of Radiant Energy: Definition, History, Basic components of Remote sensing, Passive and active remote sensing. Electromagnetic Spectrum, Energy source and its characteristics, Nature of EMR

EMR Interaction with Earth Surface Materials: Spectral signature concepts – Spectral reflectance & emittance – Typical spectral reflective characteristics of water – vegetation, soil, minerals/rock, man-made structures.

Remote Sensing Platforms And Sensors: Introduction; Satellite system parameters; instrumental and viewing parameters, sensor parameters: Spatial, Spectral and Radiometric resolutions, Imaging sensor systems: Multi spectral imaging sensor systems, Thermal sensing systems, microwave image systems. Earth resources satellites: Landsat, SPOT, IRS, and other recent satellites. Meteorological satellites: NOAA, GOES, NIMBUS, Meteosat series, Oceansat, IKONOS satellites.

Introduction of Maps: Introduction, Map as a model, Spatial elements and terminology, Classification of maps, Map scale, Spatial referencing system, Computers in map production, General software's in map production. Types of data products; Image interpretation strategy, Levels of interpretation keys; Topography

Visual Image Interpretation: Introduction; Types of pictorial data products; Image interpretation strategy, Levels of interpretation keys; Process of image interpretation; Basic elements of image interpretation. Overview on visual image interpretation equipment. **Elements of Visual Image Interpretation:** Key elements of visual image interpretation, Topography, Drainage Pattern and Texture, Erosion, Image tone, Vegetation and land use; Concept of converging evidence. Temporal aspects of image interpretation.

Image Resolution, Field Data and image interpretation – Target Variables, System Variables, Operation Conditions, Measurement of Resolution, Mixed Pixels, Kinds of Field Data, Nominal Data, Field Radiometry, Locational Information, Geographic Sampling, Image Interpretation tasks, Strategies, collateral information, interpretive overlays, preparation for manual interpretation, Image Scale Calculations.

Visual Image Analysis: Visual image analysis for land use / land cover mapping, geological and soil mapping, Agriculture applications for forestry applications, water resources applications, Urban and regional planning, Environmental assessment. Principles of land form identification and evaluation : Sedimentary, Igneous and Metamorphic rock terrain.

TEXT BOOKS:

1. Lillesand, T.M. and Kiefer R.W. Remote Sensing and Image Interpretation, John Wiley and Sons, Inc, New York, 1987.
2. M.Anji Reddy , Text book of Remote sensing and GIS by, BSP Publications, Hyderabad, 2001.

REFERENCE BOOKS:

1. Remote sensing by JAMES B. CAMPBELL. Published by Taylor & Francis Ltd.,
2. Remote Sensing Principles and Interpretation by Floyd F. Sabins, Jr. Published by Freeman & Co., New York.
3. Principles of Remote Sensing – Paul Curran P.J., - ELBS Publications

SOLID AND HAZARDOUS WASTE MANAGEMENT

COURSE CODE: 11OE416 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Solid wastes: Sources, Types, reasons for increase in generation, composition and properties of solid waste, Collection and on-site handling , Separation and processing. Solid waste disposal methods, Land filling, methods of land filling, Design of Landfills, gas production, Leachate and its control.

Conversion and recovery: Incineration, Pyrolysis, Composting methods, merits and demerits, Energy recovery, Biomethanation, use of refuse derived fuels (RDF).

Hazardous Waste, Definition, Sources, Classification, Hazardous wastes rules, and nuclear waste, biomedical wastes, Chemical wastes, disposal methods, Waste minimization. Treatment methods, Physico-chemical processes, Biological methods, Stabilization and Solidification, Thermal methods, Disposal methods Land disposal. Remedial technologies.

TEXT BOOKS:

1. Solid waste Engineering by P.Aarne Vesilind , William Worrell & Debra Reinhart, Cengage Learning India Pvt. Ltd, New Delhi
2. Environmental pollution control Engineering by C. S. Rao; New age International Publishers, New Delhi.

REFERENCE BOOKS:

1. Venkatappa Rao. G and Sasidhar. R.S.(2009), Solid waste management and Engineered Landfills, Sai Master Geoenvironmental Services Pvt.Ltd, Hyderabad
2. World Health Organization, Global Water Supply and Sanitation Assessment 2000 (Geneva2000).
3. Environment and Pollution Laws: Universal, Universal Law Publishing Co. Pvt.Ltd, Ed 2011.
4. Solid and hazardous waste management by M.N.Rao and Razia Sultana, BS Publications, Hyderabad

OPTICAL ENGINEERING

COURSE CODE: 11OE422 L – T – P: 3-0-0

PRE-REQUISITE: Nil CREDITS: 3

Introduction: Advantages of Optical fibers, Applications of Optical Fiber, Ray Theory Transmission, Total internal reflection, Acceptance angle, Critical Angle, Numerical Aperture, Fiber types: Step Index, Graded Index: Modes of Propagation: single mode and multimode fibers.

Transmission Characteristics of Optical Fibers: Attenuation, absorption, scattering and bending losses in fibers, Dispersion: Inter-model and intra-model, Polarization mode dispersion

Optical Transmitters and Detectors: LED'S: Principles of Light Emission, Light Emitting Diodes: Simple structure and characteristics. LASER: Principle, Simple structures of semiconductor Laser and its characteristics, Detectors: Principles of photo detection. PIN Photodiode, their characteristics,

Optical Sensors and Their Applications: Chemical Sensors, Temperature Sensors, Strain Sensors, Biomedical Sensors, Electrical and Magnetic Sensors, Rotation Sensor, Pressure Sensors, Displacement and Position Sensors.

Optical Fiber Systems And Instruments: Optical Amplifiers: Semiconductor Optical Amplifiers, Raman Amplifiers, Erbium Doped Fiber Amplifiers, OTDR, Instruments: optical microscopes, spectrometers, optical endoscopes, and the Hubble Space Telescope.

TEXT BOOKS

1. Keiser G, "Optical Fiber Communication, " McGraw-Hill.
2. John M Senior, "Optical Fiber Communications: Principles and Practice", 2nd Edition, PHI.
3. G. P. Agrawal, "Fiber-Optic Communications Systems," 3rd Edition, John Wiley & Sons.
4. Brain J. Thompson "Optical Science and Engineering " CRC Press.

REFERENCE BOOKS

1. W Tomasi ," Advanced Electronic Communication Systems", PHI
2. J Powers, "An introduction to fiber optic systems," 2Nd Edition, Mc. Graw Hill.
3. John Gowar, "Optical communication systems," PHI.
4. J C Palais ," Fiber Optic Communications", 2nd Edition, PHI
5. Amnon Yariv Pochi Yeh "Optical Electronics in Modern Communication, Oxford University Press, New York.

IMAGE PROCESSING

COURSE CODE: 13OE 423 L – T – P: 3-0-0

PRE-REQUISITE: Nil CREDITS: 3

INTRODUCTION: Origin of Digital Image Processing, Fields that uses Digital Image Processing, Fundamental steps in Digital Image Processing, Components of an Image Processing System.

DIGITAL IMAGE FUNDAMENTLS: Elements of Visual perception, Image sampling and Quantization, Basic relationships between Pixels, Linear and Non-linear operations. Affine transformation.

DIGITAL IMAGE TRANSFORMS: Image Transforms – The Discrete Fourier Transform, The FFT, Walsh, Hadamard, Discrete Cosine Transform, The Haar Transform, And The Slant Transform

IMAGE ENHANCEMENT IN SPATIAL DOMAIN: Some basic Grey level transformations, histogram processing, enhancement using Arithmetic/Logic operations, Smoothing Spatial Filters, Sharpening Spatial Filters.

IMAGE ENHANCEMENT IN FREQUENCY DOMAIN: Introduction to Fourier Transform and the Frequency Domain, Smoothing Frequency Domain Filters, Sharpening Frequency Domain Filters.

IMAGE RESTORATION: Noise models, Restoration in the presence of Noise, only Spatial Filtering, Periodic Noise reduction by Frequency Domain Filtering, Linear, Position-Invariant Degradations, Inverse Filtering, Wiener Filtering.

IMAGE COMPRESSION: Fundamentals – Image Compression models – Error Free Compression, Lossy Compression.

COLOR IMAGE PROCESSING: Color fundamentals, color models, pseudo color image processing, basis of full-color image processing, color transforms, smoothing and sharpening.

IMAGE SEGMENTATION: Detection of discontinuities, Thresholding, Edge based Segmentation and Region based Segmentation.

Text books:

1. Rafael C Gonzalez, Richard E Woods," Digital Image Processing", Second Edition, Pearson Education Asia, 2002. (Chapter 1, 3, 4, 5, 6, 7, 8, 9)
2. Jorg Arndt, " DSP Algorithms for Programmers"(Chapter 3)
3. Gonzalez. R & Woods B.E.," Digital Image Processing", Addison Wesley Longman Pearson Education, 2000.

REFERENCE BOOKS

1. MilanSonka, Vaclav Hlavac and Roger Boyle, Image Processing Analysis and Machine Vision, Thomson learning, Second Edition, 2001.
2. William J Prati, "Digital Image Processing", John Wiley & sons.
3. Tinku Acharya, Ajoy K Ray, "Image Processing Principles and Applications Principles and Applications", Wiley- Inter science.

MOBILE COMMUNICATION

COURSE CODE : 11 OE 424 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS:3

Introduction to Mobile Communication: Evolution of Mobile Radio Communication, Examples of Wireless Communication Systems, Cellular telephone Systems, 2G & 3G wireless networks, Cellular concept, frequency reuse, Channel Assignment strategies, Hand off strategies, Interference and system capacity, improving coverage and capacity in cellular systems.

Mobile Radio Propagation: Three basic propagation mechanisms: Reflection, diffraction, scattering, Small Scale Fading, Multipath Propagation, Types of small scale fading, Parameters of Mobile Multipath channels.

Wireless Systems & Standards: GSM Services, Features, Architecture, channel types, Frame Structure, Signal processing in GSM, CDMA Digital cellular Standards IS-95.

OFDM for Wireless Communications: Basic OFDM, FFT Implementation, Cyclic Extension, Power Spectrum, and Efficiency, Comparison with Single-Carrier, Design Example, Baseband versus Passband, Impairments of Wireless Channels to OFDM Signals.

TEXT BOOKS

1. Theodore S. Rappaport, "Wireless Communications Principles and Practice", 2nd Edition, Pearson Education, 2003.
2. David Tse and Pramod Viswanath "Fundamentals of Wireless Communication" Cambridge University Press, 2005
3. Ye (Geoffrey) Li, Gordon Stuber, "Orthogonal Frequency Division Multiplexing for Wireless Communications", Springer, 2006.

REFERENCE BOOKS

1. W. C. Y. Lee, "Mobile Cellular Communications, 2nd Edition", Mc Graw Hill,
2. Gottapu Sasi Bhushana Rao" Mobile Cellular Communication", Pearson Education

RADAR SYSTEMS

COURSE CODE: 11 OE 431	L – T – P: 3-0-0
PRE-REQUISITE: NIL	CREDITS: 3

Introduction, Basic Radar , Advantage of Basic Radar, Block Diagram of Pulse Radar, simple form of Radar equation, Detection of signals in noise, Receiver noise and signal to noise ratio, integration of Radar pulses, RCS: RCS of simple targets, RCS of multiple targets, PRF and Range Ambiguities, Doppler Effect, Limitations of CW Radar, FMCW Radar, Altimeter.

MTI Radar, Delay line cancellers: Frequency response of single delay line cancellers, Clutter Attenuation, MTI improvement factor

Tracking: Types of tracking Radar Systems, Sequential Lobing Radar, Conical Scan and Mono pulse Tracking Radar Super heterodyne Receiver, Types of Duplexers and receiver protectors, types of Displays, Radomes.

Radar Transmitter: Introduction, Linear- Beam Power Sources, Crossed- Field Amplifiers, Other RF Power Sources.

Radar Receivers: The Radar Receivers, Receiver Noise Figure, Super heterodyne Receivers, Duplexers and Receiver Protectors, Radar Displays

Synthetic Aperture Radar: Spotlight Synthetic Aperture Radar, Interferometric SAR and Coherent Exploitation

TEXT BOOKS

1.Merrill I Skolnik, " Introduction to Radar Systems", 3rd Edition, TMH, 2003

2.William L. Melvin, James A. Scheer, Principles of Modern Radar, SciTech Publishing

REFERENCE BOOKS

1.Peyton Z Peebles Jr, "Radar Principles", John Wiley Inc., 2004

2.Hamish Meikie," Modern Radar Systems", Artech House

LINEAR CONTROL SYSTEMS

COURSE CODE: 11OE 425	L – T – P: 3-0-0
PRE-REQUISITE: NIL	CREDITS: 4

Control system terminology, examples of simple control systems, open loop and closed loop control systems, Types of control systems.

Modeling: Mathematical modeling of physical systems- mechanical (Translational & rotational), Electrical (R-L-C) and Electromechanical systems – Servo Motors – AC & DC. Block diagram reduction & Signal Flow graphs

State space Modeling: Concepts of state space and state models for simple systems, solution of state equation, the state transition matrix and its properties; characteristic equation and transfer function from state models. Concepts of controllability and observability.

Testing: Time domain Testing: Transient Response & Steady state response of 1st and 2nd order systems with Standard test input time signals (step, ramp, parabolic and impulse) time domain specifications, steady state error and error constants.

Frequency domain testing: Steady state response of 1st and 2nd order systems with sinusoidal signals and frequency domain specifications and their correlation.

Stability analysis: Concept of stability and conditions for stability, Routh – Hurwitz criterion, **Root Locus Technique:** The root locus concept, basic properties, magnitude and angle conditions, properties and construction of the complex root loci, effects of adding poles and zeros to G(s) H(s) on the root loci.

Frequency response Analysis: Introduction, frequency response specifications, correlation between time and frequency response, specifications, polar (Nyquist) plot, Bode plot, phase margin and gain margin; stability analysis from Nyquist plot

Design: Lead Compensators, Lag Compensators, Lead-Lag Compensators, Proportional, PI, PID controllers

Text Books:

1. I J Nagrath & M Gopal, "Control System Engineering", 5th Edition New Age International Publication, New Delhi 2011.
2. B.C. Kuo," Automatic ontrol Systems", Prentice Hall India Publications, NewDelhi , Eighth Edition,2010.

Reference Books

1. K Ogata, "Modern Control Engineering", Prentice Hall India Publication, New Delhi , Fifth Edition,2010.
2. M.Gopal, " Control Systems Principles and Design" Tata Mc-Graw Hill Publications, Fourth Edition,2012.

   Dhanesh N. Manik, "Control Systems", Cengage Learning Pvt. Ltd., First edition, 2012

RENEWABLE ENERGY RESOURCES

COURSE CODE: 11OE426 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS: 3

Solar Radiation: Extraterrestrial solar radiation, terrestrial solar radiation, solar thermal conversion, solar ponds, solar heating/cooling technique, solar distillation, photovoltaic energy conversion, solar cells – 4 models. **Wind Energy:** Planetary and local winds, vertical axis and horizontal axis wind mills, principles of wind power, maximum power, actual power, wind turbine operation. **Energy From Oceans:** Ocean temperature differences, principles of OTEC plant operations, wave energy, devices for energy extraction, tides, simple single pool tidal system. **Geothermal Energy:** Origin and types, Bio fuels, classification, direct combustion for heat and electricity generator, anaerobic digestion for biogas, biogas digester, power generation. **Energy From Bio Mass:** Biomass energy conversion technologies-Biogas Generation-Classification of Biogas plants.

Text Books:

1. Godfrey Boyle "Renewable Energy", Oxford Publications, Second edition.
2. G. D. Rai, "Non-Conventional Energy Sources", Khanna Publishers, First edition.

Reference Books:

1. Roger H.Charlier, Charles W. "Ocean Energy- Tide and Tidal Power"ISBN: Library of Congress Control Number: 2008929624_c Springer-Verlag Brerlin Heidelberg 2009.
2. John Twidell & Toney Weir: E&F.N. Spon, "Renewable Energy Sources", Taylor & Francis New York, 2nd edition.

3. John F.Walker & N.Jenkins, “Wind Energy Technology”, John Willey and Sons Chichester, U.K – 1997

POWER SYSTEM ENGINEERING

COURSE CODE: 11OE427 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Power Stations: Layout of Hydro, Thermal and Nuclear Power Stations-Brief description of station components. Principles of electric power generation using renewable energy resources– solar, wind and ocean wave energy (qualitative treatment only). **Economic Aspects of Power Generation:** Load curve, load duration and integrated load duration curves-load factor, demand factor, diversity factor, capacity factor, utilization factor and plant use factor, depreciation methods. **Performance of transmission lines:** Representation of lines, Short transmission line, Medium length lines, Long transmission lines, ABCD constants, Ferranti effect. **Power Distribution Systems:** Distribution systems- general aspects: Classification of distribution systems, Requirements of a distribution system, Comparison of AC and DC distribution systems. DC distribution: Types of distributors, types of loading-DC distributor fed at one end, DC distributors fed at both ends, Ring distributor, Three-wire DC system. AC Distribution: Introduction, AC distribution voltage drop calculations. **Sub-stations:** Introduction, Functions of sub-stations, Classification of Sub-stations: Indoor Sub-stations, Outdoor Sub-stations. Sub-station layout showing the location of all thesub-station equipment.

Text Books:

1. “Electrical Power Systems” by C. L. Wadhwa, New Age Publications, Fourth Edition
2. “Electrical Power Systems” by J. B. Gupta, Revised edition

Reference Books:

1. “Elements of Power Station Design and Practice” by M.V. Deshpande, Wheeler Publishing, 1999.
2. “Principles of Power Systems” by V K Mehta and Rohit Mehta, 1st edn. S.CHAND & COMPANY LTD., New Delhi 2009.

ILLUMINATION AND TRACTION

COURSE CODE: 11OE428 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Illumination Fundamentals: Nature of light, Definition: Plane Angle, Solid Angle, Light energy, Luminous flux, Luminous intensity, Candle Power, Illumination, Luminance, Lamp efficiency, Depreciation Factor, Absorption factor, Reflection factor, Space height ratio, Waste light factor, Spectral distribution curve and Luminous efficiency, Relationship Between Luminous Intensity, Luminance & Lux, Laws of Illumination, Polar Curves, Photometry. **Illumination:** Different types of lamps: Gas discharge lamps, Fluorescent lamps, Ultra violet lamps, Arc lamps, Filament lamps, Types of Lighting: Street lighting-Flood lighting-Factory lighting-Monument lighting and Decorative lighting, Compact Fluorescent Lamp (CFL), Light Emitting Diode (LED) lightning; Lighting Characteristics. **Electric Traction:** General Features: Requirements of ideal system-Systems available-Systems of track electrification, The traction motor: General features of traction motors-Applications of different types, The Locomotive: Wheel arrangement and riding qualities-Transmission of drive, Characteristics and control of locomotives and motor coaches for track electrification: DC equipment-AC equipment-Electric braking with DC Motors and with AC Motors-Control gear-Auxiliary equipment, Tramways and Trolley buses: Special features of the tram and trolley buses. **Track equipment and Collector gear**: Conductor-Rail equipment-Overhead equipment-Calculations of Sags and Tensions-Collector gear for overhead equipment, Diesel Electric Equipment: Characteristics of the diesel engine-Transmission of drive-Electrical transmission systems, Train movement and Energy consumption: Speed time curves-Construction of speed time and speed distance curves- Energy consumption-Simplified speed time curves. **Braking**: Requirements of Braking system-Types of braking: Mechanical Braking- Air Braking system-Vacuum Braking system- Hydraulic-Eddy current and Magnetic brakes, Types of Electric Braking: Mechanical regenerative braking-Electrical regenerative braking.

Text Books:

1. "Art & Science of Utilisation of electrical Energy", H. Partab, Dhanpat Rai & Co, Pvt Ltd., 2007.
2. "Generation, Distribution and Utilisation of electrical Energy", C.L. Wadhwa, New Age International (P) Limited, Publishers, 2011.

Reference Books:

1. "Utilisation of Electric Energy", E. Openshaw Taylor, Orient Longman, 2006.
2. "A Text Book on Power System Engineering", M. L. Soni, P. V. Gupta, U. S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co. Pvt. Ltd., 2001.
3. "Electrical Power", S. L. Uppal, Khanna publishers, New Delhi, 2006.

ENERGY ESTIMATION & AUDIT

COURSE CODE: 11OE430 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS: 3

Domestic, Commercial and Industrial Installation Estimate Conditions and Requirements for Domestic, Commercial and Industrial Installation - steps to be followed in preparing electrical estimate (domestic, industrial and agricultural installation)

General Aspects of Energy Auditing Introduction - Types of Energy Auditing - Benefits of Energy Audit - Requirements to conduct Energy Audit - Methodology for Energy Audit - Energy Audit Report – Energy Conservation Building Code. Squirrel Cage Motors Operation of Induction Motor - Special Design feature for high efficiency motor - Torque - Speed Characteristics - Operating parameters of motor - Losses - Measurement of efficiency - Determination of energy saving - determination of Load - Assessment of economic feasibility - choice of energy efficient motor - Effect of variation of voltage on the performance of motor - effect of load variations on efficiency and power factor - unbalanced phase voltage - insulation system.

Transformers and Cables Transformers Introduction - Transformer Losses - Fixed Losses - Load Losses. Evaluation of Transformer Losses - Case Studies - reduction in Transformer Losses. Energy Conservation Building Code - mandatory requirements - maximum allowable power transformer losses. HT and LT Cabels Introduction- Selection of Cable - Construction - Insulation - inner sheath - armouring - outer sheath - specifications - Tests- Installation. Economics in selection of cables.

Lighting and Pumping Systems Lighting Systems Colour Rendering Index (CRI), Aspects of Lighting System Designing. Installed Load Efficacy Ratio. Various means for Energy Saving - use of natural day light - reduction in light fixture - high efficiency lamps and luminaries - effect of reduction in supply voltage - electronic ballasts - timers and occupancy sensors - Fluorescent tube lights - CFL lamps - Lighting Control - Exterior Lighting control - Interior Lighting power - Installed Interior Lighting Power - Exterior Lighting Power. Pumping Systems Centrifugal Pumps - Pumping System characteristics - static head vs Flow. Pump curves - pump operating point - Factors affecting pump performance - Matching pump and system head-flow characteristics - effect of over sizing the pump - energy loss in throttling. Efficient pumping system operation - effect of speed variation - effects of impeller diameter change - pump suction performance. Flow Control Strategies - pump control by varying speed - Pumps in parallel switched to meet demand- Stop/Start Control - Flow Control Valve - By-pass control - Fixed Flow reduction - Variable Frequency Drives. Energy Conservation Opportunities in Pumping Systems.

TEXT BOOK

1. Electrical Wiring, Estimating and Costing Dr.S.L.Uppal. Khanna Publishers.
2. Electrical Design Estimating and Costing.K.B.Raina & S.K.Battacharya. New age international (p) limited Publishers
3. Energy Auditing in Electrical Utilities Rajiv Shankar. Viva Books First 2010

4. ENERGY ENGINEERING AND MANAGEMENT AMLAN CHAKRABARTI PHI Learning Pvt Ltd Second Printing 2011

DATA WAREHOUSING AND MINING

COURSE CODE: 11 OE 432 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

INTRODUCTION TO DATA MINING: Motivation and importance, What is Data Mining, Relational Databases, Data Warehouses, Transactional Databases, Advanced Database Systems and Advanced Database Applications, Data Mining Functionalities, Interestingness of a pattern Classification of Data Mining Systems, Major issues in Data Mining. Data Warehouse and OLAP Technology for Data Mining: What is a Data Warehouse, Multi-Dimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Development of Data Cube Technology, Data Warehousing to Data Mining.

Data Preprocessing: Why Pre-process the Data? Data Cleaning, Data Integration and Transformation Data Reduction, Discretization and Concept Hierarchy Generation. Data Mining Primitives: Mining Association rule in large Databases, Association Rule Mining, Mining Single-dimensional Boolean Association rules from Transactional Databases, Mining Multi-dimensional Association rules from relational databases & Data Warehouse. Classification and prediction, Concepts and Issues regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian. Classification, Classification by Back-propagation, Classification Based on Concepts from Association Rule Mining. Cluster Analysis: What is Cluster Analysis? Types of Data in Cluster Analysis, A Categorization of Major clustering methods, partitioning methods, Hierarchial methods, Density-Based Methods: DBSCAN, Grid-based Method: STING; Model-based Clustering Method: Statistical approach, Outlier analysis.

Text Book:

1. Jiawei Han and Micheline Kamber,Data Mining Concepts and Techniques, Morgan Kaufman Publications

Reference Books:

1. Adriaan,Introduction to Data Mining, Addison Wesley Publication
2. A.K.Pujari Data Mining Techniques, University Press

E – COMMERCE

COURSE CODE: 11 OE 433 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Electronic Commerce: Revolution. E-Commerce Business models and concepts: The Internet and World Wide Web: E-commerce infrastructure. Building an E-commerce web site, Security and Encryption, E-Commerce payment systems E-Commerce Marketing concepts, E-Commerce Marketing communications, Ethical, Social and Political issues in E-Commerce Retailing on the Web, Online Service industries, B2B E-Commerce: Supply chain management and collaborative commerce. Internet Resources for Commerce, Technologies for Web Servers, Internet Applications for commerce, Internet Charges, Internet Access and Architecture, Searching the Internet

Text Books:

1. Kenneth C.Laudon, Carol G.Traver , E-Commerce, (Pearson Education)

Reference Books:

1. Daniel Minoli,Emma Minoli,'Web Commerce Technology Handbook',(TMG)
2. Elias M.Awad'Electronic Commerce'(PHI)

LINUX PROGRAMMING

COURSE CODE: 13OE 421 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS: 3

Linux Utilities-File handling utilities, Security by file permissions, Process utilities ,Disk utilities Text processing utilities, and Backup utilities Sed- scripts, operation, addresses, commands, applications, Awk execution, field and records , scripts, operation, patterns, actions functions using system commands in awk. Working with Bourne again Shell (bash) responsibilities, here documents , running shell script, Shell as a programming language, shell meta characters, Control structures, arithmetic in shell, examples Interrupt processing, functions, debugging shell scripts. Files : file Concept , File System Structure, I nodes, File Attributes, File types Library functions ,standard and formatted I/O in C, stream errors Kernel support for files ,System calls, file descriptors, low level file access File structure related system calls (FILE APIS), file and record locking File and directory management-Directory file APIS, Symbolic links and hard links. Process concept, Kernel support for process, process attributes, process creation , waiting for a process, Process termination ,Zombie process, orphan process, Process APIs Introduction to signals, signal generation and handling ,Kernel support for signals, signal function, unreliable signals , reliable signals Kill ,raise, alarm, pause, abort, sleep functions. Introduction to IPC, pipes, FIFOs-Introduction to three types of IPC-message queues, semaphores and shared memory -Kernel support for messages, Unix system V APIs for messages- Client /Server example

Text Books:

1. Unix system Programming using C++ T.Chan , PHI (UNIT III to Unit VIII)
2. Unix Concept and Applications, 4^{th} edn. Sumitabha dasTMH
3. Beginning Linux programming 4^{th} edn. N. Matthew, R stones Wrox Wiley India edn.

Reference Books:

1. Linux system Programming , Robot Love, O;Reilly, SPD
2. Unix Network Programming , W.R. Stevens , PHI
3. Unix and Shell Programming , B. A. Forouzan and R.F Gilberg, Cengage learning
4. Unix Internals , U Vahalia , Pearson Educaiton Unix and shell Pr

INTERNET TECHNOLOGIES

COURSE CODE: 12OE447 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS: 3

Internet Standards – Introduction to WWW – WWW Architecture – SMTP – POP3 – File Transfer Protocol - Overview of HTTP, HTTP request – response –– Generation of dynamic web pages. Markup Language (HTML): Introduction to HTML and HTML5 - Formatting and Fonts – Commenting Code – Anchors – Backgrounds – Images – Hyperlinks – Lists – Tables – Frames - HTML Forms.Cascading Style Sheet (CSS3): The need for CSS, Introduction to CSS – Basic syntax and structure -Inline Styles – Embedding Style Sheets - Linking External Style Sheets – Backgrounds – Manipulating text - Margins and Padding - Positioning using CSS. Introduction to Java Script, Objects in Java Script, Dynamic HTML with Java Script .XML: Document type definition, XML Schemas, Document Object model.

TEXT BOOKS:

1. Harvey Deitel and Abbey Deitel, "Internet and World Wide Web - How To Program", Fifth Edition, Pearson Education, 2011.
2. Web Programming, building internet applications, Chris Bates 2nd edition, WILEY Dreamtech,2011.

TELEVISION ENGINEERING

COURSE CODE: 12OE441 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS: 3

ELEMENTS OF A TELEVISION SYSTEM: Picture transmission, sound transmission, picture reception, sound reception synchronization, receiver controls, color television.Analysis and Synthesis of Television Pictures: Gross structure, image continuity, no. of scanning lines, flicker, fine structure, tonal gradation. **COMPOSITE VIDEO SIGNAL: Video** signal dimensions, horizontal sync details, vertical sync details, scanning sequence details, functions of vertical pulse train, sync details of 525 line system. **SIGNAL TRANSMISSION AND CHANNEL BANDWIDTH :**Amplitude Modulation, channel bandwidth, vestigial side band transmission, Transmission efficiency, complete channel bandwidth, reception of vestigial side band signals, frequency modulation, FM channel bandwidth, channel bandwidth for color transmission, allocation of frequency bands for television signal transmission, television standards. **THE PICTURE TUBE :**Monochrome picture tube, Beam deflection, screen phosphor, face plate, picture tube characteristics, picture tube circuit controls. Television Camera Tubes: Basic principal, Image orthicon, Vidicon. **BASIC TELEVISION BROADCASTING:** Television transmitter, positive & negative modulation. Television Receiver: Receiver sections, vestigial side band correction, choice of intermediate frequencies, picture tube circuitry & controls, sound signal separation, sound section, Sync processing & AFC circuit, vertical Deflection circuit, Horizontal deflection circuit. Television Signal propagation & Antennas: Television Transmission antennas, television receiver antennas, color television antennas.

TEXT BOOK:

1. R.R.Gulati, Monochrome and Color Television:; New Age

REFERENCE BOOK:

1. Dhake; TV and Video Engineering: TMH**.**

EMBEDDED TECHNOLOGIES

COURSE CODE: 11OE439	L – T – P: 3-0-0
PRE-REQUISITE: NIL	CREDITS: 3

EMBEDDED DESIGN LIFE CYCLE Product specification – Hardware / Software partitioning – Detailed hardware and software design – Integration – Product testing – Selection Processes – Microprocessor Vs Micro Controller – Performance tools – Bench marking – RTOS Micro Controller – Performance tools – Bench marking – RTOS availability – Tool chain availability – Other issues in selection processes. **PARTITIONING DECISION** Hardware / Software duality – coding Hardware – ASIC revolution – Managing the Risk – Co-verification – execution environment – memory organization – System startup – Hardware manipulation – memory mapped access – speed and code density. **INTERRUPT SERVICE ROUTINES** Watch dog timers – Flash Memory basic toolset – Host based debugging – Remote debugging – ROM emulators – Logic analyzer – Caches – Computer optimization – Statistical profiling. **IN CIRCUIT EMULATORS** Buller proof run control – Real time trace – Hardware break points – Overlay memory – Timing constraints – Usage issues – Triggers. **TESTING** Bug tracking – reduction of risks & costs – Performance – Unit testing – Regression testing – Choosing test cases – Functional tests – Coverage tests – Testing embedded software – Performance testing – Maintenance.

Text Books

1. Arnold S. Berger – "Embedded System Design", CMP books, USA 2002.
2. Sriram Iyer, "Embedded Real time System Programming"

Reference Books

1.. ARKIN, R.C., Behaviour-based Robotics, The MIT Press, 1998

FUNDAMENTALS OF IT

COURSE CODE: 13OE429 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Fundamentals of Computers: Introduction, Architecture, organization of a small computer, center Processing Unit, Execution cycle, Instruction categories, measures of CPU performance, Memory, Input/output devices, BUS-addressing modes. **System Software:** Assemblers, Loaders and linkers, compilers and interpreters. **Operating System:** introduction, memory management schemes, Process management, scheduling, threads. **Programming Fundamentals:** Problem solving with algorithms, Programming styles, coding Standards and Best practices, Introduction to C Programming, Testing and Debugging. Code reviews. **System Development Methodologies:** Software development Models **User Interface Design:** introduction, the process, Elements of UI design & reports. **RDBMS:** Introduction, Data processing, the database technology, Data models **ER Modeling:** Concept, Notations, Extended ER features, Logical database design. **Normalization:** Functional Dependency, Normal Forms. **SQL:** DDL statements, DML statements, DCL statements, writing Simple queries.**SQL tuning techniques:** Embedded SQL, OLTP **Object oriented concepts:** Object oriented programming, relationship, Inheritance, Abstract classes, polymorphism, UML Diagrams, Object Oriented Design Methodology. **Rational Rose Tool:** Application of OOC using Rational Rose Tool.

TEXT BOOKS

1. Andrew S. Tanenbaum, Structured Computer Organization,PHI,3rd ed.,1991
2. **S**iberschatz and Galvin, Operating System Concepts, 4th ed., Addision-Wesley,1995
3. Dromey R.G., How to solve it by Computers PHI,1994
4. Kernighan, Ritchie, ANSI C language PHI,1992
5. Wilbert o.Galitz essential Guide to user interface design john,wiley,1997
6. Alex Berson, Client server Architecture, McGrew Hill International,1994.
7. Rojer Pressman,Softer Engineering-A Practitioners approach, McGraw Hill 5th ed., 2001.
8. Alfred V Aho,E Hoproft, Jeffrey D Ullman, Design and Analysis or computer algorithms, Addison Wesley publishing Co..;1998
9. Henny F korth , Abraham Silbefrschatz, Database System concept, 2nd . McGraw- Hill international editions,1991
10. Elmasri and Navathe, Fundamentals of Database systems, 4th edition, admison Wesely, Person Eductaion inc.2000

FUNDAMENTALS OF DBMS

COURSE CODE: 12OE445 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Database fundamentals, DBMS characteristics & Advantages, Database environment, Data base users, Database architecture, data independence, Languages, tools and interfaces in DBMS. DBMS Types. Data modeling — ER Model, Notation used in ER diagram, Constraints: types, relationships in ER Model and other considerations in designing ER diagram. Any example model-University, Hospital. SQL: Data definition and other languages in SQL, Creating Tables, and Data types, Constraints, DML statements, Functions and writing SQL statements using nested sub queries, joining relations. Embedded SQL - Writing Functions and procedures with PL/SQL. (Relational Model, Relational Algebra, Operators in Relational Algebra-Basics). Normalization: Guidelines for good database design, Normalization — Normal Forms, First, Second, Third Normal Forms, BCNF (Boyce Codd Normal Form). File and storage structures: File storage, index structures, indexing and hashing (Basics). Transaction Processing: Transaction processing issues, Transaction states, problems during multiple transaction processing, ACID properties. Concurrency Control techniques: Binary Locks, Exclusive Locks, Lock based Techniques, Timestamp based techniques. •

TextBooks:

1. Fundamentals of Database System - Elmasri, R.A.,Navathe, Shyam B. Narosa Publishing House
2. Database Management Systems - Raghu Ramakrishnan Mc Graw Hill Publishing Company Limited, 2004

Reference Books:

1. Database Management System - Post, Gerald V ,Tata McGraw-Hill, 2004
2. An introduction to Database Systems - Bipin C Desai Galgotia Publications (P) Ltd., 2005
3. Database system concepts - Abraham Silberschatz, Henry F Korth and Sudharshan S Mc Graw Hill Publishing Company Limited, 2004

ROBOTICS

COURSE CODE: 12OE443 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

INTRODUCTION: Introduction to Robotics, Major components of a Robot, Classification of Robots - Classification by Coordinate System, by Power Drive and by Control Method, Specifications of Robots, Fixed versus flexible automation, Economic Analysis.

ROBOT END EFFECTORS: Introduction, Types of end effectors-Grippers and Tools, Gripper Mechanisms, Considerations in the selection and design of remote centered devices.

ROBOTIC SENSORY DEVICES: Objective, Non-Optical position sensors-Potentiometers, Synchros, inductosyn, optical position sensors-opto interrupters, Optical encoders (absolute & incremental).

PROXIMITY SENSORS: Contact type, non-contact type-reflected light scanning laser sensors.

TOUCH & SLIP SENSORS: Touch sensors – proximity Rod & Photo detector sensors, Slip sensors – Forced oscillation slip sensor, interrupted type slip sensors, force and torque sensors.

CONTROL SYSTEMS: Basic control systems concepts and Models – Mathematical Models, Transfer function, Block Diagrams- Configuration of a control system for a robot joint.

CONTROLLERS: On-off control, Proportional Control, Integral Control, Proportional plus Integral Control, Derivative control, Proportional plus Derivative control, PID Control, Control system Analysis.

PLC's, Microprocessors and Computer Control methods and their programming.

ROBOT APPLICATIONS: Industrial Applications – Material Transfer, material handling, Loading and unloading, processing, spot and continuous arc welding, spray painting, grinding, Assembly and Inspection and Non-Industrial Applications

DESIGN: Robotic systems Design based Case studies of problems derived from Domestic, Industry, Defense for example An Aerial Surveillance Robot, Automated Guided Vehicles, Multi Arm Industrial Robot, Underwater Vehicles, Medical and Surgical Robots etc.

Text Books:

1. Robotic engineering by Richard D. Klafter (PHI)
2. Industrial robotics by Mikell P.Groover, (MGH)
3. Robotics and Control by RK Mittal (MGH)

References:

1. Introduction to Robotics - John J. Craig (Pearson Education India)
2. Robotics Fundamental concepts and analysis: Ashitava Ghoshal (Oxford Higher Education).
3. Robotics – K.S. Fu, Gonzalez & Lee (MGH)
4. Robotics For Engineers by Yoram K koren (MGH)

MECHATRONICS

COURSE CODE: 12OE442 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

INTRODUCTION TO MECHATRONICS: Introduction, Elements of Mechatronic system, Applications. **SENSORS AND TRASDUCERS**: Introduction, Performance terminology, Displacement-Position-Proximity sensors, Velocity and motion, Force, Fluid pressure, Liquid flow, Liquid Level, Temperature, Light sensors Selection of sensors.

SIGNAL CONDITIONING: Introduction, Data acquisition, Quantizing theory, Analog to Digital conversion, Digital to Analog conversion.

DATA PRESENTATION SYSTEMS: Data presentation elements, Data acquisition systems, Systems measurement, Testing and calibration.

ACTUATION SYSTEMS: Pneumatic and hydraulic actuation systems, Stepper Motors.

SYSTEM MODELS: Modeling of one and two degrees of freedom Mechanical, Electrical, fluid and thermal systems. Block diagram representations for these systems.

SYSTEM RESPONSE: Introduction, Transfer function of Mechanical and electrical systems , Time response analysis of mechanical systems .

CLOSED LOOP CONTROLERS: Continuous and discrete processes, control modes, two-step, proportional, Derivative, integral, PID controllers.

DIGITAL LOGIC: Logic gates, Boolean algebra, Karnaugh maps**.**

PLC: Introduction, basic structure, I/P and O/P processing, programming, ladder diagrams, Timers, Internal relays and counters ,Data handling, Selection of a PLC**.**

DESIGN: Mechatronic systems Design based Case studies of problems derived from Domestic, Industry, Defense for example An Aerial Surveillance camera, Automated Guided Vehicles, Fully Automatic Car Parking System, Self Controlled Washing Machines, Intelligent Televisions etc.

TEXT BOOKS:

1. W.Bolton, "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering" , 3rd Edition, Pearson education,2007.
2. David G. Alciatore, Michael B. Histand ," Introduction to Mechatronics and measurement systems", 2nd Edition, McGraw-Hill Professional, 2002.

REFERENCE BOOKS:

1. Godfrey Onwubolu, "Mechatronics: Principles and Applications" 1st Edition, Elsevier, 2005.
2. Robert H. Bishop "Mechatronics: An Introduction" CRC Press, 2006.
3. Nitaigour Premchand Mahalik, "Mechatronics", Tata McGraw-Hill, 2003.
4. HMT Limited, "Mechatronics", McGraw-Hill Education (India) Pvt Ltd, 2000.

OPERATIONS RESEARCH

COURSE CODE: 13OE427 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Introduction to Operation Research: Introduction, Modeling in Operations Research, Phases of OR study, Scope and application of OR. **Linear Programming and its Applications**: Linear Programming Problem – Graphical solution of LP Problem. Simplex method, Big M method, two phase method, multiple solution, infeasible solution, unbounded solution, degeneracy, Dual Simplex method. **Transportation:** Introduction – Methods of basic feasible solution, Optimality test, Degeneracy in transportation problem, unbalanced transportation Problem, **Assignment Problems**: Hungarian method for assignment problem, Traveling salesman problem. **Theory of Games:** Introduction, to solve the rectangular two person zero sum games, solution of rectangular games in terms of mixed strategies, solution of 2x2 games without saddle point, solution of a two person zero sum 2Xn game, Graphical method for 2Xn and nX2 games. **Inventory Control:**

Introduction – EOQ with uniform rate of demand, Economic lot size with finite rate of replenishment, Quantity discounts, Deterministic model with Shortages, ABC analysis of inventory. **Dynamic Programming**: Introduction, Bellman's principle of optimality, application to shortest route problem, linear programming, tabular method. **Queuing Theory:** Introduction, single channel, Poisson arrival, exponential service time with finite population and infinite population, **Simulation:** Introduction, Monte-Carlo Simulation, Application to Inventory Control. **Project Management by PERT/CPM**: Introduction, simple network techniques, construction rules of drawing, Fulkerson's rule, Critical path method (CPM)- floats, critical path, project duration, PERT: Introduction, different Time estimates, expected time, variance, expected project duration and probability of completion. Crashing: Introduction, crashing of network, problem

Text Books:

1. Operations Research - Hamdy Taha
2. Operations Research – Hiller & Liberman.

Reference Books:

1. Quantitative Techniques – A.P. Natarajan
2. Operations Research – S.D. Sarma

Self Development

COURSE CODE : 13OE430 L – T – P: 3-0-0
PRE-REQUISITE : NIL CREDITS: 3

Orientation, Discussion on Values : Understanding Values, Behavior and Attitudes, Application of Values and Universal Values, **Philosophy of Yoga :** God, Self and Ultimate goal of yoga, Brief Introduction to various types of yoga and Integration of values in Yoga, **Study of major Religions :** Identify commonality, condition of its origin or intention vs. current state, **Art of Meditation :** Observation, Introspection, Contemplation, Meditation and Concentration, Schools of Meditation, **Systematic Practice of Meditation:** Theories of life, Need for Meditation, Natural Path, Integration **Personal Responsibility:** Stress Management, Tips for Self-Management, Choices we make, Excellence.

Text Book :

1. Self development modules from Heartfulness Institute Initiative of Shri Ram Chandra Mission (www.heartulness.org)

Reference Books :

1. Complete works of Swami Vivekananda
2. Jonathan –Livingston - Seagull
3. The Monk Who Sold His Ferrari_Robin S. Sharma
4. You can win by shiv khera
5. Many lives Many Masters
6. The road less travelled – Scott Peck
7. As a man thinketh
8. Journey of the Soul
9. The Bhagavad-Gita
10. King James version of the Holy Bible
11. Holy-Quran

ANIMATION FOR ENGINEERS

COURSE CODE : 13OE432 L – T – P: 3-0-0
PRE-REQUISITE : NIL CREDITS: 3

3D Interface of Maya: Introduction about 3D environment, Installing Maya, Introduction about the Maya user interface, Creating manipulating and viewing objects, Understand the Maya 3D scene, Components and attributes

Introduction to Modeling: Using 2D reference images, Creating a polygon primitive, Crating Intermediate polygon Models and Editing Models. Nurbs Modeling: Introduction, Creating a basic NURBS Models.

Introduction to shaders and textures: Using Maya's standard shaders, Texturing, Understanding UV coordinates & Mapping, Comparing NURBS and polygon UVs, Mapping polygon UV surfaces using texture maps. Applying 3D procedural texture nodes, Creating Textures Using Adobe Photoshop

Introduction to Lighting: Understanding the concepts of Scene and Mood of the scene like Day & Night. Exploring the types of lights.

Introduction to Rendering: Default rendering procedure in Maya software Scan line Rendering. Generating different types of output formats and knowing their standards of usage.

Introduction of Rigging: Exploring the basics of joints and types of IK Handles, skinning & types fitting skeletons to a mesh.

Introduction of Animation: Exploring the Graph editor, Dope sheet, Understanding Animation principles in 3d. Applying Path animation to various elements in Maya

Text Books:

1. Dariush Derakhshani "**Introducing Autodesk Maya" 2015**
2. Todd Palamar**, "Mastering Autodesk Maya" 2015**

Reference Books:

1. Prof. Sham Tickoo Purdue, **"Autodesk Maya 2015: A Comprehensive"** Univ. and Cadcim Technologies
2. Kelly L. Murdock, "**Autodesk Maya Basics Guide 2015"**

PHOTOGRAPHY

COURSE CODE : 13OE433 L – T – P: 3-0-0

PRE-REQUISITE : NIL CREDITS: 3

Introduction: What is Photography, Early attempts of Masters of Photography, Al Hazen, Daguerreo, Ansel Adams, Early portraits, collotype, wet calodian process, Raja Deen Dayal, Raghu Rai, Earlier attempts of picture making, early travel photography, Early Pictorial Photography, Camera and its components, Types of Cameras Pin hole camera, Box Camera, View camera, range finder, SLR, TLR, Polaroid, Panoramic Process etc, Camera formats large medium small, Light, Optics and lenses, lens, view finder, aperture, shutter efficiency, difference between different shutters, aperture and shutter relation, film compartments and Intro to Digital Cameras.

Invasion of Digital cameras and other accessories: Digital imaging principles, Advancements in Photography, how light gets register on film, sensors and retina. Differences between manual camera and digital camera. The Digital Camera and its components, Digital Picture formation on sensors, sensor characteristics, CCD and cmos sensor, LCD display, menu and operations. HDR High Definition dynamic range, single chip image sensor, capture format, Digital preservation, Advantages and disadvantages of digital Camera, Difference between basic lenses and Digital Lenses, Optical and digital zoom, Auto focusing and manual focusing systems, focal length, depth of field, depth of focus Image formation, ISO and resolution, Dynamic range, Color formation, Histogram, noise. Storage – methods of Storage-file formats storage, Storage devices Rule of third. Rule of 16, Aspects of composition, framing, point of interest, angle of view, depth of field, depth of focus, Lighting subject and people, panning zooming, different camera shots, Camera angles, aspect ratios, white balancing.

Text Books

1. History of Photography (India 1840-1980) by G Thomas
2. Basic Photography by M J Langford. Third edition focal press
3. Photographic Composition (1st edition) by Richard d Zakia

Reference Books

1. Robert Hirsch Exploring Color Photography, film to pixels, (5th edition), Elsevier focal Press.
2. Walter Daniel Emanuel, L.A.Mannheim, The all in one Camera Book
3. Basic Photography by Focal Press

INTELLIGENT VISUAL SURVEILLANCE

COURSE CODE: 13OE435 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS: 3

Basics of Image Processing: Introduction to Image Processing methods, Image Transforms, Wavelet Transform, JPEG Image Compression, Image Formats, Color Spaces - RGB, CMY, HSI.

Video Compression Standards: H. 261, H. 263, H.264, MPEG-1, MPEG-2, MPEG-4, MPEG-7, and MPEG-21, Video shot boundary detection, motion modeling and segmentation techniques.

Object Detection and Classification- Shape based object classification, motion based object classification, Silhouette-Based Method for Object Classification, Viola Jones object detection framework, Multiclass classifier boosting.

Multi-Object Tracking- Classification of multiple interacting objects from video, Region-based Tracking, Contour-based Tracking, Feature-based Tracking, Model-based Tracking, Hybrid Tracking, Particle filter based object tracking, Mean Shift based tracking, Tracking of multiple interacting objects.

Human Activity Recognition- Template based activity recognition, Sequential recognition approaches using state models (Hidden Markov Models), Human Recognition Using Gait, HMM Framework for Gait Recognition, Description based approaches, Human interactions, group activities, Applications and challenges.

Camera Network Calibration - Types of CCTV (closed circuit television) camera- PTZ (pan-tilt zoom) camera, IR (Infrared) camera, IP (Internet Protocol) camera, wireless security camera, Multiple view geometry, camera network calibration, PTZ camera calibration, camera placement, smart imagers and smart cameras.

Text Books

1. Murat A. Tekalp, "Digital Video Processing", Prentice Hall, 1995.
2. Y. Ma and G. Qian (Ed.), "Intelligent Video Surveillance: Systems and Technology", CRC Press, 2009.

TOTAL QUALITY MANAGEMENT

COURSE CODE:13OE436 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS: 3

Introduction, Quality and improvement, and evolution of TQM, Quality assurance, quality system, quality loss function, link between quality and productivity. Philosophy of Deming, Juran, Crossby. Seven tools of TQM - Control charts, check sheets, flow charts, graphs, histograms, pareto chart, cause-effect diagram, scatter diagram,

Quality function deployment – Introduction, benefits, process, quality circle, zero-defect programme .Quality control charts for variables, attributes, (X bar, R, p, c, np, U charts), Process capability,

Acceptance sampling – introduction, definition, objectives, benefits, different sampling plans, O.C.curve- construction, properties (for single sampling plan)
Bench marking, quality costs, total productive maintenance, ISO 9000- Introduction, series of standards, benefits, requirements, implementation, documentation, quality auditing.
Continuous process improvement – basic concepts of KAIZEN, 5S, POKAYOKE, JIT & KANBAN, PDSA cycle, Six sigma, Taguchi methods

Text Books:

1. D. Besterfield, Total Quality Management, 2007, Phi.
2. E. L. Grantt, Statistical Quality Control, 7th Edition, 2008, Tata Mc-Graw Hill.

Reference Books:

1. P.Charntimath, Total Quality Management, 2006, Pearson Education.
2. L.Suganthi, Anand A. Samuel, Total Quality Management, 2004, PHI.
3. D. Besterfield, Quality Control, 7th Edition, 2008, Pearson Education.
4. D.C. Montgomery, Introduction to Statistical Quality Control, 4th Edition, 2008, Wiley India

INDUSTRIAL ENGINEERING & MANAGEMENT

COURSE CODE: 13OE437	L – T – P: 3-0-0
PRE-REQUISITE:	CREDITS: 3

General Management: Definition, Functions of management, Principles of management, Types of organization structure- line, functional, line & staff. **Forms of business organization**: Salient features of sole proprietorship, partnership, joint stock company – private limited and public limited company. **Human resource management**: definition, functions of HRM, staff role in HRD, Job design, Job evaluation. Motivational theories: Maslow's Hierarchy of needs, Hedsberg two factor theory. **Marketing management**: Functions of marketing, channels of distribution, advertising and sales promotion, product life cycle, pricing, market research. **Financial management**: Concept of interest: simple interest, compound interest, equivalent cash flow diagrams, present and future worth of a single amount, concept of Annuity – uniform series to present and future worth, differed annuities. Economic evaluation of alternatives: Present worth method, future worth method, annual equivalent method, and internal rate of return method. **Depreciation**: Definition, types, Common methods – straight line, declining balance, sum of year's digits method. **Materials management**: Introduction, Purchasing – definition, objectives, source selection, vendor rating, procurement methods, break-even-analysis. **Quality control**: Inspection and types, Quality – SQC, control charts for variables, attributes, application and construction of charts, problems, Acceptance sampling, O.C.curve. **Inventory management**: definition, types, various costs associated, selective control techniques – A B C analysis. Concept of EOQ model with constant demand & shortages, EPQ model, make or buy decision analysis, quantity discount management.

Text Books

1. Knootz and Weiriech Essential of Management Science, 2nd Edition, 2005, Tata Mc-Graw Hill.
2. Stonner , Industrial Organization & Management, Tata Mc-Graw Hill Publishers.

References

1. William G. Sullivan, James A. Bontadelli, Elin M. Wicks, Engineering Economy, 11th Edition, 2001, Pearson Education Asia.
2. Banga T, Sharma Sc, Industrial Organization & Engineering Economics, 2007, Khanna Publications

MEASUREMENTS & INSTRUMENTATION

COURSE CODE: 12OE475 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Science Of Measurement: Measurement System – Instrumentation – Characteristics of measurement systems – Static and Dynamic – Errors in Measurements – Calibration and Standards. **Transducers:** Classification of Transducers – Variable Resistive transducers – Strain gauges , Thermistor, RTD- Variable Inductive transducers- LVDT, RVDT,- Variable Capacitive Transducers – Capacitor microphone- Photo electric transducers – Piezo electric transducers – Thermocouple – IC sensors - Fibre optic sensors – Smart/intelligent sensors. **Signal Conditioning And Signal Analyzers:** DC and AC bridges – Wheatstone, Kelvin, Maxwell, Hay and Schering. Pre-amplifier – Isolation amplifier – Filters – Data acquisition systems. Spectrum Analyzers – Wave analyzers – Logic analyzers. **Digital Instruments:** Digital Voltmeters – Millimeters – automation in Voltmeter – Accuracy and Resolution in DVM - Guarding techniques – Frequency counter- Data Loggers – Introduction to IEEE 488/GPIB Buses. **Data Display and Recording Systems:** Dual trace CRO – Digital storage and Analog storage oscilloscope. Analog and Digital Recorders and printers. Virtual Instrumentation - Block diagram and architecture – Applications in various fields. Measurement systems applied to Micro and Nanotechnology.

TEXT BOOKS

1.Albert D.Helfrick and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India.
2.Ernest o Doebelin and dhanesh N manik, "Measurement systems" ,5th edition ,McGraw-Hill,

REFERENCES

1.John P. Bentley, "Principles of Measurement Systems", Fourth edition, pearson Education Limited, 2005.
2.A.K.Sawhney, "Course In Electrical And Electronic Measurement And Instrumentation", Dhanpat Rai Publisher.
3.Bouwens,A.J, "Digital Instrumentation", Tata Mc-Graw Hill, 1986.
4.David A.Bell, "Electronic Instrumentation and Measurements", Second edition,Prentice Hall of India, 2007.

NANO MATERIALS AND TECHNOLOGY

COURSE CODE: 12OE453 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Introduction to Nanotechnology : Overview of the Nano science and technology, Introduction to Physics of the solid state-structure, Insulators, S.Cs, conductors-their energy bands. Size determination. Metal nanoclusters, semi conducting nano particles-photofragmentation. Types of Nano materials -Nano structured crystals, Metals and ceramics.

Nano materials Synthesis : Top down Approach &Bottom up Approach I: **Physical methods**- Thermal spraying, Electro deposition method, RF-plasma method, Ball milling method-Applications. **Chemical methods**- Thermolysis, Pulser laser ablation method, Spray pyrolysis, CVD, and sol-Gel technique.

Characterization of Nano materials: Introduction to Microscope, optical microscope, Optical absorption spectrometer, Infrared, Raman spectroscopy, UV-Visible and XRD techniques -their applications in nano technology.

Microscopic techniques: Scanning electron microscopy (SEM), and Transmission Electron microscopy.

Mechanical, Optical &Electrical Properties of Nano materials: Introduction-Nano structured materials, Mechanical behavior of Nano crystalline Metals, semiconductors and ceramics. Mechanical behavior of Two phase nano structured materials and Nano structured multilayer's

.Optical properties of nano Particles- Optical direct and indirect band gap studies. Conduction mechanism- Electrical conductivity of nano structured materials-. Semi conducting nano particles, ceramics, conducting polymers, Composites. Metal nano structured particles- and device applications.

Carbon Nano Structures & CNTs: Introduction-Carbon molecules, New carbon structures, Small carbon clusters, Discovery of $C_{60,}$ Fullerenes. **Carbon Nano Tubes**: Introduction-Types of CNTs-SWCNT and MWCNT-. Fabrication-Synthesis methods of CNTs. Electrical Properties, conductivity studies, soft lithography, Lithography using particle beams, Applications of CNTs- Carbon nano tubes in Computers, In Fuel cells and Batteries. CNTs as Chemical Sensors, Drug delivery system. Nano Devices- CNTs as Microelectromechanical systems (MEMS), -Applications.

Text Books:

1. The Physics and Chemistry of Solids - Stephen Elliott & S. R. Elliott, John Wiley & Sons, 1998.
2. Hari Singh Nalwa – Handbook of nanostructured materials and nanotechnology: Synthesis and processing, ASP,2004
3. Zhong Lin Wang, *"Characterization of Nanophase Materials"*, Wiley-VCH, 2001
4. Carl.C.Koch, "Nanostructured materials, processing, properties and applications, NFL publications, 2007.
5. T.J.Chung, P.M. Anderson, M.K.Wu and S.Hsieh, "Nanomechanics of materials and structures, Springer, 2006.

Recommended Reference:

1. Jackie Ying. Ed "*Nanostructured Materials",* Academic Press, 2001. A small edited volume with some good articles on some specialized topics such as adsorption in nanoporous materials
2. J. Bozzola and Lonnie D. Russel, "Electron Microscopy", Jones and Bartlett Publishers Inc., USA, 1999.

MINOR DEGREE COURSES

NANO TECHNOLOGY - MINOR
POLYMER NANO COMPOSITES

Course Code:11 OE 401 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Introduction of nanocomposites: Nanocomposites, Definition, Nanocomposites past and present, Nomenclature, Solids - Atomic and molecular solids, Role of statistics in materials, Primary, secondary and tertiary structure, Transitions

Properties and features of nanocomposites: Physics of modulus, Continuum measurements, Yield, Fracture, Rubbery elasticity and viscoelasticity, Composites and nanocomposites, Surface mechanical properties, Diffusion and permeability, Features of nanocomposites, basics of polymer nano composites - Nanoreinforcements, Matrix materials, Hazards of particles

Processing of nanocomposites: Viscosity, Types of flow, Viscosity- Experimental viscosity, Non-newtonian Flow, Low-viscosity processing, Solvent processing, Particle behavior, In situ polymerization, Post-Forming, Hazards of solvent Processing, Melt, high -shear, and direct processing, Melting and softening, Melt processes with small shears or Low, shear rates flow, Melt processes with large deformations or high-shear rates, Thermo-kinetic processes

Characterization of nanocomposites: Introduction to characterization, Experiment design, Sample preparation, Imaging, Structural characterization, Scales in nanocomposites, Texture, Electromagnetic energy, Visualization, Physicochemical analysis, Characterization of physical properties, Identification, Mechanical, Surface mechanical, Exposure, Barrier properties, Recipes and standards

Applications of nanocomposites: Nanocomposites, Optical, structural applications, Nanoparticulate systems with organic matrices, Applications, Biodegradable protein nanocomposites, Applications Polypropylene nanocomposites, Application as exterior automatic components, Hybrid nanocomposite materials, Application for corrosion protection

Text books

1. Thomas E. Twardowski, Introduction to Nanocomposite Materials, Properties, Processing, Characterization, DesTech Publications, April 2007
2. Klaus Friedrich, Stoyko Fakivov, Zhony Shang, Polymer Composites from Nano to Macro scale, Springer, USA, 2005

Reference books

1. Sumio Sakka, Sol-gel Science and Technology, Topics in fundamental research and applications, Volume 3, Sol-gel prepared organic, inorganic hybrids and nanocomposites, Kluwer academic publishers, Springer, 2002
2. Ray Smith, Biodegradable polymers for Industrial Applications, CRC Press, 2005

INTRODUCTION TO NANO TECHNOLOGY

Course Code: 13OE451 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Introduction: Importance of Nano-technology, Emergence of Nano-Technlogy, Bottom-up and Top-down approaches,, challenges in Nano Technology.

Zero Dimensional Nano-structures: Nano particles through homogenous nucleation; Growth of nuclei, synthesis of metallic nano particles, Nano particles through heterogeneous nucleation; Fundamentals of heterogeneous nucleation and synthesis of nano particles using micro emulsions and Aerosol.

One Dimensional Nano-structure , Nano wires and nano rods: Spontaneous growth: Evaporation and condensation growth, vapor-liquid-solid growth , stress induced recrystallization. Template based synthesis: Electrochemical deposition, Electrophoretic deposition. Electro spinning and Lithography.

Two dimensional nano-structures: Fundamentals of film growth. Physical vapour Depostion(PVD): Ebvaporation molecular beam epitaxy (MBE), Sputtering, Comparison of Evaporation and sputtering. Chemical Vapour Depostion (CVD) : Typical chemical reactions, Reaction kinetics, transportant phenomena, CVD methods, diamond films by CVD.

Atomic layer deposition (ALD), Electrochemical deposition (ECD), Sol-Gel films.

Text books:

1. Nano structures and Nano materials: Synthesis, properties and applications Guozhong Cao-Imperial College press.

NANO MATERIALS FOR ENERGY & MANAGEMENT

Course Code: 13OE452 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Energy Overview: Types of Energy and its utilization- Energy Characteristics, Energy Measures, Fundamentals of environment, Environmental aspects of energy utilization, Public health issues related to environmental pollution, Pollution Standards, environmental impact assessment

Nanomaterials used in energy and environmental applications and their properties: Evaluation of properties and performance of practical power systems that benefit from optimization of materials processing approaches.

Device applications: sensors, power semiconductor chips, fuel cells, superconductors, solar cells, energy storage and other alternative power sources. Solar cells, Thin film Si solar cells, Chemical semiconductor solar cells, Dye sensitized solar cells, Polymer solar cells, Nano quantum dot solar cells, Hybrid nano-polymer solar Cells.

Fuel Cells, principle of working, basic thermodynamics and electrochemical principle, Fuel cell classification, Fuel cell Electrodes and Carbon nano tubes, application of power and transportation.

Energy, Hydrogen Storage and Production: Fuel Cells, Battery, Solar energy Conversion, Nanomaterials in Automobiles

Text Books:

1. W.F. Kenney: Energy Conservation in the Process Industries, Academic Press, 1984
2. Tetsuo Soga, Nanostructured Materials For Solar Energy Conversion, Elsevier

Reference Books:

1. Robert K, Ian H, Mark G,Nanoscale Science and Technology, john Wiley & sons Ltd.,2005

CHARACTERIZATION OF NANO MATERIALS

Course Code: 13OE403 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Introduction and Preliminary Concepts: Macro-, Meso-, Micro- and Nanostructure of Materials, Fundamentals of crystallography and Crystal structures.

X-Ray Diffraction Methods: X-ray production, Bragg's Law, Laue's Equation, Diffraction Methods, Single Phase analysis, Multi-Phase Analysis, Particle size and strain, Orientation and Texture, Residual Stress.

Optical Microscopy: Geometry of Optics, Resolution, Construction of a Microscope, Image Contrast, Phase Contrast.

Electron Microscopy, SEM: Electron Optics - Cathodes, Electron Lenses, Aberrations, Resolution, Interaction of Electrons and Matter - Elastic and Inelastic Scattering, Backscattered Electrons, Secondary Electrons, Scanning Electron Microscopy - Image Formation, EPMA, Magnification, Depth of Field, Distortion, Detectors, Contrast, and Resolution.

Electron Microscopy, TEM: Electron diffraction, reciprocal lattice, analysis of SAD patterns; different electron diffraction techniques. Electron Microscopy, EDS: X-ray microanalysis: Energy dispersive X-ray spectroscopy (EDS) and Quantitative microanalysis using EDS.

Text Books:

1. Microstructural Characterization of Materials by **David Brandon** and **Wayne Kaplan**, John Wiley and Sons, New York, NY, 1999.
2. Elements of X-ray Diffraction by **B. D. Cullity** and **S.R. Stock**, Prentice Hall, New Jersey, 2001.

Reference Books:

1. Scanning Electron Microscopy and X-Ray Microanalysis, 3rd ed. **Joseph I. Goldstein**, Dale E. Newbury Academic/Plenum Publishers, New York, 2003 .
2. 2."Transmission Electron Microscopy" by **David B. Williams** and **Barry Carter**, Plenum Press, NY. London 1996 (or a newer edition).

MICRO & NANO FABRICATIONS

Course Code: 13OE453 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

MEMs &NEMs: Materials Aspects of Micro Electro Mechanical Systems (MEMS) and Nano Electro Mechanical Systems (NEMS) Silicon, Germanium-Based Materials, Metals, Harsh Environment Semiconductors, GaAs, InP, and Related III-V Materials, Ferroelectric Materials and Polymer Materials

Basic Microfabrication Techniques : Lithography, Thin Film Deposition and Doping, Etching and Substrate Removal, Substrate Bonding

MEMS Fabrication Techniques: Bulk Micromachining, Surface Micromachining, High-Aspect-Ratio Micromachining

Nanofabrication Techniques: E-Beam and Nano-Imprint Fabrication, Epitaxy and Strain Engineering, Scanned Probe Techniques, Self-Assembly and Template Manufacturing

Stamping Techniques for micro and nano-fabrication: High Resolution Stamps, Microcontact Printing and Nanotransfer Printing, Applications of printing techniques, Unconventional Electronic Systems, Lasers and Waveguide

Text Books:

1) Springer's Hand book of Nano-technology- Bharat bhusan (Ed.)
2) Nanotechnology and nanoelectronics- W.R.Fahrner, Springer International

NANO FLUIDS/SCIENCE & TECHNOLOGY

Course Code: 11OE405 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Introduction: Fundamentals of cooling, Fundamentals of nanofluids, Making nanofluids, Mechanisms & Models for enhanced thermal transport, Future research.

Synthesis of nanofluids: General issues of nanofluids, Synthesis methods-common issues, Study of nanoparticles, Variety in nanomaterials, Micro emulsion based methods for nanofluids, Solvo thermal synthesis, Synthesis using supports, Synthesis using biology, Magnetic nanofluids, Inert gas condensation, Anisotropic nanoparticles, Other nanofluids, summary.

Conduction heat transfer in nanofluids: conduction heat transfer, Measurement of thermal conductivity of liquids, Thermal conductivity of oxide nanofluids, Temperature dependence of thermal conductivity enhancement, Metallic nanofluids, naofluids with CNTs.

Theoretical modeling of thermal conductivity of nanofluids: Simple mixture rules, Maxwell approach, Particle distribution, Particle geometries, Symmetrical equivalent medium theory, Matrix particle interfacial effects, Dynamic models of thermal conductivity of nanofluids.

Convection in nanofluids: Fundamentals of convective heat transfer, convection in suspensions & slurries, Convection in nanofluids, Analysis of convection in nanofluids, Numerical studies of convection in nanofluids.

Boiling of nano-fluids: Fundamentals of boiling, Pool boiling of nanofluids, Critical heat flux in pool boiling of nanofluids, Other investigations related to boiling of nanofluids.

Applications and future directions: Liquid cooling, Applied research in nano cooling, Further research.

Text book:

1. Nano Fluids Science and Technology by Sarit Kumar Das, John Wiley and sons.

INDUSTRIAL ENGINEERING MINOR GROUP

INDUSTRIAL ENGINEERING TECHNIQUES

Course Code: 12OE440 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Work study: Techniques of work study, basic procedure of work study. **Method study**: Tools for recording techniques – Flow process chart, flow diagram, string diagram, multiple activity chart, Man-machine chart. **Micro motion study**: Therbligs, motion economy principles, SIMO chart. **Work measurement**: Stopwatch time study procedure - breaking the job into elements, timing methods, number of cycles to be timed, rating, allowances, setting standard time. **Work sampling**: Confidence levels, number of observations, use of random number table. **Inspection & Quality Control:** Concept and Types of Inspection, Quality Control Charts – SQC, Charts for variables and charts for attributes, application and construction of charts and problems. Acceptance sampling, Single and double sampling, OC curve, **Production Management:** Types of production systems, Mass production, Batch production, Job order production. Productivity and factors influencing productivity, Facility layout – definition, types – product layout, process layout, fixed position layout, cellular layout, introduction to computerized layout. **Scheduling :** Introduction, concept of assembly line balancing, scheduling of batch production, scheduling of job order, loading, sequencing,- definition, sequencing of n jobs through oe machine, n jobs through 2 machines, (Johnsons' algorithm), sequencing of n jobs through 3 machines, n jobs through m machines. **Forecasting:** Definition, approach, types, Methods – Qualitative methods – Judgmental methods, Quantitative methods – times series, regression, Introduction to aggregate planning, Production planning & control: Introduction, definition, functions of PPC. Brief introduction to: JIT, Lean manufacturing, Six sigma, Supply chain management

Text Books:

1. Introduction to work-study -- ILO.
2. Production & Operations Management -- Adam & Ebert

Reference Books :

1. Production & operations Management – S.N. Chari.
2. Production & operations Management -- Panner selvam.

OPERATIONS RESEARCH

Course Code: 11OE434 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Introduction to Operation Research: Introduction, Modeling in Operations Research, Phases of OR study, Scope and application of OR. **Linear Programming and its Applications**: Linear Programming Problem – Graphical solution of LP Problem. Simplex method, Big M method, two phase method, multiple solution, infeasible solution, unbounded solution, degeneracy, Dual Simplex method. **Transportation:** Introduction – Methods of basic feasible solution, Optimality test, Degeneracy in transportation problem, unbalanced transportation Problem, **Assignment Problems**: Hungarian method for assignment problem, Traveling salesman problem. **Theory of Games:** Introduction, to solve the rectangular two person zero sum games, solution of rectangular games in terms of mixed strategies, solution of 2x2 games without saddle point, solution of a two person zero sum 2Xn game, Graphical method for 2Xn and nX2 games. **Inventory Control:** Introduction – EOQ with uniform rate of demand, Economic lot size with finite rate of replenishment, Quantity discounts, Deterministic model with Shortages, ABC analysis of inventory. **Dynamic Programming**: Introduction, Bellman's principle of optimality, application to shortest route problem, linear programming, tabular method. **Queuing Theory:** Introduction, single channel, Poisson arrival, exponential service time with finite population and infinite population, **Simulation:** Introduction, Monte-Carlo Simulation, Application to Inventory Control. **Project Management by PERT/CPM**: Introduction, simple network techniques, construction rules of drawing, Fulkerson's rule, Critical path method (CPM)- floats, critical path, project duration, PERT: Introduction, different Time estimates, expected time, variance, expected project duration and probability of completion. Crashing: Introduction, crashing of network, problem

Text Books:

1. Operations Research - Hamdy Taha
2. Operations Research – Hiller & Liberman.

Reference Books:

1. Quantitative Techniques – A.P. Natarajan
2. Operations Research – S.D. Sarma

ENGINEERING MANAGEMENT

Course Code: 13OE454 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

General Management: Definition, Functions of management, Principles of management, Types of organization structure- line, functional, line & staff.

Forms of business organization: Salient features of sole proprietorship, partnership, joint stock Company – private limited and public limited company.

Human resource management: definition, functions of HRM, staff role in HRD, Job design, Job evaluation. Motivational theories: Maslow's Hierarchy of needs, Hedsberg two factor theory.

Marketing management: Functions of marketing, channels of distribution, advertising and sales promotion, product life cycle, pricing, market research.

Financial management: Concept of interest: simple interest, compound interest, equivalent cash flow diagrams, present and future worth of a single amount, concept of Annuity – uniform series to present and future worth, differed annuities. Economic evaluation of alternatives: Present worth method, future worth method, annual equivalent method, and internal rate of return method.

Depreciation: Definition, types, Common methods – straight line, declining balance, sum of year's digits method.

Materials management: Introduction, Purchasing – definition, objectives, source selection, vendor rating, procurement methods, break-even-analysis.

Quality control: Inspection and types, Quality – SQC, control charts for variables, attributes, application and construction of charts, problems, Acceptance sampling, O.C.curve.

Inventory management: definition, types, various costs associated, selective control techniques – A B C analysis. Concept of EOQ model with constant demand & shortages, EPQ model, make or buy decision analysis, quantity discounts.

RECOMMENDED TEXT BOOKS:

TEXT BOOKS

1. A.R.Aryasri, Management Science, 2nd Edition, 2005, Tata Mc-Graw Hill.
2. R.K.Gupta & Sashi K.Gupta, Industrial Organization & Management, Kalyani Publishers.

REFERENCES

1. William G. Sullivan, James A. Bontadelli, Elin M. Wicks, Engineering Economy, 11th Edition, 2001, Pearson Education Asia.
2. Banga T, Sharma Sc, Industrial Organization & Engineering Economics, 2007, Khanna Publications.
3. Philip Kottler, Marketing Management, 13th Edition, 2008, PHI.

WORK STUDY & ERGONOMICS

Course Code:11OE404 **L –T – P: -0-0**
Prerequisite: NIL **Credits: 3**

Productivity: Meaning and Importance of Productivity, Factors Affecting Productivity. Productivity and Living Standards, Productivity Measurements, Work Design and Productivity, **Operations Analysis**: Total Time for A Job Or Operation, Total Work Content And In-Effective Time, Methods And Motions, Graphic Tools. **Work Study**: Techniques of Work Study, Basic Procedure of Work Study. METHOD STUDY: Tools for Recording Techniques – Flow Process Chart, Flow Diagram, String Diagram, Multiple Activity Chart, Man-Machine Chart. MICRO MOTION STUDY: Therbligs, Motion Economy Principles, SIMO Chart. **Work Measurement**: Stopwatch Time Study Procedure - Breaking The Job Into Elements, Timing Methods, Number Of Cycles To Be Timed, Rating, Allowances, Setting Standard Time. **WORK SAMPLING**: Confidence Levels, Number Of Observations, Use Of Random Number Table. **Human Factors in Work system Design**: Human Factors Engineering/Ergonomics, Human Performance in Physical Work, Anthropometry, Design of Workstation, Design of Displays and Controls, Job Enrichment, Job Enlargement. **Types of Production Systems**: Mass Production, Batch Production, Job Order Production. Production Planning & Control Functions, **Facility Layout**: Types of Layout - Line Layout for Product Focused System, Functional Layout for Process Focused System, Fixed Position Layout, Introduction to Computerized Layout Methods, **Material Handling**: Material Handling Objectives And Principles - Unit Load Concept. Factors Affecting Choice of Handling Equipment, Classification of Material Handling

Text Books

1. Introduction to Work study by I.L.O. Geneva.
2. Motion & time study by Barnes, R.M.

Reference Books

1. Industrial Management by Ahuja, vol.1 and 2.
2. Industrial Engineering & Management by Dr. R. Ravisankar

OPERATIONS MANAGEMENT

Course Code:11OE406 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Operations Management: definition, historical development, evolution, functions, **Forecasting**: definition, approaches, types, qualitative approach, judgmental methods, quantitative approach, time series, regression, multiple regression, forecasting error estimation techniques, Introduction to aggregate planning, **Production Management**: Types of production systems, Mass production, Batch production, Job order production. Productivity and factors influencing productivity, **Facility layout**: definition, types – product layout, process layout, fixed position layout, cellular layout, introduction to computerized layout, **Material handling**: definition, objectives, principles, unit load concept, factors affecting choice of MH equipment, classification, benefits, **Scheduling**: Introduction, concept of assembly line balancing, scheduling of batch production, scheduling of job order, loading, sequencing,- definition, sequencing of n jobs through one machine, n jobs through 2 machines, (Johnsons' algorithm), sequencing of n jobs through 3 machines, n jobs through m machines. **Inspection & Quality Control**: Concept and Types of Inspection, Quality Control Charts – SQC, Charts for variables and charts for attributes, application and construction of charts and problems. **Acceptance sampling**, Single and double sampling, OC curve, **Reliability**: definition, failure rate diagram, reliability computation, **Production planning & control**: Introduction, definition, functions of PPC. **Brief introduction to**: JIT, Lean manufacturing, Six sigma, Supply chain management.

Text Books:

1. Production & Operations Management -- G.J. Monks
2. Production & Operations Management -- Adam & Ebert

Reference Books:

1. Production & operations Management – S.N. Chari.
2. Production & operations Management -- Panner selvam.

COMPUTING MINOR GROUP

PRINCIPLES OF OPERATING SYSTEM

COURSE CODE : 13OE455 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Introduction to Computer-System Organization, Computer-System Architecture, Operating-System Structure, Operating-System Operations, Process Management, Memory Management, Storage Management, Protection and Security, Distributed Systems, Special-Purpose Systems. **Operating-System Structures-** Operating-System Services , User Operating-System Interface, System Calls , Types of System Calls, Operating-System Design and Implementation, Operating-System Structure, Virtual Machines, Operating-System Generation, System Boot. **Processes-Concept**, Process Scheduling, Operations on Processes, Interprocess Communication, Examples of IPC Systems, Communication in Client-Server Systems. **Multithreaded Programming-** Multithreading Models, Thread Libraries, Threading Issues. **Process Scheduling-** Scheduling Criteria, Scheduling Algorithms, Thread Scheduling, Multiple-Processor Scheduling. **Process Synchronization-**The Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization Examples, and Atomic Transactions. **Deadlocks-** System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention. Deadlock Avoidance, Deadlock Detection. Recovery from Deadlock. **Memory Management Strategies-** Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation, Example: The Intel Pentium **Virtual Memory Management-** Demand Paging , Page Replacement , Allocation of Frames , Thrashing , Memory-Mapped Files , Allocating Kernel Memory. **File-System -** The Concept of a File, Access Methods, Directory and Disk Structure, File-System Mounting, File Sharing, Protection. **File system Implementation-** File-System Structure, File-System Implementation, Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance, Recovery, NFS, Example: The WAFL File System.

Text Books:

1.Silberschatz & Galvin, 'Operating System Concepts', 9th edition, Wiley 2012.

Reference Books:

1. W.Richard stevans,pearson,"Advanced programming in the Unix environment", 2nd edition,pearson 2009 .
2. William Stallings ,"Operating Systems: Internals and Design Principles" ,6th edition, pearson 2009
3. Albert S. Woodhull , Andrew S.Tanenbaum ,"Operating Systems: Design and Implementation",Pearson Education International, 2009.

4. Harvey M. Deitel , Paul J. Deitel , David R. Choffnes: "Operating Systems" ,3/E, Pearson/Prentice Hall, 2004.
5. Crowley, "Operating System : A Design-Oriented Approach", : 1/E, Tata Mcgraw Hill Education Private Limited (2009)
6. Gary Nutt:"Operating Systems",3/E Pearson (2004) .
7. Graham Glass, King Ables ,"Linux for Programmers and users", Prentice Hall(2006)

ALGORITHM DESIGN AND ANALYSIS

COURSE CODE: 13OE456 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Introduction: Definition of an Algorithm- Algorithm Specification - Performance Analysis. **Divide and Conquer:** Merge Sort-Quick Sort-Strassen's Matrix Multiplication- Convex Hull. **Greedy Method:** The General Method- Job Sequencing with Deadlines- Knapsack Problem- Minimum Cost Spanning Trees- Huffman Codes - Single Source Shortest Path Method. **Dynamic Programming:** Optimal Binary Search Tree- 0/1 Knapsack- Traveling Sales Person Problem.Ford Fulkerson

Backtracking: The Eight Queens Problem - Sum of Subset Problem - Graph Coloring - Knapsack Problem.

Branch and Bound: Knapsack Problem- Traveling Sales Person Problem. **NP Hard and NP Complete Problems**: **PRAM Algorithms**: Merging-Sorting. String Algorithms,Amortized Analysis

Text Books :

1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", 2nd Edition, University Press,(2008).
2. Cormen, Leizerson & Rivest, "Introduction to algorithms", 3rd Edition, Prentice-Hall, (2010).
3. Jon Kleinberg and Eva Tardos, "Algorithm Design", Pearson Education, (2006).

Reference Books:

1. Robert Sedgewick and Kevin wayne ,"Algorithms", 4th edition,Addison – Wesley Professional , (2011).
2. Anny Levitin, "Introduction to Design and Analysis of Algorithms", 2rd Edition, Person Education Press. (2007).
3. Michael T.Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis and Internet Examples, Second Edition, Wiley-India, (200)6.
4. Steven S. Skiena, "The Algorithm Design Manual", Second Edition, Springer, (2008)

THEORY OF COMPUTATION

COURSE CODE: 13OE457 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Automata – The Methods & Madness: Finite Automata**,** an Informal Picture of Finite Automata, Deterministic Finite Automata, Nondeterministic Finite Automata, Finite Automata with Epsilon Transitions.

Regular Expressions and Languages: Regular Expressions, Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions**.**

Properties of Regular Languages: Proving Languages not to be Regular, Closure Properties of Regular Languages, Decision Properties of Regular Languages, Equivalence and Minimization of Automata.

Context-Free Grammars and Languages: Context-Free Grammars, Parse Trees, Applications of Context-Free Grammars, Ambiguity in Grammars and Languages.

Pushdown Automata: Definition of the Pushdown Automaton, The Language of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata.

Properties of Context-Free Languages: Normal Forms for Context-Free Grammars, the Pumping Lemma for Context-Free Languages, Closure Properties of Context-Free Languages, Decision Properties of CFL's.

Turing Machines: Introduction to Turing Machines, Problems that Computer Cannot solves, The Turing Machines, Programming Techniques for Turing Machines, Extensions to the Basic Turing Machine, Restricted Turing Machines.

Text Books :

1. John.E.Hopcroft, R.Motwani, & Jeffery. D Ullman, "Introduction to Automata Theory, Languages and Computations", Third Edition, Pearson Education,(2008).
2. Harry R. Lewis, Christos H Papadimitriou: "Elements of the theory of computation", 2nd Edition, PHI/Pearson Education, (1997).

Reference Books:

1. Michel Sipser, "Theory of Computation", 1st Edition, Cengage Publications, (2008)
2. Elaine Rich, "Automata Computability and Complexity: Theory and Applications", 1st Edition, Pearson Publications,(2012)

PARALLEL PROCESSING

COURSE CODE: 13OE458 L – T – P: 3-0-0

PRE-REQUISITE: NIL CREDITS: 3

Introduction to Parallel Computing: Need for Ever-Increasing Performance, Building Parallel Systems, Need to write parallel programs, Approaches for writing Parallel programs: Concurrent, parallel, distributed. **Parallel hardware and parallel software** - von Neumann model background, modifications of the von Neumann model, Caching,Virtual memory, ILP, TLP, Pipelining, Arithmetic pipeline, Instruction pipeline, RISC pipeline, Vector processing, Array process , parallel hardware, and parallel software parallel program design, writing and running parallel programs.

Shared memory programming with Pthreads - processes, threads and pthreads , hello, world, matrix vector multiplication, critical sections, busy waiting, mutexes, producer consumer synchronization and semaphores , barriers and condition variables, readwritelocks, caches, cache coherence and false sharing, thread safety. **Shared memory programming with openMP-** getting started, the trapezoidal rule, scope of variables, the reduction clause, the parallel for directive, more about loops in openMP : sorting, scheduling loops, producers and consumers, caches, cache coherence and false sharing, thread safety. **Distributed memory programming with MPI-**getting started, the trapezoidal rule in MPI, dealing with I/O,collective communication, MPI derived data types, performance evaluation of MPI programs,General Purpose GPU Program.

Textbooks:

1. Peter S. Pacheco, An Introduction to Parallel Programming, 1st Edition, Elsevier, 2011.
2. M. Morris Mano, Computer System Architecture, 3rd Edition, Pearson Education

Reference Books:

1. Thomas Ruber, Parallel Programming for Multicore and Cluster Systems, 1st Edition, Springer, 2010.
2. Ananth Grama, Anshul Guptha, Vipin Kumar, —Introduction to Parallel Computing, 2nd Edition. Addison-Wesley, 2003. 3. Maurice Herlihy, Nir Shavit, The Art of Multiprocessor Programming, Morgan Kaufmann, 2008.

DATA ANALYTICS

COURSE CODE: 13OE459 L – T – P: 3-0-0
PRE-REQUISITE: NIL CREDITS: 3

Big Data, Complexity of Big Data, Big Data Processing Architectures, Big Data Technologies, Big Data Business Value, Data Warehouse, Re-Engineering the Data Warehouse, Workload Management in the Data Warehouse, New Technology Approaches.Integration of Big Data and Data Warehouse, Data Driven Architecture, Information Management and Lifecycle, Big Data Analytics, Visualization and Data Scientist, Implementing The "Big Data" Data Choices in Setting up R for Business Analytics, R Interfaces, Manipulating Data, Exploring Data, Building Regression Models, Clustering and Data Segmentation, Forecasting and Time Series Models. Writing Hadoop Map Reduce Programs, Integrating R and Hadoop, Using Hadoop Streaming with R, Learning Data Analytics with R and Hadoop, Understanding Big Data Analysis with Machine Learning.

Text Books :

1. Data Warehousing in the Age of Big Data by Krish Krishnan, Morgan Kaufmann.
2. A.Ohri, "R for Business Analytics", Springer, 2012.
3. Big Data Analytics with R and Hadoop by Vignesh Prajapati
4. Principles of Big Data Preparing, Sharing, and Analyzing Complex Information, 1st Edition, by J Berman, published by Morgan Kaufmann

FOUNDATIONS FOR WEB DEVELOPMENT

Course Code:13OE461 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Introduction to WEB: Understanding the internet and world wide web, History of WEB, protocols governing the WEB, WEB architecture, Major issues in WEB solution development, Introduction to WEB browsers and servers, Internet standards, TCP/IP protocol suite, IP Addresses, WEB applications, Planning to develop a WEB site, World wide web consortium (W3C), WEB 2.0, Personal, distributed and Client/Server Computing

Hypertext Text Markup language (HTML): HTML Basics, Elements, attributes, basic tags(Comments, Title, Paragraph, line breaks, text styles, heading, different types of text styles (Font, style, bold, underline, italicized, combining styles), Advanced Tags (Tables, cell spacing and padding, nested tables, forms, form elements, (Text, password, hidden, Label, Check Box, Radio button, selection list, text area, file load, buttons), Frames, Images, Meta Tag, Planning a WEB page, Model and Structure of a web site, Designing a WEB page, Hosting multi-media content (Audio and Video) Frames

Cascading style sheets: Introduction, adding CSS, Browser compatibility, CSS and Page Layout, Selectors, Grouping, Selectors, pseudo Classes and elements, Selectors (Attribute, Class, and ID)

Programming using XML: Introduction, XML and HTML, Syntax of XML document, XML attributes, XM: validation, XML DTD, Building blocks of XML documents, DTD elements, DTD Attributes, DTD entities, DTD Validation, XSL, XSL Transformations. XML Name spaces, XML Schema.

TEXT BOOK

1. Uttam K Roy, WEB Technologies, OXFORD Higher education, Seventh edition, 2012

REFERENCES

1. P. J. Deitel and H. M Deitel, Internet & world wide web: How to program, Pearson publishers, Fourth Edition
2. Matt J Crouch, ASP.NET and VB.NET programming, Pearson education, 3rd edition, 2009
3. Scheldt, Complete reference to core JAVA programming

4. NP Gopalan, and J Akilandeswari, WEB Technology- A developers Perspective, PHI publishers, second edition
5. Joy Sklar, WEB Design Principals, CENGAGE publishers, 5th Edition
6. Kogent Learning solution Inc. JAVA server programming JAVA EE7, 2014 Edition
7. Jim Keogh, The complete reference, Tata McGRAW – Hill Edition 2002
8. Herbert Schidlt, JAVA Complete reference, McGraw Hill Education, 9th Edition, 2014

CLIENT SIDE WEB DEVELOPMENT

Course Code: 13OE462 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Introduction: WEB application development through client server architecture, client side development, Role of WEB browser, Server side development, , Roles of WEB server. **Introduction to Browsers:** Internet Explorer, Firefox, connecting to the internet, customizing the browsers, searching the internet, Keeping track of favorite sites, File Transfer protocols, using online help, Kind of resources used as a part of the WEB**. Java Script**: Introduction (Inserting Java script into HTML code, Keywords, browser incompatibility, Placement of Java Script code), Variables, literals, operators, control structures, conditional statements, Arrays, Functions, objects), Exceptional handling, Bulletin objects, events. **User interface through Dynamic HTML with Java Scripts:** Data Validation, Opening a new window, Message and confirmations, the status bar, Writing to a different frame, Rollover Buttons, Moving Images, Multiple pages in a single download, A text only Menu System, Floating logos. **Interfacing with databases:** Introduction to relational database, Using SQL to query and manipulate data, Introduction to MySQL (Installing, setting up user accounts, creating a database, JDBC: Introduction, components, specification architecture, drivers, Exploring the features, Additional features, JDBC API, Exploring major classes and interfaces, Exploring processes with java.Sql and javax.sql, working with transactions

TEXT BOOKS

1. Uttam K Roy, WEB Technologies, OXFORD Higher education, Seventh edition, 2012
2. P. J. Deitel and H. M Deitel, Internet & world wide web: How to program, Pearson publishers, Fourth Edition
3. Matt J Crouch, ASP.NET and VB.NET programming, Pearson education, 3rd edition, 2009
4. Scheldt, Complete reference to core JAVA programming
5. NP Gopalan, and J Akilandeswari, WEB Technology- A developers Perspective, PHI publishers, second edition
6. Joy Sklar, WEB Design Principals, CENGAGE publishers, 5th Edition
7. Kogent Learning solution Inc. JAVA server programming JAVA EE7, 2014 Edition
8. Jim Keogh, The complete reference, Tata McGRAW – Hill Edition 2002
9. Herbert Schidlt, JAVA Complete reference, McGraw Hill Education, 9th Edition, 2014

REFERENCES

1. Uttam K Roy, WEB Technologies, OXFORD Higher education, Seventh edition, 2012
2. P. J. Deitel and H. M Deitel, Internet & world wide web: How to program, Pearson publishers, Fourth Edition
3. Matt J Crouch, ASP.NET and VB.NET programming, Pearson education, 3rd edition, 2009
4. Scheldt, Complete reference to core JAVA programming
5. NP Gopalan, and J Akilandeswari, WEB Technology- A developers Perspective, PHI publishers, second edition
6. Joy Sklar, WEB Design Principals, CENGAGE publishers, 5th Edition
7. Kogent Learning solution Inc. JAVA server programming JAVA EE7, 2014 Edition
8. Jim Keogh, The complete reference, Tata McGRAW – Hill Edition 2002
9. Herbert Schidlt, JAVA Complete reference, McGraw Hill Education, 9th Edition, 2014

WEB APPLICATION DEVELOPMENT ON SERVER SIDE

Course Code: 13OE463 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Introduction: WEB application development through client server architecture, client side development, Role of WEB browser, Server side development, , Roles of WEB server

WEB Servers (IIS, Apache): Introduction, HTTP Transactions, Multi-tier application architecture, Client side scripting Vs Server side scripting, Accessing WEB servers, Introduction to IIS and APACHE, requesting documents and Web resources

CGI Scripting: Introduction to CGI, Developing CGI, Processing CGI, Returning a basic HTML page, Introduction to CGI.pm, CGI.pm methods, Creating HTML pages dynamically, using CGI/pm, adding robustness, uploading files, Tracking users with Cookies, Tracking users with hidden data, Using data files, restricting access with session IDs.

PHP: Introduction, Basics, String processing and regular expressions, form processing and business logic. Connecting and accessing database, using cookies, dynamic contents, operating procedure chart, web resources

Servlets: server side Java, servlet alternatives, Servlet strengths, servlet architecture, servlet Life Cycle, Generic servlet and HTTP servlet, Building servlets, passing parameters to servlets, Retrieving parameters, server side includes, Cookies, Filters, problems with servlets

JSP: JSP and HTTP, JSP Engines, How JSP works, JSP and Servlets, JSP syntax, JSP Components(Directives, comments, expressions, scriplets, objects, variables, methods, classes, standard actions, tag extensions, Iterating a tag body, sharing data between pages), session tracking, connecting to and accessing a database

TEXT BOOKS

1. Uttam K Roy, WEB Technologies, OXFORD Higher education, Seventh edition, 2012
2. P. J. Deitel and H. M Deitel, Internet & world wide web: How to program, Pearson publishers, Fourth Edition
3. Chris Bates, WEB programing, Wiley India, 2nd Edition

REFERENCES

1. Matt J Crouch, ASP.NET and VB.NET programming, Pearson education, 3rd edition, 2009
2. Scheldt, Complete reference to core JAVA programming
3. NP Gopalan, and J Akilandeswari, WEB Technology- A developers Perspective, PHI publishers, second edition
4. Joy Sklar, WEB Design Principals, CENGAGE publishers, 5th Edition
5. Kogent Learning solution Inc. JAVA server programming JAVA EE7, 2014 Edition
6. Jim Keogh, The complete reference, Tata McGRAW – Hill Edition 2002
7. Herbert Schidlt, JAVA Complete reference, McGraw Hill Education, 9th Edition, 20

WEB APPLICATION DEVELOPMENT THROUGH .NET FRAMEWORK

Course Code: 13OE464 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Introduction to Application Development through .NET: The client WEB server model, .NET framework, WEB forms, class library, managed components, language independence, COM+ component services

Application development through VB.NET: Introduction, first program, Variables, constants, operators, functions, sub-routines, Control flow, exception handling, Object oriented programming, multi-thread programming

Application development through ASP.NET: Introduction, Features, anatomy, wen forms, basics of ASP.NET related IDEs, separating the content and the code, HTML Controls, using web controls, displaying and formatting data through WEB controls, Developing GUI controls through WEB controls(Button, Image, Link, Text, choices, lists, links), page directives, Rich controls, validation controls, Data controls, user controls, saving state, intrinsic objects

Accessing data with ADO.NET: Overview of data access on the WEB, Programming objects and architecture, displaying data sets, programming using data list and data grid controls, Data table objects, maintaining data integrity, dealing with database level transactions

Text Book

1. Matt J Crouch, ASP.NET and VB.NET programming, Pearson education, 3rd edition, 2009

REFERENCES

1. **Uttam K Roy, WEB Technologies, OXFORD Higher education, Seventh edition, 2012**
2. **P**. J. Deitel and H. M Deitel, Internet & world wide web: How to program, Pearson publishers, Fourth Edition
3. Scheldt, Complete reference to core JAVA programming
4. NP Gopalan, and J Akilandeswari, WEB Technology- A developers Perspective, PHI publishers, second edition
5. Joy Sklar, WEB Design Principals, CENGAGE publishers, 5th Edition
6. Kogent Learning solution Inc. JAVA server programming JAVA EE7, 2014 Edition
7. Jim Keogh, The complete reference, Tata McGRAW – Hill Edition 2002
8. Herbert Schidlt, JAVA Complete reference, McGraw Hill Education, 9th Edition, 20

COMPONENT BASED WEB DEVELOPMENT THROUGH EJB

Course Code: 13OE465 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Working with EJB: Understating EJB, Classifying EJB, Introduction to session beans, implementing the session beans, introduction of MDB, Implementing MDB,

Implementing Transactions in JAVA EE: Transaction properties, Transaction model, distributed transactions, Implementing transactions using EJB, Bean – Managed transactions, container-managed transactions,

Interceptors: Introduction, interceptor class, Life cycle call back methods in an interceptor class, Call back interceptor methods in an MDB, Call back interceptor methods in an Bean

Implementing entities and JAVA persistence: Introduction to JAVA persistence, and Entity Manager API, Introducing the entities, Describing the life cycle of entity, Entity relationships, collection based relationships, Entity inheritance, JPQL Developing applications (Directory structure, creating WEB modules, configuring connection pools and JDBC resources

Implementing JAVA persistence using the hibernate: Introduction, Architecture, HQL, O/R mapping, working with hibernate, implementing hibernate with O/R

TEXT Book

1. Kogent Learning solution Inc. JAVA server programming JAVA EE7, 2014 Edition

REFERENCES

1. Uttam K Roy, WEB Technologies, OXFORD Higher education, Seventh edition, 2012
2. P. J. Deitel and H. M Deitel, Internet & world wide web: How to program, Pearson publishers, Fourth Edition
3. Matt J Crouch, ASP.NET and VB.NET programming, Pearson education, 3rd edition, 2009
4. Scheldt, Complete reference to core JAVA programming
5. NP Gopalan, and J Akilandeswari, WEB Technology- A developers Perspective, PHI publishers, second edition
6. Joy Sklar, WEB Design Principals, CENGAGE publishers, 5th Edition

7. Kogent Learning solution Inc. JAVA server programming JAVA EE7, 2014 Edition
8. Jim Keogh, The complete reference, Tata McGRAW – Hill Edition 2002
9. Herbert Schidlt, JAVA Complete reference, McGraw Hill Education, 9th Edition, 20

Course of BIO INFORMATICS minor

BASIC BIOLOGY

Course Code: 13OE466 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Introduction, Living organisms, Cell structure and Organelles, Organogenesis, Human Anatomy, **Systems of Life:** Digestion, Respiration, Circulation, Excretion, Reproduction, Thinking and coordination and Defense, **Diet and Nutrition:** Macro (Carbohydrates, proteins, lipids) - and Micronutrients (vitamins), Essential minerals and their role; deficiency symptoms; and their role; deficiency symptoms. **Micro organisms:** Classification of Microorganisms, beneficial and harmful effects of Bacteria, Fungi and Viruses. **Biosensors,** biomechanics and Medical Imaging technology, Applications of Biosensor in Food and Agriculture.

Text Books:

1. Advanced Biotechnology; Dr RC Dubey; S Chand Publications.
2. Elements of Biotechnology; P K Gupta; RASTOGI Publications.

BIOINFORMATICS

Course Code: 13OE467 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Introduction to bioinformatics & databases- Need of Computers in Biotechnology Research- Biological Information on the web. Introduction to Biological databases – their Organization and management - Database search – Algorithms issues in database search - Information retrieval from Databases - Concepts of Data mining, data warehousing and Data integration.

Sequence comparisions and alignments-String similarity- Local, Global alignment; pair wise alignments – Dot plots, Dynamic Programming Methods, Heuristic methods – FASTA, BLAST; Amino acid substitution matrices- PAM and BLOSUM.

Multiple sequence Methods-for Multiple sequence alignments- local and global multiple sequence alignment; Significance and applications of MSA- sequence comparisons- Profile analysis, Block analysis, pattern searching. Phylogenetic analysis-Origins of Molecular Phylogenetics; Methods of Phylogenetic analysis- Maximum Parsimony Maximum Likelihood and Distance based methods, Tree Evaluation, Problems in Phylogenetic Analysis, Automated Tools for Phylogenetic Analysis;

Programing using perl-Introduction to PERL. Programming basics, scalar, arrays and hashes. Control statements, I/O, Regular expressions, data formats, file handles, file tests. File and directory manipulations.

Texts:

1. P. Baldi, S. Brunak ,"Bioinformatics: A Machine learning approach ", MIT press(1988).
2. SC Rastogi, N Mendiratta & P Rastogi ,"Bioinformatics: Methods and Applications".

Reference books:

1. Joao Carlos Setubal, Joao Meidanis, JooaoCarlos Setuba,"Introduction to Computational Molecular Biology".

MOLECULAR MODELING AND DRUG DESIGN

Course Code: 13OE468 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Introduction to Molecular Modeling; History of molecular modeling, physical and computer models, different representations of computer models, Generation of 3D coordinates–using x-ray crystallographic databases, compilation of fragment libraries with standard geometrics, drawing of 2D structures using sketch. **Basic concepts of Protein**

Modeling; concepts of Force Fields, Quantum and Molecular mechanical force fields, Generation of potential energy surfaces, Geometry Optimization, Energy-Minimizing Procedure, and Use of Charges. Salvation Effects, Methods, Ab initio Methods, Semi-empirical Molecular Orbital Methods, Conformational Analysis **Protein structure Determination** ; Comparative Modeling of Proteins, Ab initio modeling and fold recognition Transmembrane Protein Models Based on High-Throughput Molecular Dynamics Simulations with Experimental Constraints, Nuclear Magnetic Resonance-Based Modeling and Refinement of Protein Three-Dimensional Structures and Their Complexes. **Molecular Dynamics and Simulations**; Molecular Dynamics Simulations, Monte Carlo Simulations, Hybrid Quantum and Classical Methods for Computing, Kinetic Isotope Effects of Chemical Reactions in Solutions and in Enzymes, Normal Modes and Essential Dynamics **Molecular modeling applications in Drug designing**; Identifying Putative Drug Targets and Potential Drug Leads: Starting Points for Virtual Screening and Docking Receptor Flexibility for Large-Scale In Silico Ligand Screens: Chances and Challenges, Molecular Docking

Recommended textbooks:

1. Molecular modeling basic principles and applications-Hans-Dieter Holtje and Gerd Folkers, Wiley (2003).
2. Molecular modeling of Proteins-edited by Andreas Kukol, Humana Press. (Apr 2008)

Reference books:

1. Molecular Modeling Principles and Applications- AR Leach, Longman, 1996.

BIOPERL AND PERL PROGRAMMING

Course Code: 13OE469 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

An Introduction to Perl & Variables and Data Types; The Perl Interpreter - Perl Variables -Scalar Values-Variable Definition -Special Variables. **Arrays and Hashes;** Arrays-Array Manipulation - Push and Pop, Shift and Unshift –Splice-Other Useful Array Functions-List and Scalar Context -Hashes -Maintaining a Hash. **Control Structures & String Manipulation;** Comparisons Choices- If - Boolean Operators- Else-Loops-For Loops -For each Loops 52. Indeterminate Loops -While -Repeat Until -Loop Exits -Last - Next and Continue -Array-Based Character Manipulation -Regular Expressions –Match-Substitute – Translate. **Input and Output ;**Program Parameters -File I/O -File handles- Working with Files -Built-in File Handles -File Safety - The Input Operator –Binary- Interprocess Communications – Processes- Process Pipes-Creating Processes - Monitoring Processes. **Bioperl;** Sequences –Seq Feature – Annotation-Sequence - Example Bioperl Programs

Recommended text books:

1. Beginning Perl for Bioinformatics, James Tisdall, O'Reilly Publishers
2. Jamison D. Perl Programming for Biologists, Wiley publishers

Reference text books:

1. Introduction to computers, Peter Norton, Tata Mc Graw Hill publishers

BIO MINING GENOMICS AND PROTEOMICS

Course Code: 13OE470 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Genomes and Genome analysis; Organization and structure of genomes, Genome Mapping: Construction of genomic libraries, mapping strategies and techniques. Human Genome Project, Genomes of other organisms. Principles of gene expression; Global analysis of gene expression, Peptide nucleic acid technology. **Comparitive and Functional genomics;**

Comparative genomics: protein evolution from exon shuffling, Protein structural genomics, Gene function by sequence comparison. Functional Genomics, Pharmacogenomics, Genomics in relation to molecular Diagnosis, Role of genomics in Drug discovery and development.**Microarrays;** Whole genome analysis of mRNA and protein expression, microarray analysis, types of micro arrays and applications in cancer diagnosis. Protein Biochips, Protein arrays. **Proteomics;** Principles of separation of Bio-molecules, 2D-Gel Electrophoresis, MALDI-TOF, Protein-protein interaction networks: Topology, Network motifs, Protein Expression profiling and applications. **Protein Networks and mapping; Y**east two hybrid, Co-Precipitation, Phage Display, Phylogenetic Profile, Domain fusion, Gene Neighborhood, Gene Cluster, Mirror Tree, Analysis of genome wide Protein-Protein Interactions in yeast, Genome wide yeast two hybrid analysis of other organisms, Protein fragment complementation assays.

Texts Books:

1. S.Sahai, Genomics and Proteomics, "Functional and Computational Aspects ", Pienum Publications, 1999.
2. Moody P C E and A J Wilkinson. Protein Engineering. IRL Press.

Reference Books:

1. Creighton T E, Proteins. Freeman W H. Second edition 1993.

COURSE OF ELECTRONICS MINOR

ELECTRONIC DEVICES

Course Code:13OE471 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Semiconductor Diode : PN junction, current equations, Diffusion and drift current densities, V-I characteristics, Forward and Reverse characteristics, Switching Times. **Bipolar Junction Transistor :**NPN –PNP -Junctions-Early effect-Current equations – Input and Output characteristics of CE,CB CC-Hybrid pi model -h-parameter model —Eber Moll Model-Power BJT Gummel poon-model. **Field Effect Transistors:** JFETs – Drain and Transfer characteristics,-current equations-pinch off voltage and its significance MOSFET- characteristic-DMOSFET, EMOSFET-,current equation-model-parameters -, threshold voltage modifications by ion implantation-channel length modulation.-power MOSFET. **Special Semiconductor Devices :** Metal-Semiconductor Junction-Schottky barrier diode-Zener diode-Varacter diode –Tunnel diode- Gallium Arsenic device, LASER diode,LDR, and MESFETs

Power & Display Devices: UJT, SCR, Diac, Triac, DMOS, VMOS, FINFET, DUALGATE,MOSFET, LED, LCD, Photo transistor,Opto Coupler,Solar cell, CCD,MULTI EMITTER Transistor.

TEXT BOOKS

1. Donald A Neaman,"Semiconductor Physics and Devices", Third Edition, Tata Mc GrawHill Inc. 2007.
2. Streetman,"Solid State Electronic Devices "-Fifth Edition-Prentice Hall Of India-2004

REFERENCES

1. B.JAYANT BALIGA "Power semiconductor Devices"-THOMPSON-1996
2. H.Taub Donal Schilling "Digital Integrated Electronics" Mcgrawhill-2006
3. Yang, "Fundamentals of Semiconductor devices", McGraw Hill International Edition.

DIGITAL ELECTRONICS

Course Code:13OE472 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Boolean Algebra: Review of Number Systems – Fixed point and floating point representations – Review of computer codes - Number complements - Signed number addition and subtraction - Boolean Algebra - Demorgan's theorem - Canonical forms - Simplification of Boolean functions using K-maps and Quine Mclusky methods **Combinational Logic Design:** Gates - Universal set of modules - Standard combinational modules - Decoders - Encoders – Multiplexers - Demultiplexers – Comparators - Code Converters - Function realization using Gates and Multiplexers – Adders - Carry Look Ahead Adder - Subtraction using adders - BCD adder. **Sequential Logic Design:** Basic latch circuit - Flip-flops - Truth table – Excitation table - Analysis and design of synchronous sequential circuits - Introduction to asynchronous sequential circuits **Counters and Shift Registers :** Asynchronous Counter design and Synchronous Counter design - Up/Down counter - Modulus counter - Shift Registers - Johnson Counter – Ring Counter - Application of Counters and Shift Registers **Introduction To Logic Families :** Introduction to logic families: - RTL, DTL, ECL, TTL, NMOS, CMOS - GaAs Building blocks - Operating conditions – Interfacing between different families.

TEXT BOOKS

1.Khan & Khan, "Digital Logic Design", Scitech, 2008
2.Morris Mano, " Digital logic ", Prentice Hall of India, 1998

REFERENCES

1.William I. Fletcher, "An Engineering Approach to Digital Design", Prentice- Hall of India, 1980
2.Floyd T.L., "Digital Fundamentals", Charles E. Merril publishing company, 1982
3.Jain R.P., "Modern Digital Electronics", Tata McGraw Hill, 1999.
4.John. F. Wakerly, "Digital design principles and practices", Pearson Education, Fourth Edition, 2007 .
5.Charles H. Roth, Jr, "Fundamentals of Logic Design", Fourth edition, Jaico Books, 2002

ANALOG ELECTRONICS

Course Code:13OE473 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Analysis and design of small signal low frequency BJT amplifiers Classification of Amplifiers – Distortion in amplifiers, Analysis of CE, CC, and CB Amplifiers and CE Amplifier with emitter resistance, low frequency response of BJT Amplifiers, effect of coupling and bypass capacitors, Design of single stage RC coupled amplifier Different coupling schemes used in amplifiers, Analysis of Cascaded RC Coupled amplifiers, Cascode amplifier, Darlington pair, Frequency response of BJT amplifier - Analysis at low and high frequencies, The Hybrid- pi (?) - Common Emitter transistor model, CE short circuit current gain, current gain with resistive load, single stage CE transistor amplifier response, Gain-bandwidth product **FET Amplifiers:** Analysis of FET Amplifiers, Analysis of CS, CD, CG JFET Amplifiers comparison of performance with BJT Amplifiers, Basic Concepts of MOS Amplifiers, –MOSFET – MOSFET Characteristics in Enhancement and Depletion mode - MOS Small signal model, Common source amplifier with resistive, Diode connected and Current source loads, Source follower, Common Gate Stage Cascode and Folded Cascode Amplifier - frequency response. **Positive & Negative Feedback in Amplifiers** Classification of amplifiers, Concepts of feedback - Classification of feedback amplifiers - General characteristics of negative feedback amplifiers - Effect of Feedback on Amplifier characteristics - Voltage series - Voltage shunt, Current series and Current shunt Feedback configurations - Simple problems. Condition for oscillations. RC and LC type Oscillators - Frequency and amplitude stability of oscillators - Generalized analysis of LC oscillators, Quartz, Hartley, and Colpitts Oscillators - RC-phase shift and Wien-bridge oscillators. **Large Signal Amplifiers** Class A Power Amplifier, Maximum Value of Efficiency of Class - A Amplifier, Transformer Coupled Amplifier - Push Pull Amplifiers - Complimentary Symmetry Class B and Class AB Power Amplifiers – Principle of operation of class –

C Amplifier, Transistor Power Dissipation, Heat Sinks. **Tuned Amplifiers** Introduction, Q-Factor, Small Signal Tuned Amplifiers, Effect of Cascading single Tuned amplifiers on Bandwidth, Effect of Cascading Double Tuned amplifiers on Bandwidth, Stagger Tuned Amplifiers, Stability of Tuned amplifiers

TEXT BOOKS

1.Electronic Devices and Circuit Theory, Robert L.Boylestad, Louis Nashelsky, 9th Edition, Pearson Education.
2.Electronic Devices and Circuits, S. Salivahanan, N.Suresh Kumar, A Vallvaraj, 2nd Edition, TMH.
3Design of Analog CMOS Integrated circuits – Behzad Razavi, TMH, 2008.

REFERENCES

1.Integrated Electronics, Jacob Millman, Christos C Halkias, TMH
2.Introductory Electronic Devices and Circuits (Conventional flow version) – Robert T. Paynter, 7th Edition, 2009, PEI.
3.Microelectronic Circuits – Sedra / Smith – 5th Edition – Oxford, 2009
4.Electronic Circuit Analysis – K. Lal Kishore, BS Publications, 2004.
5. Electronic Devices and Circuits, Anil.K. Maini, Varsha Agrawal, 1st Edition, WILEY.
6.Electronic Devices and Circuits, David A. Bell – 5th Edition, Oxford.

PULSE & DIGITAL CIRCUITS

Course Code:13OE420	**L –T – P: 3-0-0**
Prerequisite: NIL	**Credits: 3**

Linear Wave Shaping: High pass and low pass RC circuits and their response for Sinusoidal, Step, Pulse, Square, & Ramp inputs, High pass RC network as Differentiator, Low pass RC circuit as an Integrator, Attenuators and its application as a CRO Probe, RL and RLC Circuits and their response for Step Input, Ringing Circuit. **Non-Linear Wave Shaping**: Diode clippers, Transistor clippers, Clipping at two independent levels, Comparators, Applications of Voltage comparators. Clamping Operation, Clamping circuit taking Source and Diode resistances into account, Clamping Circuit Theorem, Practical Clamping Circuits, Effect of Diode Characteristics on Clamping Voltage, Synchronized Clamping. **Switching Characteristics of Devices** : Diode as a Switch, Piecewise Linear Diode Characteristics, Diode Switching times, Transistor as a Switch, Break down voltages, Transistor in Saturation, Temperature variation of Saturation Parameters, Transistor-switching times, Silicon-controlled-switch circuits, Sampling Gates : Basic operating principles of Sampling Gates, Unidirectional and Bi-directional Sampling Gates, Four Diode Sampling Gate, Reduction of pedestal in Gate Circuits **Multivibrators**: Analysis and Design of Bistable, Monostable, Astable Multivibrators and Schmitt trigger using Transistors, Time Base Generators: General features of a Time base Signal, Methods of Generating Time Base Waveform, Miller and Bootstrap **Time Base Generators**-Basic Principles, Transistor Miller Time Base generator, Transistor Bootstrap Time Base Generator, Transistor Current Time Base Generators, Methods of Linearity improvement. **Synchronization and Frequency Division:** Pulse Synchronization of Relaxation Devices, Frequency division in Sweep Circuit, Stability of Relaxation Devices, Astable Relaxation Circuits, Monostable Relaxation Circuits, Synchronization of a Sweep Circuit with Symmetrical Signals, Sine wave frequency division with a Sweep Circuit, A Sinusoidal Divider using Regeneration and Modulation. **Realization of Logic Gates Using Diodes & Transistors:** AND, OR and NOT Gates using Diodes and Transistors, DCTL, RTL, DTL, TTL and CML Logic Families and its Comparison.

TEXT BOOKS

1. Millman's Pulse, Digital and Switching Waveforms –J. Millman, H. Taub and Mothiki S. Prakash Rao, 2 ed., 2008, TMH.
2. Solid State Pulse circuits –David A. Bell, 4 ed., 2002 PHI.

REFERENCES

1.Pulse and Digital Circuits – A. Anand Kumar, 2005, PHI.

2. Fundamentals of Pulse and Digital Circuits- Ronald J. Tocci, 3 ed., 2008.

3.Pulse and Digital Circuits – Motheki S. Prakash Rao, 2006, TMH.

4.Wave Generation and Shaping - L. Strauss.

LINEAR INTEGRATED CIRCUITS

Course Code:13OE474 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Circuit Configuration For Linear ICS: Current sources, Analysis of difference amplifiers with active loads, supply and temperature independent biasing, Band gap references, Monolithic IC operational amplifiers, specifications, frequency compensation, slew rate and methods of improving slew rate. **Applications of Operational Amplifiers:** Linear and Nonlinear Circuits using operational amplifiers and their analysis, Inverting and Non inverting Amplifiers, Differentiator, Integrator Voltage to Current converter, Instrumentation amplifier, Sine wave Oscillators, Low pass and band pass filters, comparator, Multivibrator and Schmitt trigger, Triangle wave generator, Precision rectifier, Log and Antilog amplifiers, Non-linear function generator. **Analog Multiplier and PLL:** Analysis of four quadrant and variable Tran conductance multipliers, Voltage controlled Oscillator, Closed loop analysis of PLL, AM, PM and FSK modulators and demodulators. Frequency synthesizers, Compander ICs **Analog to Digital and Digital To Analog Convertors :** Analog switches, High speed sample and hold circuits and sample and hold IC's, Types of D/A converter Current driven DAC, Switches for DAC, A/D converter, Flash, Single slope, Dual slope, Successive approximation, DM and ADM, Voltage to Time and Voltage to frequency converters. **Special Function ICS:** Timers, Voltage regulators - linear and switched mode types, Switched capacitor filter, Frequency to Voltage converters, Tuned amplifiers, Power amplifiers and Isolation Amplifiers, Video amplifiers, Fiber optics ICs and Opto couplers, Sources for Noises, Op Amp noise analysis and Low noise OP-Amps.

TEXTBOOKS

1. Sergio Franco, " Design with operational amplifiers and analog integrated circuits", McGraw Hill, 1997.

REFERENCES

1.Gray and Meyer, " Analysis and Design of Analog Integrated Circuits ", Wiley International, 1995.

2. Michael Jacob J., " Applications and Design with Analog Integrated Circuits ",PHI

3. Ramakant A. Gayakwad, " OP - AMP and Linear IC's ", Prentice Hall, 1994.

4. Botkar K.R., " Integrated Circuits ", Khanna Publishers, 1996.

5. Taub and Schilling, " Digital Integrated Electronics ", McGraw Hill, 1977.

6. Caughlier and Driscoll, " Operational amplifiers and Linear Integrated circuits ",PHI

MEASUREMENTS & INSTRUMENTATION

Course Code: 13OE475 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Science Of Measurement: Measurement System – Instrumentation – Characteristics of measurement systems – Static and Dynamic – Errors in Measurements – Calibration and Standards. **Transducers:** Classification of Transducers – Variable Resistive transducers – Strain gauges , Thermistor, RTD- Variable Inductive transducers- LVDT, RVDT,- Variable Capacitive Transducers – Capacitor microphone- Photo electric transducers – Piezo electric transducers – Thermocouple – IC sensors - Fibre optic sensors – Smart/intelligent sensors. **Signal Conditioning And Signal Analyzers:** DC and AC bridges – Wheatstone, Kelvin, Maxwell, Hay and Schering. Pre-amplifier – Isolation amplifier – Filters – Data acquisition systems. Spectrum Analyzers – Wave analyzers – Logic analyzers. **Digital Instruments:** Digital Voltmeters – Millimeters – automation in Voltmeter – Accuracy and Resolution in DVM - Guarding techniques – Frequency counter- Data Loggers – Introduction to IEEE 488/GPIB Buses. **Data Display and Recording Systems:** Dual trace CRO – Digital storage and Analog storage oscilloscope. Analog and Digital Recorders and printers. Virtual Instrumentation - Block diagram and architecture – Applications in various fields. Measurement systems applied to Micro and Nanotechnology.

TEXT BOOKS

1.Albert D.Helfrick and William D. Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice Hall of India.

2.Ernest o Doebelin and dhanesh N manik, "Measurement systems" ,5th edition ,McGraw-Hill,

REFERENCES

1.John P. Bentley, "Principles of Measurement Systems", Fourth edition, pearson Education Limited, 2005.

2.A.K.Sawhney, "Course In Electrical And Electronic Measurement And Instrumentation", Dhanpat Rai Publisher.

3.Bouwens,A.J, "Digital Instrumentation", Tata Mc-Graw Hill, 1986.

4.David A.Bell, "Electronic Instrumentation and Measurements", Second edition,Prentice Hall of India, 2007.

COURSES OF ELECTRICAL POWER ENGINEERING MINOR

ELECTRICAL CIRCUITS

Course code: 130E476 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

CIRCUIT ELEMENTS:

Circuit concept, VI characteristics of Active, Passive circuit elements, Ideal, Practical, Independent and dependent sources, Voltage and Current division; series/parallel combination of circuit elements; Energy stored in Inductor and Capacitor. Kirchhoff's Current law; Mesh and Nodal analysis.

SINUSOIDAL STEADY STATE ANALYSIS & RESONANCE:

R, L, C series, parallel and Series/Parallel circuits to sinusoidal excitation, analysis including j operator.

Series and Parallel resonance, various resonance curves, Importance of Q factor.

Transients & Transformed Network:

Response of R - L, R - C and R - L - C circuits subjected to dc excitation using Laplace Transform method.

COUPLED CIRCUITS:

Defining self and mutual inductance, coefficient of coupling, dot convention, solution of coupled circuits, series and parallel connections of two coupled coils, tuned circuit analysis (single and double tuned) development of circuit equations in time domain and frequency domain

TWO PORT NETWORKS:

Open circuit impedance and short circuit admittance parameters, transmission (ABCD) and inverse transmission parameters, hybrid parameters, interrelation between them; inter connection of 2-port networks.

Polyphase Systems:

Interconnection of 3 phase sources and loads, analysis of 3 phase balanced and unbalanced systems. Power measurement by using 3 wattmeter and 2 wattmeter methods

TextBooks:

1. W. H. Hayt & J.E. Kimmerly ,"Engineering circuit analysis,6th edition,TMH"
2. David a. Bell, "Electric circuits, Oxford University Press

Reference Books:

1. M.E Vanvalkenberg," Network Analysis", 3rd Edition, Prentice Hall of India.
2. Joseph Edminister & Mahmood Nahvi," Electric circuits, 4th edition,TMH
3. N.C. Jagan and C.Lakshminarayana, "Network theory, B.S publications

ELECTRICAL MACHINES

Course code: 130E477 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

DC MACHINES: Principle of operation of DC Machines- EMF equation – Types of generators – Magnetization and load characteristics of DC generators

D.C. MOTORS: DC Motors – Types of DC Motors – Characteristics of DC motors – 3-point starters for DC shunt motor – Losses and efficiency – Swinburne's test – Speed control of DC shunt motor – Flux and Armature voltage control methods.

TRANSFORMERS: Principle of operation of single phase transformer – types – Constructional features – Phasor diagram on No Load and Load – Equivalent circuit.

PERFORMANCE OF TRANSFORMERS: Losses and Efficiency of transformer and Regulation – OC and SC tests – Predetermination of efficiency and regulation (Simple Problems).

THREE PHASE INDUCTION MOTOR: Principle of operation of three-phase induction motors –Slip ring and Squirrel cage motors – Slip-Torque characteristics – Efficiency calculation – Starting methods.

SINGLE PHASE INDUCTION MOTORS: Principle of operation - Shaded pole motors – Capacitor motors, AC servomotor, AC tachometers, Synchros, Stepper Motors – Characteristics.

ALTERNATORS: Alternators – Constructional features – Principle of operation – Types - EMF Equation – Distribution and Coil span factors – Predetermination of regulation by Synchronous Impedance Method – OC and SC tests.

ELECTRICAL INSTRUMENTS: Basic Principles of indicating instruments – Moving Coil and Moving iron Instruments (Ammeters and Voltmeters)

TEXT BOOKS:

1. Introduction to Electrical Engineering – M.S Naidu and S. Kamakshaiah, TMH Publication
2. J. B. Gupta "Theory & Performance of Electrical Machines" S.K.Kataria & Sons, 14th Edition

REFERENCE BOOKS:

1. Theory and Problems of basic electrical engineering - I.J. Nagarath and D.P Kothari, PHI Publications
2. Basic Electrical Engineering - T.K. Nagasarkar and M.S.Sukhija, Oxford University Press

ELECTRICAL POWER GENERATION

Course Code:13OE478 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Generation of Electrical Power

Electrical energy systems and a prospective, basic structure of power system, Types of power Generating Stations, Choice of Generation.

Thermal power stations: layout and its salient features. Hydroelectric Stations: general arrangement and operation of hydroelectric plants and its function.
Nuclear Power Stations: Principles of nuclear power station.
Gas Turbine Plants: Layout of gas turbine plant, principle of operation. Improvement of thermal efficiency of gas plant.
Economics of Generation
Economical Aspects: Economics of generation, factors affecting cost of generation, load curves, Demand Factor, load factor, diversity factor, Plant Capacity Factors & Plant Use Factor, Utilization Factor. Reductions of cost by inter connected stations, Power factor considerations, causes of low power factor, methods of improving power factor considerations.
Tariff: Characteristics of Tariff, types of Tariff.
Solar Energy: Basics of solar energy, solar constant, extra terrestrial radiation, types of conversion systems, solar thermal power plants, solar pond, solar cell.
Wind Energy: Principles of wind power, types, expression for total power, maximum power and force on blades, wind turbine operation, types of wind generator.
Energy from Oceans: Ocean temperature differences, principles of OTEC plant operations, wave energy, simple single pool tidal system.
Geothermal energy: Origin and types, Bio Foiling.
Energy from Bio-mass: Biomass Conversion Technology, Biogas generation, Classification of Biogas plant.
Fuel Cells: Principle of operation of Fuel cells & its applications

TEXT BOOKS:

1. Generation of Electric Power by B.R.Gupta, BSP Publicatioins, India
2. Non-Conventional Energy Sources by G.D.Rai, Khanna Publications. New Delhi.

REFERENCE BOOKS:

1. A Course in Electric Power by Soni,Gupta and Bhatnagar, Dhanapati Rai & Sons, New Delhi.
2. A Course in Power Systems by J.B.Gupta, S.K.Kataria & Sons, New Delhi

TRANSMISSION & DISTRIBUTION

Course Code: 13OE479 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Transmission line parameters

Expressions for inductance and capacitance of single phase and 3-phase lines of symmetrical and transposed configurations, concept of self GMD (GMR) and mutual GMD, double circuit lines and bundled conductors, effect of ground on capacitance.
Transmission line theory: Short, medium and long lines, regulation and efficiency, Pie, T and rigorous methods of solution, ABCD constants, sending and receiving end power equations, Ferranti effect, Corona, factors affecting corona, critical voltages and power loss; Radio interference due to Corona
Mechanical Design: Mechanical design, sag and stress in overhead conductors suspended at level supports and at different levels, effect of wind and ice on sag.
Distribution: Comparison of copper efficiencies between DC, AC Single phase, 3-phase, 3-wire & 4-wire systems, calculation of voltage regulation feeders fed at one end and both ends, ring feeders without and with interconnections, choice of voltage and frequency, Kelvin’s law for most economical cross section.
Substation Practice:Classification of substations, indoor and outdoor substations, busbar arrangements – single busbar, sectionalized single busbar, main and transfer busbar system, sectionalized double busbar system, ring mains, group switching, Substation layout showing the location of PT’s and CT’s, lightening arrestors, earth switches, isolators, circuit breakers and auxiliaries.
Insulators: Types of insulators, voltage distribution in a string of suspension insulators, Grading of insulators. Underground Cables: Types of cables, lying of cables, insulation resistance, electric

stress and capacitance of single core cable, use of intersheath, capacitance grading, capacitance of three core belted type cable.

TEXT BOOKS:

1. Power Systems by C L Wadhwa, New Age Publications
2. A Course in Electrical Power by Soni,Gupta and Bhatnagar, Danapathi Rai & Sons Publications, New Delhi.

REFERENCE BOOKS:

1. A course in Power Systems by J B Gupta, S.K. Kataria & Sons, New Delhi
2. Power system analysis and design By B.R. Gupta, BSP Publications.
3. Elements of Power system analysis by W.D.Stevenson, TMH Publishers, New Delhi.
4. Electric Power Generation, Transmission & Distribution by S.N.Singh, PHI, 2003

POWER SYSTEM ANALYSIS & PROTECTION

Course Code:13OE480 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Representation & Modelling of Power System Elements

Modelling of transmission lines, two-winding transformers synchronous generator modeled as constant voltage behind synchronous / transient reactance, representation of loads, Power angle equation of synchronous generator connected to infinite bus,

One line diagram, Impedance and Reactance diagrams, per-unit Quantities, changing the base of per-unit quantities, selection of base for per-unit computations, Advantages of per-unit computations.

Symmetrical Faults: Concept of Symmetrical short circuit on an unloaded synchronous generator-steady state, transient and sub transient conditions, calculation of symmetrical short circuit currents for simple systems.

Symmetrical components & Networks: Symmetrical components of unsymmetrical phases, sequence impedances and sequence networks, sequence networks of unloaded generators.

Unsymmetrical Faults: Single line-to-ground, line to line and double line to ground faults on an unloaded generator.

Load flow Analysis

Formation of Ybus, Classification of buses for load flow, Static load flow equations, Gauss Siedel power flow solution

Protective Relays:

Introduction, basic requirement of protective relaying, zones of protection – primary and backup protection, construction and operation features of induction disc relays, Definitions of over current – under voltage relays, instantaneous and inverse definite minimum time relay, directional and non-directional relays, Distance relay and Buchholz's relay, Introduction to Differential protection

Switchgear: Elementary principles of arc phenomenon, arc quenching, Principles of operations of various types of circuit breakers.

Stability of power system

Steady state and transient stability, development of the swing equation, swing curve,application of equal area criterion to one machine infinite bus critical clearing angle, critical clearing time, factors affecting steady state and transient stability, methods of improving stability,

TEXT BOOKS:

1. Power System Analysis by Stevenson, TMH Publications, New Delhi.
2. Electrical Power System by C L Wadhwa, New Age Publications, New Delhi

REFERENCE BOOKS:

1 Power system analysis by Hadi Saadat , McGraw Hill Company, New Delhi
2 Electric Energy systems theory by O.I.Elgerd , TMG, New Delhi
3 Modern Power System Analysis by D P Kothari and I J Nagrath, TMH, New Delhi

UTILIZATION OF ELECTRICAL POWER

Course Code: 11OE429 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

MOTOR POWER RATING AND SELECTION

General considerations in selecting motor power ratings. Selection of motor capacity for continuous duty. Equivalent current, torque and power methods, selection of capacity for short time and intermittent periodic duty. Heating and cooling of motors. Load equalization, Fly wheel and its applications in load equalization. Electric braking advantages, Plugging, rheostatic and regenerative braking applied to D.C. Motors.

ELECTRIC TRACTION

Systems of electric traction – Transmission of drive – mechanics of train movement, speed – time curves, effect of speed acceleration and distance on schedule, Power and energy output from driving axles, specific energy output.

Series Parallel method of speed control open circuit transition, shunt bridge transition, bridge transition, collection of currents, third rail overhead wires, bow collector, trolley collector, pantograph collectors, Different types of electric braking, reverse current, Rheostatic and regenerative braking. Counter current braking and reversal of shunt motors.

ELECTRIC HEATING : Elementary principles of heat transfer, Stefan's law, electric Furnaces, Resistance furnace, design of heating element, losses and efficiency – Construction and working of different types of induction furnaces – Dielectric heating – Arc furnaces, Control Equipment.

WELDING: types of welding, resistance and arc welding, Characteristics of Carbon and metallic arc welding, comparison (Excluding electronic controls)

Illumination:Light production by excitation, gas discharge tamps, Fluorescent lamps, Ultra violet lamps, Arc lamps, Filament lamps, polar curves. Effect of voltage variation, lighting calculations solid angle and square law methods of calculation, Factory lighting, flood lighting and street lighting.

TEXT BOOKS :

1. A Course in Electrical Power – by Soni, Gupta, Bhatnagar, Dhanpathi Rai&Sons Pub.
2. Utilization of Electric Energy – by Openshaw Taylor, Orient Longman Ltd.

REFERENCE BOOKS :

1. Generation, Transmission & Utilization of Electric Power – by Atstarr, Pitman Publishing Limited-London.
2. Utilization of Electrical Energy – by H. Partab, Dhanpathi Rai & Sons Publications.

Course of ELECTRICAL MACHINES Minor

ELECTRICAL CIRCUITS : Refer 13OE476 IN ELECTRICAL POWER ENGINEERING(MINOR GROUP)

ELECTRICAL MACHINES: Refer 13OE477 IN ELECTRICAL POWER ENGINEERING(MINOR GROUP)

ADVANCED CONTROL SYSTEMS

Course Code: 13OE483 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Control system terminology, examples of simple control systems, open loop and closed loop control systems, Types of control systems.

Modeling: Mathematical modeling of physical systems- mechanical (Translational & rotational), Electrical (R-L-C) and Electromechanical systems – Servo Motors – AC & DC. Block diagram reduction & Signal Flow graphs **State space Modeling**: Concepts of state space and state models for simple systems, solution of state equation, the state transition matrix and its properties; characteristic equation and transfer function from state models. Concepts of controll ability and observability.

Testing: Transient Response & Steady state response of 1st and 2nd order systems with Standard test input time signals (step, ramp, parabolic and impulse) time domain specifications, steady state error and error constants, Steady state response of 1st and 2nd order systems with sinusoidal signals and frequency domain specifications and their correlation.

Stability analysis: Concept of stability and conditions for stability, Routh – Hurwitz criterion, **Root Locus Technique:** The root locus concept, basic properties, magnitude and angle conditions, properties and construction of the complex root loci, effects of adding poles and zeros to G(s) H(s) on the root loci. Polar (Nyquist) plot, Bode plot, phase margin and gain margin; stability analysis from Nyquist plot

Design:

Lead, Lag, Lead-Lag Compensators, Tuning of P, PI, PID controllers, LQR, State Regulator, State feedback controller.

Text Books:

1. I J Nagrath & M Gopal, "Control System Engineering", 5th Edition New Age International Publication, New Delhi 2011.
2. B.C. Kuo," Automatic Control Systems", Prentice Hall India Publications, NewDelhi , Eighth Edition,2010.

Reference Books

1. K Ogata, "Modern Control Engineering", Prentice Hall India Publication, New Delhi , Fifth Edition,2010.
2. M.Gopal, " Control Systems Principles and Design" Tata Mc-Graw Hill Publications, Fourth Edition,2012.
3. Dhanesh N. Manik, "Control Systems", Cengage Learning Pvt. Ltd., First edition, 2012
4. Norman S. Nise, Control Systems Engineering, John Wiley & Sons, 2008

POWER ELECTRONICS DEVICES & CIRCUITS

Course Code: 13OE484 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Power devices: SCR, Theory of operation of SCR, Two transistor model of SCR, Characteristics and ratings, SCR turn on and turn off methods, Firing circuits, R, RC, UJT and Ramp comparator, Protection of SCR, Series and parallel operation of SCRs, P-N-P-N devices, SCS, LASER, DIAC, TRIAC, IGBT, MOSFET, turn on and turn off methods of SCR, Snubber Circuits

Converters: Principles of phase controlled converter operation, single phase half wave converters, single phase semi converter and single phase full converters with R, RL types of load, single phase dual converter, three phase half wave converters, three phase full wave converters, three phase dual converter with R, L loads, effects of source and load inductance.

AC voltage controllers: Principle and operation of single-phase AC voltage controllers and applications. Three phase-three phase AC voltage controllers

Cyclo converters: Principle and operation of single-phase cyclo converters and applications. Three phase-three phase cyclo conveters

Inverters: Principle of inverter operation, single phase inverters- series, parallel inverters, Mc Murray Bedford half bridge inverters, three phase inverters (120,180 modes of operation), voltage source inverters, current source inverters.

Choppers: Principle of choppers, step up and step down choppers, different classes of chopper circuits and their analysis, Speed control of DC motors, circuit breakers.

TEXT BOOKS:
1. Power Electronics by P.S.Bhimbra, Dhanpat Rai & Sons Publication
2. Power Electronics by M.D.Singh and Khanchandani, TMH Publications

REFERENCE BOOKS:
1. Power Electronics, circuits, devices and applications by M.H.Rashid, PHI(India) Publications
2. Power Electronics by W.Launder, Khanna Publishers

POWER SEMICONDUCTOR DRIVES

Course Code: 13OE485 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Introduction: Electric drives, advantages of electric drive, Type of electric drives, components of electric drives, Status of dc and ac drives Control of Electric Drives: Modes of operation, Speed control and drive classification.

Dynamics of Electric Drives: Fundamental torque equations, Speed torque conventions and multi quadrant operation, Equivalent values of drive parameters, Components of load torques, some common load torques, Nature and classification of load torques

DC motor Drives: DC motors and their performance, Starting, methods of braking, speed control, Methods of armature voltage control, Transformer and uncontrolled rectifier control Controlled Rectifier fed DC Drives: Single phase fully and half controlled rectifier control of separately excited dc motor. Three phase fully and half controlled rectifier control of separately excited dc motor Dual converter control of separately excited dc motor, Rectifier control of dc series motor Chopper fed DC Drives: Control of separately excited dc motors, Chopper control of series motor.

Induction motor drives: Three phase induction motors, Operation with unbalanced source voltages and single phasing, Operation with unbalanced rotor impedances, Starting, braking, transient analysis, Speed control, pole amplitude modulation, stator voltage control, Variable frequency control from voltage and current sources, rotor resistance control, slip power recovery, Variable speed constant frequency generation-

Synchronous motor drives: Synchronous motors, Operation and fixed frequency supply, Synchronous motor variable speed drives, braking of synchronous motor. Variable frequency control of multiple synchronous motors , self control synchronous motor drive employing load commutated thyristor inverter, starting large synchronous machines, self control synchronous motor drive employing a cyclo converter

TEXT BOOKS:
1. Power Semiconductor controlled drives by G.K.Dubey , N. Jersey Publications
2. Power semiconductor drives by S.B.Dewan, G.R.Selmon & Straughen ,John Wiley publications

REFERENCE BOOKS:
1. Fundamentals of Electric drives by G.K.Dubey, Narosa publications

SPECIAL MACHINES

Course Code: 13OE486 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

SINGLE PHASE MACHINES: Principles and construction of split phase motors – Shaded pole motor – Repulsion motor - Universal motor – Unexcited synchronous single phase motor – Reluctance and Hysteresis motor – Schrage motor - Applications.

STEPPER MOTORS: Constructional features, Principle of operation, Modes of excitation, Types of motors, Drive systems & circuit for control of Stepper motor, Applications Dynamic characteristics.

SWITCHED RELUCTANCE MOTORS: Constructional features - Principle of operation - Torque prediction - Power controllers - Characteristics and control - Applications.

PERMANENT MAGNET BRUSHLESS DC MOTORS: Commutation in DC motors - Difference between mechanical and electronic commutators - permanent magnet brushless motor drives - Torque and Emf equation; Torque-Speed characteristics; Sensors - Controllers; Applications.

PERMANENT MAGNET SYNCHRONOUS MOTORS : Principle of operation, Constructional features, EMF, Power input and torque expressions - Phasor diagram - Power controllers - Torque-Speed characteristics - Vector control - Applications.

Text Books:

1. T.J.E. Miller, "Brushless Permanent Magnet and Reluctance Motors Drives", Clarendon Press, Oxford
2. I.J.Nagrath & D.P.Kothari, "Electrical Machines", Tata McGraw Hill

REFERENCE BOOKS:

1. A. Hughes, "Electric Motors and Drives", Affiliated East-west Pvt., Ltd., Madras
2. T. Kenjo and S.Negamori, "Permanent Magnet Brushless DC Motors" Clarendon Press, Oxford

COURSE OF DIGITAL DESIGN MINOR

SYSTEM ON CHIP ARCHITECTURE

Course Code: 13OE487 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Microcomputer Based Systems, Embedded Systems, Types of Hardware, Classifications of Processors. Microprocessor vs Micro-controller, System on Chip

System on Chip Introduction, Design Methodology for Logic cores: SoC Design flow, General guide lines for design reuse, design process for soft, firm and hard cores. Design Methodology for Memory Cores and Analog cores: Design methodology for embedded memories, specifications of analog circuits

Design Validation: core level validation, core interface verification SoC design validation. On-chip communication Architectures: A quick overlook, Basic concepts of bus based communication Architectures: Terminology, characteristics of Bus based communication architectures, data transfer modes, Bus topology types.

On chip Communication Architecture Standard: standard on chip bus based communication architectures; socket based on chip interface standards.

Text Books:

1. System On a Chip Design and Test? by Rochit Rajsuman, Library of Congress Cataloging-in-Publication Data,2000.
2. On chip communication Architectures? by Sudeep Pasricha and Nikil Dutt , Morgan Kaufmann Publishers,2008

VLSI DESIGN

Course Code: 13OE489 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Technology Introduction: Introduction to IC Technology – MOS, PMOS, NMOS, CMOS

MOS Theory Analysis: Basic Electrical Properties of MOS Circuits: **Ids-Vds** Relationships, , **gm**, **gds**, Figure of Merit **ωo**, Pass Transistor, Transmission Gate, NMOS Inverter, Various Pull-ups, CMOS Inverter Analysis and Design, Bi-CMOS Inverters, Latch up in CMOS Circuits.

CMOS Circuits and Logic Design Rules: MOS Layers, Stick Diagrams, Lambada Based rules, Scaling of CMOS Circuits.

CMOS Circuit Characterisation and Performance Estimation: Sheet Resistance **RS** and its Concept to MOS, Area Capacitance Units, Transistor Sizing, Power Dissipation.

CMOS Fault models: need for testing, manufacturing test principles.

TEXT BOOKS

1. Kamran Ehraghian, Dauglas A. Pucknell and Sholeh Eshraghiam, "Essentials of VLSI Circuits and Systems" – PHI, EEE, 2005 Edition.
2. Neil H. E. Weste and David. Harris Ayan Banerjee,, "CMOS VLSI Design" - Pearson Education, 1999.

REFERENCES

1. Sung-Mo Kang, Yusuf Leblebici,"CMOS Digital Integrated Circuits" TMH 2003
2. Jan M. Rabaey, "Digital Integrated Circuits" Pearson Education, 2003
3. Wayne Wolf, "Modern VLSI Design ", 2nd Edition, Prentice Hall, 1998.

SIMULATION TEXT BOOKS

1. Etienne Sicard, Sonia Delmas Bendhia, "Basics of CMOS Cell Design", TMH, EEE, 2005.

SWITCHING THEORY AND LOGIC DESIGN

Course Code: 13OE490 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Basic Principles of Digital Systems: Digital Versus Analog Electronics, Digital Logic Levels, Review of Number systems, Digital Waveforms, Classification of codes. **Logic Functions and Gates:** Basic Logic Functions, Derived Logic Functions, DeMorgan's Theorems and Gate Equivalence, Enable and Inhibit Properties of Logic Gates, Integrated Circuit Logic Gates.

Boolean Algebra: Boolean Expressions, Logic Diagrams and Truth Tables, Sum of Products and Product of Sums Forms, Theorems of Boolean Algerba,

Simplifications: Simplifying SOP and POS Expressions, Simplification by the Karnaugh Map Method (Up to 4 Variables), Simplification by DeMorgan Equivalent Gates, Universal Property of NAND/NOR Gates.

Combinational Logic Functions: Adder, Substractor, Decoders, Endoders, Multiplexers, Demultiplexers, Magnitude Comparators, Parity Generators and Checkers,

Sequential Logic Functions: Latches, NAND/NOR Latches, Gated Latches, Edge- Triggered Flip-flops.

Registers and Counters: Shift registers, Bidirectional shift register with parallel load. Asynchronour (Ripple) counter, Synchronous Counters, updown counter, Ring counter, Johnson Counter, Modulus counter.

Text Books:

1. R. P. Jain, "Modern Digital Electronics", McGraw-Hill
2. M. Morris Mano, "Digital Logic and Computer Design", Pearson
3. Robert K. Dueck, "Digital Design" Cengage Learning-India Edition.

Reference Books:

1. Stephen Brown and Zvonko Vrane "Fundamentals of Digital Logic with Verilog Design" Second Edition, McGraw-Hill
2. ZviKohavi, "Switching and Finite Automata Theory" 2nd Edition, TMH
3. Digital Circuits and Logic Design – Samuel C. Lee, PHI

COMPUTER ORGANIZATION

Course Code:13OE491 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

Introduction: Overview of basic digital building blocks; basic structure of a digital computer. Number system and representation of information, arithmetic and logical operation, hardware implementation,

Basic building blocks for the ALU: Adder, Subtractor, Shifter circuits.

CPU Sub block: Data path - ALU, Registers, CPU buses; Control path - microprogramming (only the idea), hardwired logic; External interface. Various addressing modes. Concept of sub-routine and sub-routine call. Use of stack for handling sub-routine call and return, instruction interpretation and execution.

Memory Sub block: Memory organization; concepts of semi-conductor memory, CPU memory interaction, organization of memory modules, cache memory and related mapping and replacement policies, virtual memory.

I/O Sub block: I/O techniques - interrupts, polling, DMA; Synchronous vs. Asynchronous I/O; Controllers.

TEXT BOOKS

1. Morris M.Mano, “Computer Systems Arichitecture”,3rd Edition.

REFERENCE BOOKS

1. John P Hayes, “Computer Arichitecture and Organization”, 2nd Edition.
2. V.Carl Hamacheret.al, “Computer Organization”, 2nd Edition.
3. Computer architecture and organization by Raja Raman and Radha Krishna-PHI

MICROPROCESSORS & INTERFACING

Course Code:13OE492 **L –T – P: 3-0-0**
Prerequisite: NIL **Credits: 3**

History of Computing, Evolution of Integrated Circuits, Introduction to Microprocessor, Memories, Input / Output Peripherals, System Bus, Clock.

8086 Microprocessor internal architecture, Register organization, Memory segmentation, pipelining process, 8086 pin diagram, Minimum & maximum mode of operation, Timing diagrams, Stack structure and subroutines, procedures and macros, 8086 interrupts & interrupt responses.

Instruction set & Assembly Language programming: Addressing modes of 8086, Instruction set descriptions with examples, Assembler directives; Programmable parallel I/O 8255, modes of 8255. Digital interfacing: Interfacing Microprocessor to LED, 7-segment display, keyboard, stepper motor

TEXT BOOKS:

1. D.V.Hall “Microprocessor and Interfacing”, 2nd Edition Tata McGraw Hill Publishing Company, 2006.
2. A.K. Ray & K. M Bhurchavdi, “Advanced Microprocessors & peripherals”, Tata Mc Graw Hill Publishing Company 2002.

REFERENCE BOOKS:

1. Yu.Cheng Liu & Glenn A Gibson,” Microcomputer System, 8086/8088 Family”, 2nd Edition, PHI, 1986.
2. Ramesh.S.Gaonkar”Microprocessor Architecture,-Programming & applications with 8085/8080”-Penram International-1997.
3. Rafiquzzaman M., "Microprocessor Theory And Applications-Intel And Motorola", PHI, 2002.

FUNDAMENTALS OF GEOSPATIAL TECHNOLOGY

Course code : 13OE493 **L – T – P : 3-0-**0

Prerequisite : NIL **Credits: 3**

INTRODUCTION: Definition, History of Remote Sensing. Basic components of Remote sensing, Electromagnetic Remote sensing process, Passive and active remote sensing. Electromagnetic Spectrum, Energy source and its characteristics, Nature of EMR, Blackbody radiation priciples, radiation quantities and termirology**PHYSICS OF REMOTE SENSING:** EMR Interaction With Earth Surface Materials -Spectral signature concepts – Spectral reflectance & emittance – Typical spectral reflective characteristics of water – vegetation, soil, minerals/rock, man-made structuresAtmospheric properties, solar radiant energy characteristics with atmosphere Atmospheric Scattering, Particulate scattering & absorption, Rayleigh's & Mie's theories. Sunlight & skylight & its spectral composition, Atmospheric Windows.

REMOTE SENSING PLATFORMS AND SENSORS: Introduction; Satellite system parameters; instrumental and viewing parameters, sensor parameters: Spatial, Spectral and Radiometric resolutions, Imaging sensor systems: Multi spectral imaging sensor systems, Thermal sensing systems, microwave image systems. Earth resources satellites: Landsat, SPOT, IRS, AEM and other recent satellites. Meteorological satellites: NOAA, GOES, NIMBUS, Meteosat series, Oceansat, IKONOS satellites.

Visual Image Interpretation: Introduction; Types of pictorial data products; Image interpretation strategy, Levels of interpretation keys; Process of image interpretation; Basic elements of image interpretation. Overview on visual image interpretation equipment.Key elements of visual image interpretation, Topography, Drainage Pattern and Texture, Erosion, Image tone, Vegetation and land use; Concept of converging evidence. Temporal aspects of image interpretation.

Image Analysis: Visual image analysis for land use / land cover mapping, geological and soil mapping, Agriculture applications for forestry applications, water resources applications, Urban and regional planning, Environmental assessment. Principles of land form identification and evaluation : Sedimentary, Igneous and Metamorphic rock terrain.

Text books:

1. Lillesand, T.M. and Kiefer R.W. Remote Sensing and Image Interpretation, John Wiley and Sons, Inc, New York, 1987.
2. Remote Sensing by JAMES B. CAMPBELL Published by Taylor & Francis Ltd.
3. M.Anji Reddy , Text book of Remote sensing and GIS by, BSP Publications, Hyderabad, 2001.

GEOGRAPHICAL INFORMATION SYSTEM

Course code :13OE494 **L. T. P : 3-0-0**

Pre Requisite: NIL **Credits: 3**

INTRODUCTON: Introduction, Definitions of GIS and related terminology, The Evaluation of GIS, Components of GIS, Geospatial data, Spatial data infrastructure, Introduction, Map as a model, Spatial elements and terminology, Classification of maps, Map scale, Spatial referencing system, Computers in map production, Trends in computer construction, General software's in map production.**FUNDAMENTALS OF GIS:**A brief history of GIS, GIS architecture, Components of a GIS, GIS workflow, Theoretical models of GIS: Functional elements, Fundamental operations, Theoretical framework, GIS categories, Levels of measurement.Introduction; Stages of GIS data modeling; Graphic representation of Spatial Data, Raster data representation, Vector data representation, Spatial data models; Raster GIS models: Types of raster GIS models, Compact raster data models; Vector GIS models, Spaghetti model, Topological model, Shape file, Compact vector data models; Comparison of Raster and Vector Models.**GIS DATA MANAGEMENT:**Introduction, Database management systems: Functions of DBMS, Components of DBMS; GIS data file management: Simple list, Ordered sequential files, Indexed files, Building GIS worlds; Database models: Hierarchical database models, Network systems, Relational database models, Standard query language (SQL), Storage of GIS data, The hybrid data model, The integrated data model; Object based data models: Entity-Relationship-Attribute model, Organizational strategy of DBMS in GIS**.DATA INPUT, DATA EDITING AND DATA QUALITY:** Introduction, The data stream, Data input methods: Keyboard entry, Manual digitizing, Scanning and automatic digitizing; GPS for GIS data captureData editing, Detecting and correcting errors, Data reduction and generalization, Edge matching and Rubbersheeting **DATA QUALITY:**Components of data quality. Accuracy, Precision and resolution, Consistency, Completeness, Sources of error in GIS; Modeling errors, Point data error models, Line and area data error models, Models for dot and pixel counting; Error evaluation by graphical methods. **GIS APPLICATIONS:**Remote sensing and GIS Linkage, GIS software, Topography as an environmental factor, locational factor, topographic elements, topographic structures and topographic connections. Case studies

Text Books:

1. Manual of Geospatial Science and Technology Edited By John. D. Bossler, Taylor And Francis, London
2. Text book of Remote sensing and GIS by M. Anji Reddy, BSP Publications, Hyderabad.
3. Geographical Information Sysytems by Demmeers

ENVIRONMENTAL GEOINFORMATICS

Course code :13OE495 **L.T.P :** 3-0-0

Pre Requisite: NIL **Credits: 3**

Forest Resources Management: Geomatics in forestry, forest cover mapping and change detection, forest inventory and stock mapping, dynamics of forest ecosystem and forest canopy, forest damage assessment, parameters of forest inventory, development of working plan, forest management information system (FMIS), forest fire forecasting and risk area mapping, biodiversity characterization, wildlife habitat mapping.**Watershed Management**:Introduction and concepts of watershed, role of remote sensing and GIS database for watershed management, objectives of watershed management, Watershed characteristics, research approach, thematic mapping for a model watershed, watershed management for sustainable development.**Water Quality Mapping and Modeling:** Geoinformatics for water resources development and management, ground water exploration and targeting using RS and GIS, water quality management case studies – groundwater and surface water quality mapping and salt water intrusion modeling.

Solid Waste Management: Introduction, types and classification of solid waste, impacts of solid waste, physical and chemical characteristics of solid waste, factors affecting solid waste generation rates, collection and transportation systems, solid waste sampling techniques, types, merits and demerits of solid waste disposal methods, hierarchy of solid waste management, disposal site identification.**Natural Disaster Management:**Introduction, types of landslides, common features of landslides, causes of landslides and related phenomena, landslide analysis, remote sensing for landslide mapping, hazard mapping of landslides. **Urban Planning and Management**:Introduction, geoinformatics in urban planning, issues in urban planning, urban growth management, urban sprawl assessment, urban land use and infrastructure, urban transport network identification and mapping, urban city guide map change detection and updation, pipeline alignment studies, Land evaluation and suitability studies, Land use/Land cover mapping and planning.

Textbooks:

1. Geoinformatics for Environmental Management by Anji Reddy, M.
2. Introduction to Environmental Remote Sensing by Barrett, E.C.
3. Remote Sensing and Tropical Land Management by Eden, M.J., Parry I.T.
4. Remote Sensing and Image Interpretation by Lillesand and Kiefer.
5. Remote Sensing in Hydrology by Engman
6. Advances in Environmental Remote Sensing by F. Mark Danson.
7. Remote Sensing in Geology by Siegal.
8. Remote Sensing in Soil Science by Mulders M.A.
9. Principles odd GIS for Land Resources Assessment by Burrough P.A.

GIS DATA ANALYSIS&MODELING

Course code : 13OE496 **L.T.P :** 3-0-0

Pre Requisite: NIL **Credits: 3**

Fundamentals of GIS: Map – scale, projection and symbolism. GIS - Introduction, definition and terminology, categories, components, fundamental operations, functional elements. Data structures, data models, GIS data, acquisition, input, storage, output generation. Data preprocessing, database management, integrated analysis of spatial and attribute data.**GIS Spatial Analysis:** Introduction, Defining spatial objects - point, line and area objects based on their attributes, higher level point, line and area objects. **Measurement:** Measuring length of linear objects, measuring polygons, measuring shape, measuring distance. Classification – Principles, Neighborhood functions, Polygonal neighborhoods, Buffers.**Statistical Surfaces:** Surface mapping, sampling the statistical surface, Digital Elevation Model (DEM). Interpolation- linear and non-linear, uses and problems. Terrain reclassification – steepness of slope, aspect, shape or form. Discrete surfaces - dot distribution maps, choropleth maps. **Spatial Arrangement:** Spatial Arrangement - Point patterns, Theissen Polygons, Area patterns, Linear patterns, Directionality of Linear and Areal objects, Connectivity of Linear objects, Routing and allocation.**Overlay Analysis:** Cartographic overlay, point-in-polygon and line-in-polygon operations, Polygon overlay, Automating point-in-polygon and line-in-polygon procedures in Raster, Automating Polygon overlay in Raster, Automating vector overlay, types of overlay.**Data Modelling:** The state of GIS for Environmental Problem Solving, A Perspective on the State of Environmental Simulation Modeling, GIS and Environmental Modeling, The Role of Software Venders in Integrating GIS and Environmental Modeling, Cartographic Modeling, Scope of GIS and relationship to environmental modeling, data models and data quality. **Integrated Modelling using GIS:** Hydrological Modeling - water quality modeling, watershed management and modeling, saltwater intrusion models. Land-surface-subsurface Process Modeling - pipeline alignment studies, solid and hazardous waste disposal site selection, zoning atlas for industrial siting, environmental information system development. Ecosystem modeling, risk and hazard modelling.

Text Books:

1. Fundamentals of GIS by MICHAEL N DEMERS. Published By john Wiley & Sons Inc.
2. Environmental Modelling with GIS, Michael F. Goodchild, Bradley O. Parks, Louis T. Steyaert

GEOSAPTIAL TECHNOLOGY FOR NATURAL RESOURCES &DISASTER MANAGEMENT

Course code : 13OE497 **L.T.P:** 3-0-0

Pre Requisite: NIL **Credits: 3**

Land Resources: Land evaluation and suitability studies by Remote sensing and GIS. Techniques of land use / land cover map preparation. Land use / land cover mapping and planning. **Municipal GIS:** Geomatics in Solid and Hazardous waste disposal site selection, Environmental Information System Development for municipalities: Case studies **Geosciences:** Role of Remote sensing and GIS in geological studies and case studies. **Water Resources:** Ground water exploration and targeting. Watershed characteristics, watershed management and Integrated approach for sustainable planning. Water quality modeling. **AGRICULTURE**Soil and altitude, Soil and aspect, Soil and slopes, Soil landscapes, Soil erosion modeling.Crop type classification, area estimates, and spectral response of different crops. Crop diseases and Assessment, Crop and Water management and monitoring. Advances in Crop monitoring. **FORESTRY:**Survey and mapping of forest cover, Forest change detection, Forest damage assessment and Forests monitoring, Land evaluation for forestry. **Ecosystem Modeling:** Spectral response of vegetation and mapping, Ecosystem Analysis, Environmental impact analysis and monitoring, Ecosystem modeling, Wetland mapping. Spatial Models of Ecological Systems and Process. **Disaster Management:** Introduction and Overview- Natural and man made hazards – land slides- volcanoes- floods and famines- earth quakes- forest fires Human Induced disasters- industrial disasters- dams- constructional and others.

Text books:

1. Environmental Modelling with GIS, Michael F. Goodchild, Bradley O. Parks, Louis T. Steyaert
2. Manual of Geospatial Science and Technology Edited By John. D. Bossler, Taylor And Francis, London
3. Lillesand, T.M. and Kiefer R.W. Remote Sensing and Image Interpretation, John Wiley and Sons, Inc, New York, 1987.
4. Geographical Information Systems by David Martin
5. RS in Geology by Siegal
6. RS in Forest Resources by John. A. Howard, Chapman and Hall.

GEOSPATIAL APPLICATIONS

Course code : 13OE498 **L – T – P : 3-0-0**

Pre Requisite: NIL **Credits: 3**

Interpretation: Fundamentals of interpretation, Land use/Land cover mapping, Geological and soil mapping, agriculture, water resources, Rangeland and Wildlife Ecology applications, Interpretation for terrain evaluation – Soil characteristics, Land use suitability.**Plant Sciences:** Introduction, Manual interpretation, Structure of the Leaf, Spectral Behavior of the Living Leaf, vegetation Indices, Applications of Vegetation Indices, Phenology, Advanced very High Resolution Radiometer (AVHRR), Separating Soil Reflectance from Vegetation Reflectance, Tasseled Cap Transformation.**Earth Sciences:** Introduction, Photogeology, Lineaments, Geobotany, Direct Multispectral Observation of Rocks and Minerals, Mineral targeting, Photoclinometry, Band Ratios, Soil and Landscape Mapping, Integrated Terrain Units.**Hydrospheric Sciences:** Introduction, Spectral Characteristics of Water Bodies, spectral Changes as Water Depth increases, Location and Extent of Water Bodies, Roughness of the water Surface, Bathymetry, Chromaticity diagram, Drainage basin Hydrology, Evapotranspiration, manual interpretation irrigation and command area development, ground water mapping, watershed delineation.**Land Use and Land Cover:** Introduction, Significance of Land Use and Land Cover Information, Applications of Remote Sensing, Land Use classification, mapping land use change, broad – scale land cover studies. **Global Remote Sensing:** Introduction, Biogeochemical Cycles, Advanced Very High Resolution Radiometer (AVHRR), Earth Observing System, EOS Instruments, EOS Bus, EOS Data and Information system, Long –Term Environment Research Sites, Global Land Information System, Global Data Base.

Text book:

1. Introduction to Remote Sensing by JAMES B.CAMPBELL. Published by Taylor & Francis Ltd.

2. Remote Sensing and Image Interpretation by THOMASLILLESAND AND RALPH W KEIFER published by John Wiley & Sons

MANAGEMENT (HS) ELECTIVES

EMOTIONAL INTELLIGENCE

Course Code: 11HS201 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Emotional Intelligence: The Concept, dimensions of emotions; Theories of Multiple intelligences; importance of emotions; emotions and the brain; The Role of Emotions in Organizations; Self-Awareness and Self-Control; Empathy; Social Expertness; Personal Influence.

Emotional Intelligence and Personality; relationship between EQ and IQ; human mind; consequences of low and high EQ; EQ development; Emotional Skills; emotional factors: Emotional Competency, Emotional Maturity, and Emotional Sensitivity

Levels of EI; Models of Emotional Intelligence; emotional intelligence competencies; emotional intelligence and leadership behavior; emotional intelligence and stress management; art of influencing people.

The Role of Emotional Intelligence in Professional Success: Emotional Intelligence and the Complexity of Work; Emotional Intelligence and High IQ Professions; Emotional Intelligence and Leadership; manage emotional upsets; Emotional 'Winner'.

EQ in the Indian Perspective; EQ and Managerial Effectiveness; the soft art of being a tough leader.

RecommendedTextbook(s):

1. Dalip Singh - Emotional Intelligence at Work: A Professional Guide – Response Books – 2006.

Reference Books:

1. Daniel Goleman, Emotional Intelligence, Bantam Books, 2006.
2. Moshe Zeidner, Gerald Matthews, and Richard D. Roberts, What We Know About Emotional Intelligence – How It Affects Learning, Work, Relationships, and Our Mental Health, The MIT Press, 2009.
3. James Bradford Terrell and Marcia Hughes , A Coach's Guide to Emotional Intelligence: Strategies for Developing Successful Leaders , Wiley, 2008.
4. Dr. Jeanne Segal , The Language of Emotional Intelligence, McGraw-Hill, 2008.

PARADIGMS IN MANAGEMENT THOUGHT

Course Code:11HS202 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Management Introduction - Early management thought - Management Concept – as an activity, as a process, as a economic resource, as a team, as an academic discipline, - Nature -

Management as art, science, profession, - Scope and functions of Management, - Levels of Management, - Importance of management - Arthashastra – Lessons for Management theory and practice.

Classical Approach to Management: (a) Scientific Management- The advent of Scientific Management – Frederick W Taylor's contributions, - Contribution by Henry L Gantt, - Contribution by Frank & Lillian Gilberth – criticisms.

(b) General Administrative Approach: Henry Fayol's contributions towards general management – Max Weber's Bureaucracy Approach – Contributions and criticisms

Quantitative Approach: important contributions – TQM – implications in today's management

Behavioral Approach: Organizational Behaviour – Contributions of Elton Mayo's – .Hawthorne studies – contributions of Mary Parker Follett – Chester Bernard.

Contemporary Approach: Systems Theory – Contingency Theory – Chao's Theory -Peter F Drucker Contributions – Gandhi's Philosophies on trusteeship and Concepts of Seven Sins – C K Prahlad's Contribution – Porter's theory.

Recommended Text Book(s):

1. Management by Stephen P Robbins, Mary Coulter, Neeharika Vohra – Pearson – 10th edition

Reference Books:

1. Management by Stoner, Freeman, Gilbert – PHI – 7th edition.
2. Management A Global & Entrepreneurial Perspective – Weihrich, Cannice, Koontz – Mc Graw Hill – 13th Edition.
3. The evolution of management thought by Daniel A Wren, Arther G Bedeian : john wiley & sons

INDIAN ECONOMY

Course Code: 11HS203 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Economy: Meaning, types, problems and functions - Modeling of the economy: Circular flow of economic activity: two sector, three sector and four sector models. Sectoral distribution of the economy.

Nature and features of Indian Economy; Sectoral contribution of National Income -Share of Public and Private Sectors in GDP- Personal Income distibution and measures of inequality- Inequalities in income distribution-Unemployment causes and remedial measures;Poverty in India- Poverty Line – antipoverty programs.

Agricultural Sector of India: importance and general problems; Industrial Sector of India: Importance and general problems: Small Scale Sector: Importance and general problems. Human development: concept and measurement - Human Development Index.

Importance of Teritiary Sector in India – Infrastructure Development – Transport – Road– Ways, Railways – Banking and Insurance –Communication – Science and Technology – Software industry: Its role in national economy.

Economic Planning in India: Over all Objectives and achievments of various Five Year Plans. 12th Five Year Plan; Economic Liberalisation: LPG strategy-General Agreement on Tariffs and Trade (GATT) - Objectives of GATT and Evaluation of WTO – WTO and the Indian Economy.

Recommended Text Book(s):

1. G.Dutt and K.P.M.Sundaram: Indian Economy(2011), S.Chand&Co New Delhi
2. S.K.Mishra and V.K.Puri : Indian Economy,30th edn, Himalaya Publishing House, New Delhi.
3. M.L.Jingan : Macro Econmics, 6th edn., Konark Publishing House.

Reference Books:

1. P.K.Dhar, Indian Economy-Its growing dimension, Kalyani Publishers
2. Alok Ghosh, Indian Economy, its Nature and Problem (World Press).
3. A.N.Agarawal, Indian Economy- Problems of Development and Planning, New Age

PROFESSIONAL ETHICS AND VALUES

Course Code: 11HS205 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Values in human society and types of values: Understanding of values; definition; culture and values; The wider applications of values; societal values; aesthetic values; organizational values; spiritual values;

Ethics and ethical values: Importance of values; value crisis at individual level, societal level, cultural level; social disorganization; value crisis management; Canons of ethics; types of ethics.

Professional ethics: Overview; ethics in engineering profession; code of professional ethics; organizational ethics; Violation of code of ethics: causes and consequences; Whistle blowing.Industry and Industrialization: Problems of man-machine interaction; impact of assembly line and automation; industrial relations; ethics and industrial law.

Science, Technology and Engineering: Engineering as a profession; renewable and non-renewable resources; sustainable development; technology transfer; joint ventures of technology transfer and subsequent Indianization.

Environment and Eco-friendly technology: What is environment? Human development and environment; pollution and pollution control; Eco-friendly technologies.

Recommended Text Book(s):

1. Samita Manna and Suparna Chakraborti, 2010, **Values and Ethics in Business and Profession**, Published by Asoke K. Ghosh, PHI Learning Pvt. Ltd., M-97, Connaught Circus, New Delhi - 110001

Reference books:

1. William O' Donohue, Kyle Ferguson, 2003, **Handbook of Professional Ethics for Psychologists**, Sage Publications, Inc., California.
2. S. Dinesh Babu, 2007, **Professional Ethics and Human Values**, Laxmi Publications, Pvt. Ltd., 113, Golden House, Daryagunj, New Delhi-2.
3. Vaisali R. Khosla, Kavitha Bhagar, 2009, **Human Values and Professional Ethics,** first edition, Technical Publications, Pune.
4. R S Nagarazan, 2007, **A Text Book of Processional Ethics and Values**, New Age International.
5. A. Alavudeen, R. Kalil Rahman, M. Jayakumaran, 2008**, Professional Ethics and Human Values**, Laxmi Publications, Pvt. Ltd., 113, Golden House, Daryagunj, New Delhi-2.

BEHAVIORAL SCIENCES

Course Code: 11HS206 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Introduction to Behavioural Science; Foundations of Individual Behavior: Personality- Personality determinants; Personality traits: The Big Five Model, Major personality attributes influencing OB; Theories of personality; Values – Types of Values.

Learning- Theories of learning; Principles of learning; Attitudes – Source of attitudes; Types of Attitudes, Attitudes and consistency – Cognitive Dissonance theory.

Perception**-** Perceptual process; Factors influencing Perception; perceptual distortion; Linkage between perception and individual decision making; Motivation – Theories of Motivation – Hierarchy Needs Theory – Two-Factor Theory – Expectancy Theory; Applications of Motivation.

Foundations of Group Behavior**:** Groups – Nature of groups; Types of groups; Stages of Group Development; Group Cohesiveness; Teams vs Groups

Leadership – Nature; Leadership Styles; Theories of leadership: Trait Theories, Behavioral Theories and Contingency Theories.

Text Book(s):

1. Aswathappa, **Organizational Behaviour**, Himalaya Publishing House, 2010.

Reference books:

1. Robbins, Stephen, Timothy, A & Sanghi, S. **Organizational Behavior**, 13th Edn, Pearson Education. 2009.
2. Fred Luthans, **Organizational Behaviour**, Prentice Hall, 2007.
3. Udai Pareek, **Organizational Behavior**, Oxford Publishers, New Delhi, 2008.

MANAGING PERSONAL FINANCES

Course Code: 11HS208 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Financial planning process: Introduction-Importance of Financial Planning- Process of financial planning -The planning environment-Determinants of personal income- Financial statements and plans-Concept of Time value of money - Preparing a personal balance sheet - Preparing the income and expense statement-Using personal financial statements - Ratio Analysis.

Managing Taxes: Introduction-Importance of tax planning-Basic concepts of income tax - Personal taxation -Income tax benefits on certain long term investments -Tax planning-Ethical consideration in tax planning.

Making decisions regarding houses and automobiles:- Meeting housing needs-The rental option - The home buying process - Financing the housing transaction - Housing finance institutions in India - Housing schemes in India- Automobile purchase planning.

Planning for Investments:- Types of investment vehicles-Factors considered in the choice of investments- Developing the investment strategy-Investing in Equities- Investment Process-Investing in Fixed Income Securities- Bond Market-Bond Investing Strategies-Types of Bonds-Bond Returns- Risks from Investing in Bonds

Insurance:-Insurance planning - Buying a life insurance - Life insurance products in India- Health Insurance-Need-Types and Sources of health care plans-Providers of Health care-Long term care insurance-Disability income insurance-Health Insurance in India.

Text Book(s):

1. Jack R Kapoor, “Personal Finance” Mc Graw Hill Publications, New Delhi, 2008.
2. KC Mishra and Steward Doss, “Basics of Personal Financial Planning” Cengage Learning, First Edition 2009.

Reference books:

1. Joehnk, Billingsley and Gitman “Planning Your Personal Finances” Cengage Learning India Private Limited, Delhi, 2012.
2. Mark Hirschey and John Nofsinger “Investments Analysis” and Behavior” Mc Graw Hill Publications, New Delhi, 2008.
3. Harrington and Niehaus “Risk Management and Insurance” Mc Graw Hill Publications, New Delhi, 2008.
4. Taxmann’s Income Tax and Wealth Tax.

BASICS OF MARKETING FOR ENGINEERS

Course Code: 11HS209 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Introduction and Nature of Marketing: Evolution; Core concepts of marketing: Needs, Wants, Demand, Transaction, Exchange, Value, Satisfaction, and Relationship. Scope and Importance of Marketing. Consumer & Industrial Markets.

Difference between Selling and Marketing-Marketing Myopia -Classification of markets: commodity market, bullion market, labour market, primary market, secondary market, business markets, and International market.

Understanding Consumer Behaviour: nature, scope and importance of consumer behaviour. Buying roles, decision making process, evaluation of alternatives, purchase decision. Market Segmentation and targeting.

Marketing mix-Product definition, levels of product, product classification, difference between goods and services, Importance of Price.

Promotion mix, difference between Advertising and Personal Selling. Need for Personal Selling in Technology based organizations. Process of selling. Channels of distribution.

Recommended Text Book(s):

1. Rajan Saxena, **Marketing Management**- 3rd Edition, TMH, New Delhi.
2. Philip Kotler and Gary Armstrong- **Principles of Marketing-** 11th Edition, PHI, New Delhi.

Reference Books:

1. V.S. Ramaswamy and S.Namakumari – **Marketing Management**, 3rd edition, Mc Millan Publications, New Delhi.
2. Stanton- **Principles of Marketing**, 11th edition, Pearson Education, Prentice Hall, 2009.
3. Etzel, Walker, Station and Pandit, **Marketing: Concepts and Cases,** TMH- New Delhi.
4. Philip Kotler- **Marketing Management**, Prentice Hall, EEE 14th edition.

SELF MANAGEMENT

Course Code: 11HS210 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

A New practice for a New Reality; Getting control of your life: The five stages of mastering work flow: collection, processing, organizing, reviewing and doing.

Your Self: Levels of Self; Self and learning; Towards self mastery; Stress management and self development.

Managing yourself: Managing your Body; Managing your Mind; Managing your Emotion.

Self management in Society: Yourself in society; Return on Investment in your Self.

Stephen Covey's Seven Habits of Highly Effective People: Be pro-active, Begin with end in mind, Put first things first, Think win –win, Seek first to understand and then to be understood, Synergize and Sharpen the saw.

Recommended Text Book(s):

1. David Allen, 2003, Getting Things Done: The Art of Stress-Free Productivity, David Allen, Penguin Books.
2. Jagdish Parikh, 2003, Managing Your Self, Blackwell publishing.
3. Stephen R.Covey, 2004, The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change, Free Press.
4. David Allen, 2008, Making It All Work: Winning at the Game of Work and Business of Life, Viking Adult.

ORGANIZATION MANAGEMENT

Course Code: 11HS211 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Development of Management thought – Introduction, Various theories; Functional approach, scientific management approach, human relations approach, latest management thoughts, organisation theory-classical organisation, neo-classical organisation theory, modern organisation theory.

Organization Structure--Principles of organisation, organizational theories, departmentalism, authority, power, organizing, organizational effectiveness, structuring the organisation, organizational change, organisation charts; types of organisations—line , functional and line and staff relations, Organisational manuals.

Motivation, Morale and behavioral science—Motivation: Characteristics, importance, Kinds of motivation. Thoughts of motivational philosophy: Gouglass Mc Gregore—X and Y theory; Herzberg's theory. Human needs, Incentive as motivators, Managing dissatisfaction and frustration. Morale, Absenteeism, Behavioral science, Group dynamics, Group behavior. Leadership—Meaning, importance, styles, theories, leaders Vs managers.

Management concept—Management, Administration, Organisation, Difference and Relationship between Management, Administration and Organisation, Importance of Management, Characteristics of management, Managerial Skills, Managerial Objectives, Harmonization of Objectives, Hirechy of Objectives.

Industrial Relations, Trade Union And Collective Bargaining—Industrial relations, Industrial Psychology, Industrial disputes, Conflict management, Views about conflict, Labor Policy. Workers grievances, Suggestion system. Trade Unions. Collective Bargainning, Negotiations, Industrial Safety—working conditions, Accidents, Preventive measures, Safety training.

TEXT BOOKS

1. Stephen P. Robins, Organizational behavior, PHI / Pearson education, 11^{t} edition , 2008.
2. Koontz & Wehrich., Essentials of Management, 12^{th} edition, Tata Mc Grawhill, 2007.

REFERENCES

1. Banga & Sarma , Industrial Engineering Management including Production management, 11^{th} edition, 2010.
2. O.P. Khanna , Industrial engineering management, Khanna publications, 2006

CONSTRUCTION PROJECT MANAGEMENT

Course Code: 13HS212 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Construction – Unique features of construction, construction project, types and Features, phases of a project, agencies involved and their methods of execution.

Construction project planning- Stages of project planning; pre-tender planning, pre-construction planning, detailed construction planning, role of client and contractor, level of detail. Process of development of plans and schedules, work break-down structure, activity lists, assessment of work content, estimating durations, sequence of activities, activity utility data.

Techniques of planning – Bar charts, Networks: basic terminology, types of precedence relationships: finish to start, start to start, finish to finish, start to finish, preparation of CPM networks: activity on link and activity on node representation, analysis of single relationship (finish to start) networks, computation of float values, critical and semi critical paths, calendaring networks.

Resource Scheduling – Bar chart, line of balance technique, resource constraints and conflicts, resource aggregation, allocation, smoothening and leveling.

PERT – Assumptions underlying PERT analysis, determining three time estimates, analysis, slack computations, calculation of probability of completion.

Planning and organizing construction site and resources – Site: site layout, developing site organization, record keeping at site, Manpower: planning, organizing, staffing, motivation, Materials: concepts of planning, procurement and inventory control, Equipment: basic concepts of planning and organizing, Funds: cash flow, sources of funds.

Construction costs – Classification of costs, time cost trade-off in construction projects, compression and decompression. **Monitoring & control-Supervision,** record keeping, periodic progress reports, periodical progress meetings. Updating of plans: purpose, frequency and methods of updating. Common causes of time and cost overruns and corrective measures. Quality control: concept of quality, quality of constructed structure, use of manuals and checklists for quality control, role of inspection, basics of statistical quality control. Safety and health on project sites: accidents; their causes and effects, costs of accidents, occupational health problems in construction, organizing for safety and health.

Text Books

1. Barrie D.S. & Paulson B.C, Professional Construction Management, McGraw Hill
2. Chitkara K.K, Construction Project Management, Tata McGraw Hill

Reference Books

1. P K Joy, Handbook of Construction Management
2. King & Hudson, Construction Hazard and Safety Handbook, Butterworths
3. Antill J M & Woodhead R W, Critical Path Methods in Construction Practice, Wiley.

DISASTER MANAGEMENT

Course Code: 11OE414 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Concept of disaster management, Types of disasters. Disaster mitigating agencies and their organization structure at different levels. Overview of Disaster situations in India: Vulnerability profile of India and vulnerability mapping including disaster prone areas, communities and places. Disaster preparedness-ways and means; skills and strategies; rescue, relief, reconstruction and rehabilitation

Seismic vulnerability of urban areas, Seismic response of R.C frames buildings with soft first storey. Preparedness and planning for an urban earthquake disaster. Tsunami and its impact.

Landslide hazards, zonation mapping and geo-environmental problems associates with the occurrence of landslides

Role of remote sensing, science & technology, Rehabilitation programmes, Management of Relief Camp, information systems & decision making tools, voluntary Agencies & community participation at various stages of disaster Management, School Awareness & Safety programme

TEXT BOOKS:

1. Disaster Management, RB Singh (Ed), Rawat Publications, 2000.

REFERENCE BOOKS:

1. Natural Hazards in the Urban habitat by Iyengar, CBRI, Tata McGraw Hill
2. Natural Disaster management, Jon Ingleton (Ed), Tulor Rose, 1999
3. Anthropology of Disaster management, Sachindra Narayan, Gyan Publishing house, 2000

RESOURCE SAFETY AND QUALITY MANAGEMENT

Course Code: 11HS212 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Resource Management (Man Power, Materials & Machinery):

Introduction; Resource smoothing; Resource Leveling, Establishing workers productivity; Objectives of material management;

Functions of material management department; ABC classification of materials; Inventory of materials; Material procurement; Storage management;

Classification of construction equipment; Earth moving equipment; Excavation equipment; Hauling equipment; Earth compaction equipment; Hoisting equipment; Concrete plant and equipment; Time and motion study; Selection of equipment – Task consideration, cost consideration; Factors affecting the selection; Factors affecting cost owning and operating the equipment; Equipment maintenance.

Safety and Quality Management:

Accident prevention program; Immediate attention in case of accident; Approaches to improve safety in construction; Safety benefits to employees, employees and customers; Prevention of fire in construction industries; Fault tree analysis; Safety information system; Safety budgeting;

Importance of quality; Elements of quality; Organization for quality control; Quality assurance techniques; Documentation; Quality control circles; Total quality management; ISO 9000 – 2008.

TEXT BOOKS:

1. Construction Engineering and Management by S.Seetharaman; Umesh Publications, Nai Sarakl, Delhi.
2. Fundamentals of PERT/CPM and Project Management by S.K.Bhattacharjee; Khanna Publishers, Nai Sarak; Delhi.

REFERENCE BOOKS:

1. Construction Management and Planning by B.Sengupta and H.Guha; Tata Mc.Graw-Hill Publishing Co. Ltd., New Delhi.
2. Construction Planning, Equipment and Methods by Peurifoy R.L; MC Graw-Hill International Book Company.

WATER

Course Code: 13OE422 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Introduction: Natural Resources – definition – types, Water – Definition and importance for mankind, Hydrological cycle, Rainfall distribution, Water Conflicts. Water Availability in India, Water Budgets, and water Conservation for sustainability.Sources and Quality Water: Surface and Underground sources of water. Quality parameters and their significance. Indian standards for drinking water quality. Factors affecting selection of particular sources of water supply for cities and rural environment. Community involvement in water supply schemes.

Surface Water: Floods and droughts, causes and impacts, Water storage through dams/reservoirs, Impact of dams on river ecosystem, forest, man & animals. Storage capacity of reservoirs.

Ground Water :Occurrence of ground water, Confined and unconfined aquifers, Use and misuse of ground water, Quality considerations for ground water sources.

Water Purification and Distribution: General introduction about water treatment, System of supply – advantages & limitations. Laying of Pipes and leak detection in distribution networks pressure requirements, Balancing reservoir and its role in water distribution.

Text Books:

1. Environmental Studies and Green Technology, S.K. Garg and Ranjini Garg, Khanna Publishers, Delhi, First Edition, 2008.
2. Water Supply Engineering, S.K.Garg, Khanna Publishers, Twentieth Edition, 2010.
3. Water Supply and Sewerage, E.W. Steel and T.J. McGhee, Mcgraw Book Hill Company, 8th Edition, 1985.

Reference Book:

1. Manual on Water Supply and Treatment, Central Public health and Environmental Engineering Organization, Ministry of Works and Housing 1977.

EVENT MANAGEMENT

Course Code: 13HS214 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Introduction to Event management: Event management-meaning, concept, aims and objectives of event. Types and category of events-conference, convention, exhibition, sports, rallies wedding and others, meeting planning-meaning and process, Organizational structure and protocol, Planning Events - The nature of planning, planning for onetime events; planning the setting. Location and site, the operation plan, developing the strategic plan, event planning principle- theme, logistics, graphics and special effects. Nature of Marketing, Process of Marketing, Marketing Mix, Sponsorship, Developing a marketing plan, the difference between sales and marketing, the importance of marketing, the marketing plan, steps of the marketing plan, Cross Occupational skills – Organizing and implementing, communication and cooperation, application of mental technique and learning methods, independency and responsibility feeling, stress bearing.

Event Production & Logistics: Concept, theme, fabrication, light & sound, handling venders, Logistic policy, procedures, performance standards, functional areas, motivation and leadership. Relevant legislations, liquor licenses, trade acts, Stake holders and official bodies. Convention services - The service function, the convention service manager and other convention service staff, guest room reservation system, room assignment, preparing the event, function rooms and meeting setups, audio visuals requirements, budgeting and financial control for the events, convention billing and post-convention review/performance. Food services- Type of food function, menu planning, managing food for the events, factor affecting for the food and beverage decisions, food and beverage services for various types of events, staffing requirements for serving the food and beverage, food and beverage control procedure, display and exhibitions.

Planning, Scheduling and Organizing: Arrangement of infra-structure and facilities - Venue, Material, Transport facilities, P A system, decoration, tenting, Furniture, food supplying, Firefighting requirement, First aid, electrical safety, refreshment and recreation, General amenities, Legal formalities & Permission from competent authority Cost estimation. Feedback and Evaluation - Communication processing skill, Gathering the all relevant information analyzing the existing discrepancies, adopting the means to plug it, Documentation & Record keeping

Text books:

1. Donaldgetz: Event Management & Event Tourism, 1999.
2. Goldbalttjj: The art of Science, New York, 1990.

Reference Books:

1. Watt dc event management in leisure and Tourism, Harlow, Essex, audition Welsy Ltd; 1998
2. Event Management - for tourism, cultural, business and sporting events, Wagen, Lynn Van Der, Melbourne, Hospitality Press, 2001.

3. Successful event management: a practical handbook, Shone, Anton and Parry, Bryn, London and New York: Continuum, 2001.

PUBLIC ADMINISTRATION

Course Code: 13HS215 **L –T – P: 3-0-0**

Prerequisite: NIL **Credits: 3**

Introduction, Basic Concepts and Principles: Meaning, Nature, Scope and importance of Public Administration, Public Administration & Private Administration, Evolution of Public Administration -Comparative Public Administration- Development Administration- New Public Administration, E-Governance, Good governance, Public Administration in the context of Liberalization, Privatization and Globalization – Major issues and challenges in the third world- Public Private Partnership - Meaning and Basis of Organization - Hierarchy, Span of Control, Unity of Command, Co-ordination, Supervision, Communication, Centralization & Decentralization

Theories of Administration: Classical Approach - Gulick and Urwick, Scientific Management Approach –Contribution of FW Taylor, Bureaucracy – Theory of Authority – Characteristics of Bureaucracy - Weber's contribution , Human Relations Theory –Hawthorne Studies. Decision Making – Simon's concept of decision making , Ecological Approach – FW Riggs –Ideal Models – Prismatic Model Hierarchy of Needs - Abraham Maslow , Theory X and Theory Y - Douglas Mc Gregor - Leadership – Meaning – Definition –Leadership Theories

Indian Administration: Evolution of Indian Administration: Kautilya's Arthashastra; Legacy of British rule in administration – Basic features of Indian Constitution - Philosophical and Constitutional framework of Government. Union Government and Administration: Parliament, Judiciary - structure, functions, work processes; recent trends; Cabinet Secretariat; Prime Minister's Office; Central Secretariat; Planning Commission- Union-State administrative, legislative and financial relations; : Budget – Concept and principles of budgeting-types and forms; Budgetary process -Comptroller and Auditor General of India.

State, District and Local Administration: Governor; Chief Minister; Council of Ministers; Chief Secretary; State Secretariat; Directorates.District Administration since Independence: Changing role of the Collector; District administration and democratic decentralization. Rural Development programmes - Decentralization and Panchayati Raj-Balwant Rai Mehta and Ashok Mehta Committee reports- 73rd Constitutional Amendment- Urban Local Government- Main features, structures, 74th Constitutional Amendment –Urban Development authorities.

Text books/Reference Books:

1. Awasthi & Maheshwari Public Administration, Laximinarayan Agrawal, Agra, 1997
2. Goel S.L. Advanced Public Administration, Sterling, New Delhi
3. Felix Nigro & Liyod Nigro Modern Public Administration-Harper and Row Publication, New York
4. Prasad R and Others (ed) : Administrative Thinkers
5. Hoshiar Singh & Pradeep Sachdeva. : Administrative Theory, Kitab Mahal, New Delhi, 1999.
6. M.J.K.Thavaraj: Financial Administration in India.
7. DD Basu: Introduction to the Constitution of India
8. SR Maheswari : Indian Administration,Orient longmen, New Delhi
9. S.S.Khera :District Administration in India-National Publishing House, New Delhi.
10. Ramesh K Arora and Rajani Goyal :Indian Public Administration, Wishwa Prakashan, New Delhi
11. SR Maheswari : Local Government in India.

AUDITED COURSES

ENERGY & SOCIETY

COURSE CODE : 13AC201 L – T – P: 2-0-0
PRE-REQUISITE: NIL CREDITS: NIL

Energy definition, techno, economical, environmental and institutional aspects of energy, relationship with quality of life. Different forms of energy, renewable and non-renewable energy, modern forms of energy supply chains, cost and performance of energy chains, hidden costs of energy, energy efficiency, overall efficiency of a energy chain, end use technology. Energy usage, quality of life in rural and urban areas, population demographics, economic poverty and energy poverty, impact of energy on environment, concepts of climate changes and its impacts ,Ecological foot prints of an individual , a family, an organization and a region. Sustainable development issues, energy usage with respect to sustainable development. Energy systems: past, present and future, management, planning and controlling, Integrated energy planning, role of institutions in managing, the economic and industrial activity effect on energy systems. Energy audit, principles of energy auditing, basics of energy estimation, energy audit and energy reporting process, case study: the energy audit of an institution.

REFERENCE BOOKS:

1. Energy, 1994 Aubrecht, Gorden J, Prentice Hall
2. Energy for sustainable World, Goldberg, 1998, J, Johnson H, Reddy AKR, and Williams R,Wiley Eatern
3. Energy for the 21st century, A comprehensive guide in conventional and alternative sources,
4. Roy L. Nersesian, M. E.Sharpe. Renewable Energy: power for sustainable features, 2004, Godfrey Boyle, Oxford University Press.
5. Energy, Resources and the long term feature, 2007, Avery, John Scales, World Scientific New Jersey.

EMPLOYABILITY SKILLS

COURSE CODE : **13AC 202** L – T – P: 1-0-2
PRE-REQUISITE: NIL CREDITS: NIL

Competency 1: Career View

- Introduction to the EES Course- Importance of career , INDUSTRY WATCH etc
- Statement of Purpose-1
- Statement of Purpose-2
- Presentation Techniques-1
- Presentation Techniques-2
- Attitude-1 : Required for Job or Entrepreneurial Career
- Attitude-2: How to Improve Attitude: Case Studies

Competency 2: Principles of effective communication

- Business Vocabulary-1
- Business Vocabulary-2
- Resume Preparation-1:Layout, Format, Power Verbs etc
- Resume Preparation-2:Discussion of How to- Incorporate Attributes, Analysis
- Business Correspondence-1 Technical report Writing-1- Layout, Format
- Business Correspondence-2 Technical report writing- 2-Language

- Business Correspondence-3 Business/ Technical Proposal writing
- Business Correspondence - 4
- Adaptability: Cases and Workouts

Competency 3: Group and Office dynamics and application of decision making principles

- Group Tasks-1- Importance and dynamics
- Group Tasks-1- Decision Making
- Group Tasks-1- Discussion- Lecture input
- Group Tasks-1- Discussion- Practice using Business vocabulary
- Career Search What is it? Speculative career search, How? Where? When?
- Job Hunting Skills: Relationship and Networking, Morale Keeping and Boosting

Competency 4: Corporate etiquette and grooming

- Email and Telephone Etiquette
- Telephonic Interviews
- Grooming

Competency 5: Interview skills

- Interview Skills 1
- Interview Skills 2
- Interview Skills 3
- Self Review – Presentations 1
- Self Review– Presentations 2

LAB: EES - I

Session No	Topic
1	Ice Breakers: Focus on Career Needs - 1
2	Ice Breakers: Focus on Career Needs - 2
3	Industry watch Presentation followed by Questions from Faculty guides
4	Self Introduction Activity(Interview Focus) - 1
5	Self Introduction Activity(Interview Focus) - 2
6	Industry Watch Presentation- followed by Questions from Faculty guides
7	Action Planning for future / Career Discussion
8	Self awareness: strengths and opportunities
9	Industry Watch Presentation- followed by Questions from Faculty guides
10	Attitude and Team Development Work out
11	Industry Watch Presentation- followed by Questions from Faculty guides
12	Problem Solving Skills: Lecture 30 Min Activity 60 Min
13	Telephonic Interview Mock Rounds (Two Intercom Needed in the Labs)
14	Leadership Development: Situation Reaction Test
15	Test Buffer

Reference books:

- The Seven Habits of Highly Effective People - Stephen R. Covey.(with CD)
- Goal - Eliyahu Goldratt.
- Working with Emotional Intelligence - David Goleman.
- Who Moved My Cheese - Dr. Spenser Johnson (with CD)
- Developing Communication Skills by Krishna Mohan and Meera Banerji; MacMillan India Ltd., Delhi
- Essentials of Effective Communication, Ludlow and Panthon; Prentice Hall of India.

- Good To Great - Jim Collins
- Perspectives of English Language Teaching—A.K. Paliwal, Surabhi Publications. Jaipur 2002.
- Curriculum Development and Educational Technology---- Mall Reddy Mamidi, Sterling Publishers.
- The study of Language--- George Yule, Cambridge University Press UK.
- New directions in Grammar and English Language Teaching---- A K Banerjee Pointer Publishers.

ADVANCED EMPLOYABILITY SKILLS

COURSE CODE : 13AC 301 L – T – P: 1-0-2

PRE-REQUISITE: 13AC202 CREDITS: NIL

Competency 1: Industry recommended schemes of reporting during the Practice School

- Practice School: The Concept, Advantages
- Practice School:: requirements-KSA
- Practice School:: Data Management
- Practice School:: Reports to be maintained Weekly, Monthly, Interim and Final
- Practice School:: Reports to be maintained Weekly, Monthly, Interim and Final

Competency 2: Professional behaviors at workplace.

- Assertiveness Development - 1
- Assertiveness Development - 2
- Assertiveness Development : Communicating With Difficult People
- Self Motivation Techniques
- Taking Up Responsibility
- Sense of Ownership

Intra Personal Skills **Competency 3:** Leadership qualities in a business context

- Interpersonal Skills
- Negotiation and Persuasion Skills - 1
- Negotiation and Persuasion Skills - 2
- Time Management-1
- Time Management-2

Competency 4: Achieving Organizational and Personal goals through collaboration and innovation

- Workplace Collaboration & Workplace Communication - 1
- Workplace Collaboration & Workplace Communication - 2
- Personal Goal Setting - 1
- Personal Goal Setting - 2
- Creativity & Innovation - 1
- Creativity & Innovation - 2

Competency 5: Development of leadership and emotional stability in stressful business contexts.

- Emotional Intelligence - 1
- Emotional Intelligence - 2
- Personal Organization and Productivity - 1
- Personal Organization and Productivity - 2
- Conflict resolution - 1
- Conflict resolution - 2
- Stress Management

LAB: EES-II

Session No	Topic
1	Review of the Previous Semester Objectives
2	Industry watch : Student Interest In Practice School Sector
3	Assertiveness Development : Case Study and Role Plays
4	Industry Watch : Core Industry:
5	How to Show Professional Responsibility: Case Study Presentation
6	Industry Watch : Core Industry:
7	Inter Personal and Intra Personal Skills: Activity
8	Industry Watch: Core Industry: Practice School
9	Negotiation Skills: Activity
10	Industry Watch: Allied Industries: Opportunities
11	Telephone Interviews: Mock Practice(phone required in the Lab) :
12	Goal Setting: Success Story Case Study and Practice
13	Conflict Resolution: CCC Cases, Gender Cases, Ego Cases
14	TEST BUFFER
15	TEST BUFFER

REFERENCE BOOKS: For Essentials of Employability Skills I and II:

- Business Communication: Bovee and Phill by Pearson
- Business Communication Strategies by M Monipalli
- Business Communication by Raymond Lesikar
- English for technical communication by Aruna Koneru
- Soft Skills for managers by Dr.Kalyan Chakravarthy and Latha
- Awaken the Giant Within: Tony Robbins
- How to Win Friends and Influence People: Dale Carnegie
- Richest Man in Babylon: George Clason
- Change Your Thoughts, Change Your Life: Wayne Dyer
- Money and the Law of Attraction: Esther Hicks
- A New Earth: Echart Tolle
- How To Actively Take Control of Your Time and Your Life
- How to Create Your Personal Development Plan
- How To Get Motivated
- Never Check Email First Thing In The Morning
- Covey's Time Management Matrix (Illustrated with Comics)
- Famous Failures - Michael Jordan, Abraham Lincoln and J.K. Rowling
- Writing Down Your Goals - The Harvard Written Goal Study
- Will Power: How To Improve Your Personal Self Discipline
- The Definitive Guide to Organize Your Life And Get Rid of Clutter
- Rules For Living Your Best Life
- How To Stop Wasting Time Online
- Think and Grow Rich: Naopleon Hill
- Science of Getting Rich: Wallace D Wattles
- One Minute Millionaire: Jack Canfield and Mark Victor Hansen
- Getting Things Done: David Allen
- Seven Habits of highly Effective People: Covey
- Manage Your Self: Jagdis Parekh
- You Can win: Shiv Khera
- Soft Skills: gurumurthy
- Soft Skills: Meenakshi Raman

QUANTITATIVE APTITUDE AND REASONING

COURSE CODE : 13AC302 L – T – P: 0-0-2
PRE-REQUISITE: Nil CREDITS: AC

Competency 1: Simple equations, Ratio, Proportion, Variation, Percentages,

Simple equations

- Definition of Linear Equations
- Formation of simple equations
- Problems on Ages, Fractions and Digits
- Indeterminate system of equations
- Special cases in indeterminate system of equations

Ratio and proportion

- Definition of Ratio
- Properties of Ratios
- Comparison of Ratios
- Problems on Ratios
- Compound Ratio
- Problems on Proportion, Mean proportional and Continued Proportion

Variation

- Direct variation
- Inverse variation
- Joint variation
- Problems on Variations

Competency 2: Percentages, **Profit and loss, Partnership, Simple interest and Compound interest, Quadratic equations, progressions**

Percentages

- Introduction
- Converting a percentage into decimals
- Converting a Decimal into a percentage
- Percentage equivalent of fractions
- Problems on percentages

Profit And Loss

- Problems on Profit and Loss percentage
- Relation between Cost Price and Selling price
- Discount and Marked Price
- Two different articles sold at same Cost Price
- Two different articles sold at same Selling Price
- Gain% / Loss% on Selling Price

Partnership

- Introduction
- Relation between capitals, Period of investments and Shares

Simple Interest

- Definitions
- Problems on interest and amount
- Problems when rate of interest and time period are numerically equal

Compound Interest

- Definition and formula for amount in compound interest
- Difference between simple interest and compound interest for 2 years on the same principle and time period.

Quadratic equations

- General form of Quadratic equations
- Finding the roots of Quadratic equations

- Nature of the roots
- Relation between the roots
- Maximum and minimum value of Quadratic Expression

Progressions

- Arithmetic Progression
- Geometric Progression
- Harmonic Progression
- Arithmetic Mean, Geometric Mean and Harmonic Mean and their relation.

for Reasoning

Competency 3:

Deductions

- Finding the conclusions using Venn diagram method
- Finding the conclusions using syllogism method

Connectives

- Definition of a simple statement
- Definition of compound statement
- Finding the Implications for compound statements
- Finding the Negations for compound statements

Competency 4:

Analytical Reasoning puzzles

- Problems on Linear arrangement
- Problems on Circular arrangement
- Problems on Double line-up
- Problems on Selections
- Problems on Comparisions

Competency 5:

Clocks

- Finding the angle when the time is given
- Finding the time when the angle is known
- Relation between Angle, Minutes and Hours
- Exceptional cases in clocks

Calendars

- Definition of a Leap Year
- Finding the number of Odd days
- Framing the year code for centuries
- Finding the day of any random calendar date

Blood relations

- Defining the various relations among the members of a family
- Solving Blood Relation puzzles
- Solving the problems on Blood Relations using symbols and notations

TEXT BOOKS:

1. GL Barrons, Mc Graw Hills, Thorpe's verbal reasoning, LSAT Materials
2. R S Agarwal, S.Chand , 'A modern approach to Logical reasoning'
3. R S Agarwal, S Chand, 'Quantitative Aptitude'
4. Quantitative Aptitude - G. L BARRONS
5. Quantitative Aptitude - Abhijit Guha, Mc Graw Hills

REFERENCES:

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3. www.managementparadise.com
4. www.coolavenues.com
5. www.indiaedu.com/entrance-exams/cat.../books.html
6. www.mycatprep.com
7. www.testprepreview.com/**lsat**_practice.htm -
8. www.folj.com
9. www.lsatexampracticetests.com/**analytical**-**reasoning**-**questions**-allocation-problems.html -
10. www.businessworld.in/index2.php?option=com_content...1

13AC203: Sports / Games / Yoga

Pre-requisite: Nil

13AC204: NCC /NSS /NSO/CEA

Pre-requisite: Nil

Suggested Course structure for B.Tech programs
BIOTECHNOLOGY
COURSE STRUCTURE FOR THE A.Y. 2014-15

Semester 1

S No	Code	Title	L	T	P	Cr
1	13HS101	English	2	0	2	3
2	13BS104/ 13BS108	Basic Mathematics/Basic Biology	3	1	0	4
3	13BS103	Engineering Physics	3	0	2	4
4	13BS104	Engineering Chemistry	3	0	2	4
5	13 ES106	Engineering Mechanics	3	0	2	4
6	13 HS 104	Human values	2	0	0	2
7	13 ES 105	Work shop practice	0	0	4	2
						23

Semester 2

S No	Code	Title	L	T	P	Cr
1	13 HS 102	Language and Reasoning skills	2	0	2	3
2	13 ES103	Engineering Materials	3	0	0	3
3	13ES101	Problem Solving through Programming	3	0	2	4
4	13 BS 101	Linear algebra and Multivariable calculus	3	0	2	4
5	13ES102	Measurements	3	0	2	4
6	13 BS 107	Organic chemistry	2	0	0	2
6	11ES 104	Engineering Graphics with CAD	0	0	4	2
						22

Semester 3

S No	Code	Title	L	T	P	Cr
1	13BS202	Differential Equations	3	1	0	4
2	13ES201/ 13ES206	Thermodynamics (2013 Batch)/ Biochemical Thermodynamics(2014 batch)	3	0	0	3
3	13ES204	Data Structures	3	0	2	4
4	13BT201	Biochemistry	3	0	2	4
5	13BT202	Microbiology	3	0	2	4
6	13BT203	Process Engineering Principles	3	1	0	4
7	13AC201	Energy & Society	2	0	0	2
8	13AC203	Sports/Games/Yoga	0	0	2	NC
9	13NC201	Certificate Course	0	0	2	NC
						25

*** Note: Biochemical Thermodynamics instead of Thermodynamics**

Semester 4

S No	Code	Title	L	T	P	Cr
1	13BS204	Probability and Statistics	3	0	0	3
2	13ES203	Network Theory	3	0	2	4
3	13ES202	Object oriented programming	3	0	2	4
4	13ES205/ 13ES207	Digital Signal processing (2013Batch) / Biomedical systems and Systems (2014 Batch)	3	0	2	4
5	13BT204	Bioanalytical Techniques	3	0	2	4
6	13BS109	Cell and Molecular Biology	3	1	0	4
7		Management elective	3	0	0	3
8	13NC202	Certificate Course	0	0	2	NC
9	13AC202	Employability Skills	0	0	2	NC
10	NC	Industrial Training	0	0	0	NC
						26

Semester 5						
S No	**Code**	**Title**	**L**	**T**	**P**	**Cr**
1	13BT301	Fluid Mechanics & Heat Transfer	3	0	2	4
2	13BT302	Genetic Engineering	3	0	2	4
3	13BT303	Bioinformatics	3	0	2	4
4	13BT304	Fermentation Technology	3	0	2	4
5	OE 1	Open elective 1	3	0	0	3
6	13BT307	Food Technology	3	0	2	4
7	13AC301	Advanced Employability Skills	1	0	2	NC
						23

Semester 6						
S No	**Code**	**Title**	**L**	**T**	**P**	**Cr**
1	13BT305	Biochemical Reaction Engineering	3	0	2	4
2	13BT306	Immunology	3	0	2	4
4	13BT308	Plant & Animal Biotechnology	3	0	2	4
5		Professional elective -1	3	0	0	3
6		Professional elective -2	3	0	0	3
7	13AC302	Quantitative Aptitude & Reasoning	0	0	2	NC
						18

Semester 7						
S No	**Code**	**Title**	**L**	**T**	**P**	**Cr**
1	13BT401	Mass Transfer Operations	3	0	2	4
2	13BT402	Downstream processing	3	0	2	4
3		Professional elective -3	3	0	0	3
4		Professional elective -4	3	0	0	3
5		Professional elective -5	3	0	0	3
6	13TP401	Term Paper	0	0	4	2
						15

Semester 8 - A						
S No	**Code**	**Title**	**L**	**T**	**P**	**Cr**
1	OE 2	Open elective 2	3	0	0	3
2	OE 3	Open elective 3	3	0	0	3
3	13PW401	Project Work	0	0	24	12
						18
		OR				
Semester 8 - B						
1	13PS401	Practice School	0	0	24	12
2	OE 2	Open elective 2	3	0	0	3
3	OE 3	Open elective 3	3	0	0	3
						18
						170

DEPARTMENT OF CIVIL ENGINEERING

COURSE STRUCTURE FOR (2014 -15 Batch)

	SEMESTER 1				
	Subject Name	**L**	**T**	**P**	**Credits**
13-HS 101	English	2	0	2	3
13-BS 102	Differential Equations	3	1	0	4
13-BS 103	Engineering Physics	3	0	2	4
11-BS 104	Engineering Chemistry	3	0	2	4
13-ES 106	Engineering Mechanics	3	0	2	4
11-BS 105	Ecology & Environment	2	0	0	2
13-ES 105	Workshop Practice	0	0	4	2
		16	1	12	**23**

	SEMESTER 2				
	Subject Name	**L**	**T**	**P**	**Credits**
13-HS 102	Language and Reasoning Skills	2	0	2	3
13-ES 103	Engineering Materials	3	0	0	3
13-ES 101	Problem Solving through Programming	3	0	2	4
13-BS 101	Linear Algebra and Multi variate calculus	3	0	2	4
13-ES 102	Measurements	3	0	2	4
13-HS 104	Human Values	2	0	0	2
11-ES 104	Engineering Graphics with CAD	0	0	4	2
		16	0	12	**22**

	SEMESTER 3				
	Subject Name	**L**	**T**	**P**	**Credits**
13-CE201	Mechanics of Materials	3	0	2	4
13-CE202	Fluid Mechanics	3	0	2	4
13-CE205	Surveying	3	0	2	4
13-ES 201	Thermodynamics	3	0	0	3
13-ES 203	Network Theory	3	1	0	4
13-BS 201	Mathematical Methods	3	0	0	3
13-AC302	Quantitative Aptitude and Reasoning	0	0	2	0
13-AC203	Sports(Audit Course)	0	0	2	0
		18	1	10	**22**

	SEMESTER 4				
	Subject Name	**L**	**T**	**P**	**Credits**
13-CE 203	Structural Analysis	3	0	2	4
13-CE204	Hydraulics & Hydraulic Machines	3	0	2	4
13CE302	Engineering Geology and RS&GIS	3	0	2	4
13CE301	Construction Materials and Concrete Techonology	3	0	2	4
13CE208	Building Planning and Construction	3	0	2	4
13-BS 203	Complex variables and Finite differential Methods	3	0	0	3
13-AC201	Energy & Society	2	0	0	0
		20	0	10	**23**

	SEMESTER 5				
	Subject Name	**L**	**T**	**P**	**Credits**
13CE206	Soil Mechanics	3	0	2	4
13CE305	Design of Reinforced Concrete Structures	3	0	2	4
13CE207	Environmental Engineering	3	0	2	4
13CE307	Water Resources Engineering	3	1	0	4
13CE303	Transportation Engineering	3	0	2	4
OE 1	Open Elective - 1	3	0	0	3
13AC202	Employability Skills	0	0	2	0
13NC201	Certificate course 1	0	0	2	0
		18	1	12	**23**

	SEMESTER 6				
	Subject Name	**L**	**T**	**P**	**Credits**
13CE306	Design of Steel Structures	3	0	2	4
13CE304	Foundation Engineering	3	0	2	4
13CE309	Advanced Design of Reinforced Concrete Structures	3	0	2	4
	Professional Elective - 1	3	0	0	3
	Professional Elective - 2	3	0	0	3
13AC301	Advanced Employability Skills	0	0	2	0
13AC204	NCC/CEA (Audit course)	0	0	2	0
13TP401	Term Paper	0	0	4	2
13NC202	Certificate course 2	0	0	2	0
		15	0	16	**20**

	SEMESTER 7				
	Subject Name	**L**	**T**	**P**	**Credits**
13CE308	Advanced Structural Analysis	3	2	0	4
13CE310	Quantity Surveying and Estimation	3	0	2	4
	Department Elective - 3	3	0	0	3
	Department Elective - 4	3	0	0	3
	Department Elective - 5	3	0	0	3
ME	Management Elective	3	0	0	3
		18	2	2	**20**

	SEMESTER 8				
	Subject Name	**L**	**T**	**P**	**Credits**
OE 2	Open Elective - 2	3	0	0	3
OE 3	Open Elective - 3	3	0	0	3
13PS401/ 13PW401	PROJECT / PRACTICE SCHOOL	0	0	24	12
		6	0	24	**18**

TOTAL CREDITS	**171**

Computer Science and Engineering (2014 -15 Batch)Course Structure

SEMESTER 1				
S.No	**Code**	**Course Name**	**L-T-P**	**Credits**
1	13HS102	Language & Reasoning Skills	2-0-2	3
2	13BS102	Differential Equations	3-0-2	4
3	13ES103	Engineering Materials	3-0-0	3
4	13ES101	Problem Solving through Programming	3-0-2	4
5	13ES102	Measurements	3-0-2	4
6	11ES104	Engineering Graphics Through CAD	0-0-4	2
7	13HS104	Human Values	2-0-0	2
Total Credits				**22**

SEMESTER 2				
S.No	**Code**	**Course Name**	**L-T-P**	**Credits**
1	13HS101	English	2-0-2	3
2	13BS101	Linear Algebra & Multivariate Calculus	3-0-2	4
3	13BS103	Engineering Physics	3-0-2	4
4	13ES106	Engineering Mechanics	3-0-2	4
5	11BS105	Ecology & Environment	2-0-0	2
6	11BS104	Engineering Chemistry	3-0-2	4
7	13ES105	Workshop Practice	0-0-4	2
Total Credits				**23**

SEMESTER 3				
S.No	**Code**	**Course Name**	**L-T-P**	**Credits**
1	13BS201	Mathematical Methods	3-0-0	3
2	13ES202	Object Oriented Programming	3-0-2	4
3	13ES204	Data Structures	3-0-2	4
4	13CS201	Digital Logic Design & CO	3-0-2	4
5	13CS202	Human Computer Interaction	3-0-2	4
6	13ES205	Signal Processing	3-0-2	4
7	13AC302	Quantitative Aptitude & Reasoning	0-0-2	NIL
8	13AC203	Sports/Games/Yoga		
Total Credits				**23**

SEMESTER 4				
S.No	**Code**	**Course Name**	**L-T-P**	**Credits**
1	13BS206	Discrete Mathematics	3-0-0	3
2	13ES203	Network Theory	3-1-0	4
3	13ES201	Thermodynamics	3-0-0	3
4	13CS203	Operating systems	3-0-2	4
5	13CS204	Database Management Systems	3-0-2	4
6	13CS205	Computer Networks	3-0-2	4
7	HS	HS Elective-1	3-0-0	3
8	13IS201	Industrial Training (4 WEEKS)		NC
Total Credits				**25**

SEMESTER 5				
S.No	Code	Course Name	L-T-P	Credits
1	11EC311	Microprocessors & Microcontrollers	3-0-2	4
2	11EM301	Internet Programming	3-0-2	4
3	13CS301	Software Engineering	3-0-2	4
4	13CS302	Design and Analysis of Algorithms	3-0-2	4
5	13CS303	Information Assurance & Security	3-0-2	4
6	OE	Open Elective -1	3-0-0	3
7	13AC202	Employability Skills	1-0-2	NIL
8	13NC201	Certificate Course-1	0-0-2	NIL
Total Credits				**23**

SEMESTER 6				
S.No	Code	Course Name	L-T-P	Credits
1	13CS304	Artificial Intelligence	3-0-2	4
2	13CS305	Distributed Computing	3-0-2	4
3	13CS306	Automata Theory & Formal Languages	3-0-2	4
4	PE	Professional Elective -1	3-0-0	3
5	PE	Professional Elective -2	3-0-0	3
6	13TP401	Term Paper	0-0-4	2
7	13AC301	Advanced Employability Skills	2	0
8	13AC204	NCC/NSS/NSO/CEA		
9	13NC202	Certificate Course-2		
Total Credits				**20**

SEMESTER 7				
S.No	Code	Course Name	L-T-P	Credits
1	13CS401	Compiler Design	3-0-2	4
2	13CS402	Simulation & Modeling	3-0-2	4
3	PE	Professional Elective -3	3-0-0	3
4	PE	Professional Elective -4	3-0-0	3
5	PE	Professional Elective -5	3-0-0	3
6	13MP401	Miniproject	0-0-6	3
7	13AC201	Energy & Society	2-0-0	NIL
Total Credits				**20**

SEMESTER 8				
S.No	Code	Course Name	L-T-P	Credits
1	OE	Open Elective -2	3-0-0	3
2	OE	Open Elective -3	3-0-0	3
3	13PW401 OR 13PS401	Major Project OR Practice School	0-0-18	12
Total Credits				**18**

Total Credits of the program **174**

Electronics and Communications Engineering (2014 -15 Batch) Course Structure

Semester 1					
S.No	**Code**	**Course Name**	L-T-P	**Hours**	**Credits**
1	13-HS 102	Language & Reasoning Skills	2-0-2	4	3
2	13-BS 102	Differential Equations	3--1--0	4	4
3	13-ES 103	Engineering Materials	3-0-0	3	3
4	13-ES 101	Problem Solving through Programming	3-0-2	6	4
5	13-ES 102	Measurements	3-0-2	6	4
6	11-ES 104	Engineering Graphics Through CAD	0-0-4	4	2
7	13-HS 104	Human Values	2-0-0	2	2
				29	**22**

Semester 2					
S.No	**Code**	**Course Name**	L-T-P	**Hours**	**Credits**
1	13-HS 101	English	2-0-2	2	3
2	13-BS 101	Linear Algebra & Multivariate Calculus	3-0-2	6	4
3	13-BS 103	Engineering Physics	3-0-2	6	4
4	13-ES 106	Engineering Mechanics	3-0-2	6	4
5	11-BS 105	Ecology & Environment	2-0-0	2	2
6	11-BS 104	Engineering Chemistry	3-0-2	6	4
7	13-ES 105	Workshop Practice	0-0-4	4	2
				32	**23**

Semester 3					
S.No	**Code**	**Course Name**	L-T-P	**Hours**	**Credits**
1	13-BS 201	Mathematical Methods	3-0-0	3	3
2	13-ES 202	OOPS	3-0-2	6	4
3	13-ES 203	Network theory	3-0-2	6	4
4	13-ES 204	Data Structures	3-0-2	6	4
5	13-ES 205	Signal Processing	3-0-2	6	4
6	13-EC 201	Design of Electronic Systems	3-0-2	6	4
7	13-AC 302	Quantitative Aptitude & Reasoning	0-0-2	2	0
8	13-NC201	Certificate Courses-1	****	**	**
				35	**23**

Semester 4					
S.No	**Code**	**Course Name**	L-T-P	**Hours**	**Credits**
1	13-EC 205	Analog Electronic Circuit	3-0-2	6	4
2	13-EC 207	Analog Communication	3-0-2	6	4
3	13-EC 203	Basics of Digital Systems	3-0-2	6	4
4	13-ES 201	Thermodynamics	3-0-2	4	4
5	13-BS 202	Complex Variables & Discrete Mathematics	3-0-0	4	4
6	13-EC 202	Electromagnetic Field Theory	3-0-2	6	4
7		HS_Electives	3-0-0	3	3
8	13-NC202	Certificate Courses-2			
				35	**27**

Semester 5						Semester 6					
S.No		Subject Name		**Hours**	**Credits**	**S.No**		Subject Name		**Hours**	**Credits**
1	13-EC 313	Antenna & Wave Propagation	3-0-2	6	4	1	13-EC 312	Design with PLD and FPGA	3-0-2	6	4
2	13-EC 308	Digital Communication	3-0-2	6	4	2	13-EC 314	Microwave Engineering	3-0-2	6	4
3	13-CS 205	Computer Networks	3-0-2	6	4	3	11-EC 311	Microprocessors & Microcontrollers	3-0-2	6	4
4	13-EC 206	CMOS VLSI Design	3-0-2	6	4	4		Professional Elective -1	3-0-0	3	3
5		Open Elective -1	3-0-0	3	3	5		Professional Elective -2	3-0-0	3	3
6	13-EM201	Computer Organization	3-0-2	6	4	6	13 TP 401	Term Paper	0-0-4	4	2
7	13-AC202	Employability Skills	1-0-2	2	0	7	13-AC301	Advanced Employability Skills	1-0-2	2	0
				35	**23**					**30**	**20**

Semester 7						Semester 8					
S.No		Subject Name		**Hours**	**Credits**	**S.No**		Subject Name		**Hours**	**Credits**
1	11-EE 304	Control Systems	3-0-2	6	4	1		Open Elective -2	3-0-0	3	3
2	13-EC 415	DSP Processors & Architecture	3-0-2	6	4	2		Open Elective -3	3-0-0	3	3
3		Professional Elective -3	3-0-0	3	3	3	13 PW 401	Major Project	0-0-24	9	12
4		Professional Elective -4	3-0-0	3	3					**15**	**18**
5		Professional Elective -5	3-0-0	3	3			Total Credits			**173**
6	13-AC201	Energy & Society	2-0-0	2	0						
				23	**17**						

COURSES FOR B.TECH (ECM) FOR (2014 -15 Batch)

I SEMESTER								II SEMESTER							
S. NO	COURSE CODE	SUBJECT NAME	L	T	P	HOURS	CREDITS	S. NO	COURSE CODE	SUBJECT NAME	L	T	P	HOURS	CREDITS
1	13-HS-101	English	2	0	2	2	3	1	13HS102	Language And Reasoning Skills	2	0	2	4	3
2	13-BS-102	Differential Equations	3	1	0	4	4	2	13ES103	Engineering Materials	3	0	0	3	3
3	13-BS 103	Engineering Physics	3	0	2	6	4	3	13ES101	Problem Solving Thorugh Programminmg	3	0	2	6	4
4	11-BS-104	Engineering Chemistry	3	0	2	6	4	4	13BS101	Linear Algebra And Multivariate Calculus	3	0	2	6	4
5	13-ES 106	Engineering Mechanics	3	0	2	6	4	5	13ES102	Measurements	3	0	2	6	4
6	11BS105	Ecology And Environment	2	0	0	2	2	6	13HS104	Human Values	2	0	0	2	2
7	13-ES105	Workshop Practice	0	0	4	4	2	7	11ES104	Engineering Graphics With Cad	0	0	4	4	2

III SEMESTER								IV SEMESTER							
S. NO	COURSE CODE	SUBJECT NAME	L	T	P	HOURS	CREDITS	S. NO	COURSE CODE	SUBJECT NAME	L	T	P	HOURS	CREDITS
1	13-BS-201	Mathematical methods	3	0	0	3	3	1	13-BS-206	Discrete Mathematics	3	0	0	3	3
2	13-ES-202	Object oriented programming	3	0	2	6	4	2	13-ES 201	Thermodynamics	3	0	2	3	4
3	13-ES 204	Data Structures	3	0	2	6	4	3	13-EC 203	Basics of Digital Systems	3	0	2	6	4
4	13-ES 203	Network Theory	3	0	2	6	4	4	13-EC 205	Analog Electronic Circuits	3	0	2	6	4
5	13-ES 205	Digital Signal Processing	3	0	2	6	4	5	13-CS 204	Data Base Management	3	0	2	6	4
6	13-EC201	Design of Electronic Systems	3	0	2	6	4	6	13-CS 203	Operating Systems	3	0	2	6	4
7	13-AC 302	Quantitative Aptitude and Reasoning	2	0	0	2	-	7		HS-Electives	3	0	0	3	3
8	13-AC 204	Sports / Games / Yoga (Audit Course)				35	23	8	13-NC 201	Certificate Course-1					

V SEMESTER								VI SEMESTER							
S. NO	COURSE CODE	SUBJECT NAME	L	T	P	HOURS	CREDITS	S. NO	COURSE CODE	SUBJECT NAME	L	T	P	HOURS	CREDITS
1	13CS205	Computer Networks	3	0	2	6	4	1	13EC311	Microprocessors & Micro Controllers	3	0	2	6	4
2	11EM301	Internet Programming	3	0	2	6	4	2	11EM401	Embedded Systems	3	0	2	6	4
3	13EM201	Computer organization	3	0	2	6	4	3	13CS301	Software Engineering	3	0	2	6	4
4	13EC312	Design with PLD/FPGA	3	0	2	6	4	4		PE – I	3	0	0	3	3
5	13EM202	Communication Systems	3	0	2	6	4	5		PE - II	3	0	0	3	3
6		OE-I	3	0	0	3	3	6	13TP401	Term Paper		0	4	4	2
7	13AC202	Employability Skills-I	1	0	2	2	-	7	13AC301	Advanced Employability Skills	1	0	2	2	-
8	13NC 202	Certificate Course-2													

VII SEMESTER								VIII SEMESTER							
S. NO	COURSE CODE	SUBJECT NAME	L	T	P	HOURS	CREDITS	S. NO	COURSE CODE	SUBJECT NAME	L	T	P	HOURS	CREDITS
1	11EE304	Control Systems	3	0	2	6	4	1	11EE304	Control Systems	3	0	2	6	4
2	13EC206	CMOS VLSI Design	3	0	2	6	4	2	13EC206	CMOS VLSI Design	3	0	2	6	4
3		PE-III	3	0	0	3	3	3		PE-III	3	0	0	3	3
4		PE-IV	3	0	0	3	3	4		PE-IV	3	0	0	3	3
5		PE-V	3	0	0	3	3	5		PE-V	3	0	0	3	3
6	13AC201	Energy & Society	2	0	0	2	0	6	13AC201	Energy & Society	2	0	0	2	0
						23	17			OR				23	17
		OR						1	13PW 402	Final Year Project	0	0	24	24	12
1	13 PS 401	Practice School	0	0	24		12	2		OE-II	3	0	0	3	3
2		OE-II	3	0	0	3	3	3		OE-III	3	0	0	3	3
3		OE-III	3	0	0	3	3							30	18
						30	18								172

COURSES FOR B.TECH (EEE) FOR (2014 -15 Batch)

First Semester					Second Semester				
S.No.	**Course Code**	**Course Name**	**L-T-P**	**Credits**	**S.No.**	**Course Code**	**Course Name**	**L-T-P**	**Credits**
1	13-HS 101	English	2-0-2	3	1	13-HS 102	Language	2-0-2	3
2	11-BS 105	Ecology & Environment	2-0-0	2	2	13-HS 104	Human Values	2-0-0	2
3	13-BS 101	Linear Algebra & Multi Variate Calculus	3-0-2	4	3	13-BS 102	Differential Equations	3-1-0	4
4	13-BS 103	Engineering Physics	3-0-2	4	4	11-BS 104	Engineering Chemistry	3-0-2	4
5	13-ES 103	Engineering Materials	3-0-0	3	5	13-ES 102	Measurements	3-0-2	4
6	11-ES 104	Engineering Graphics	0-0-4	2	6	13-ES 105	Workshop	0-0-4	2
7	13-ES 101	C-Programming	3-0-2	4	7	13-ES 106	Engineering Mechanics	3-0-2	4
				22					23

Third Semester					Fourth Semester				
S.No.	**Course Code**	**Course Name**	**L-T-P**	**Credits**	**S.No.**	**Course Code**	**Course Name**	**L-T-P**	**Credits**
1	13ES201	Thermodynamics	3-0-0	3	1	13ES202	Object Oriented Programming	3-0-2	4
2	13ES203	Network Theory	3-1-0	4	2	13ES204	Data Structures	3-0-2	4
3	13BS201	Mathematical Methods	3-0-0	3	3	13BS202	Complex Variables and Discrete Mathematics	3-0-0	3
4	13ES205	Signal Processing	3-0-2	4	4	13EE202	Fields & Networks	3-0-2	4
5	13EC201	Design of Electronics Systems	3-0-2	4	5	13EE203	AC Machines	3-0-2	4
6	13EE201	DC Machines & Transformers	3-0-2	4	6	13EE205	Analog Electronic Circuits	3-0-2	4
7	13-AC 203	Audit Course -1 (Yoga/Sports)			**7**	13-AC 201	Audit Course-2(Energy & Society)		
				22					23

Fifth Semester					Sixth Semester				
S.No.	**Course Code**	**Course Name**	**L-T-P**	**Credits**	**S.No.**	**Course Code**	**Course Name**	**L-T-P**	**Credits**
1	11EE203	Electrical Power Generation and Distribution	3-0-2	4	1	11EE302	Power System Analysis	3-0-2	4
2	11EE304	Control Systems	3-0-2	4	2	11EE307	Electrical Drives	3-0-2	4
3	11EE303	Power Electronics	3-0-2	4	3		Open Elective-1	3-0-0	3
4	11EE205	Electrical Power Transmission	3-0-2	4	4		Professional Elective-1	3-0-0	3
5	13EC203	Basics of Digital Systems	3-0-2	4	5		Professional Elective-2	3-0-0	3
6		Audit Course -3		0	6		Management Elective	3-0-0	3
7	13-NC-201	Certificate Course -1		0	7	13-TP-401	Term Paper	0-0-4	2
				20	8		Audit Course -4		
					9	13-NC-202	Certificate Course -2		22

Seventh Semester					Eighth Semester				
S.No.	**Course Code**	**Course Name**	**L-T-P**	**Credits**	**S.No.**	**Course Code**	**Course Name**	**L-T-P**	**Credits**
1	11EC311	Microprocessors & Microcontrollers	3-0-2	4	1	13PS401	Practice School	0-0-24	12
2	13EE402	Power System Operation & Control	3-0-2	4			OR		
3	11EE305	Power System Protection	3-0-2	4	2	13PW401	Final Year Project	0-0-24	12
4		Professional Elective-3	3-0-0	3			Open Elective -2	3-0-0	3
5		Professional Elective-4	3-0-0	3			Open Elective -3	3-0-0	3
6		Professional Elective-5	3-0-0	3					
7		Audit Course -5							
				21					18
									172

Department of Mechanical Engineering

B.Tech Mechanical Engineering Curriculum (2014 -15 Batch)

I Semester				
S.NO	**Course Code**	**Course Title**	**L - T - P**	**Credits**
1	13 BS 102	Differential Equations	3-1-0	4
2	13 HS 101	English	2-0-2	3
3	13 BS 103	Engineering Physics	3-0-2	4
4	13 BS 104	Engineering Chemistry	3-0-2	4
5	13 ES 106	Engineering Mechanics	3-0-2	4
6	13 BS 105	Ecology & Environment	2-0-0	2
7	13-ES105	Workshop Practice	0-0-4	2
	Total			23

II Semester				
S.NO	**Course Code**	**Course Title**	**L - T - P**	**Credits**
1	13 HS 102	Language & Reasoning Skills	2-0-2	3
2	13 ES 103	Engineering Materials	3-0-0	3
3	13 ES 101	Problem solving through programming	3-0-2	4
4	13 BS 101	Linear Algebra & Multi Variable calculus	3-0-2	4
5	13 ES 102	Measurements	3-0-2	4
6	13 HS 104	Human Values	2-0-0	2
7	11 ES 104	Engineering Graphics through CAD	0-0-4	2
	Total			22

III Semester				
S.NO	**Course Code**	**Course Title**	**L - T - P**	**Credits**
1	13 ME 201	Fluid Mechanics & Hydraulic Machines	3-0-2	4
2	13 ME 204	Manufacturing Processes	3-0-2	4
3	13 ME 205	Strength of Materials	3-0-2	4
4	13 ES 201	Thermodynamics	3-0-0	3
5	13 ES 203	Network Theory	3-1-0	4
6	13 BS 201	Mathematical Methods	3-0-0	3
7	13 AC 302	Quantitative Aptitude and Reasoning (Audit Course)	0-0-2	0
8	13 AC 203	Sports (Audit Course)		0
	Total			22

IVSemester				
S.NO	**Course Code**	**Course Title**	**L - T - P**	**Credits**
1	13 ME 202	Applied Thermodynamics	3-0-2	4
2	13 ME 206	Mechanisms & Machine Theory	3-0-2	4
3	13 ES 202	Object Oriented Programming	3-0-2	4
4	13 ES 204	Data Structures	3-0-2	4
5	13 ES 205	Signal Processing	3-0-2	4
6	13 BS 202	Complex Variables & Discrete Mathematics	3-0-0	3
7	13 AC 201	Energy & Society (Audit Course)	2-0-0	0
8		Machine Drawing (Audit Course)	2-0-0	0
	Total			23

V Semester				
S.NO	**Course Code**	**Course Title**	**L - T - P**	**Credits**
1	13 ME 301	I C Engines & Gas Turbines	3-0-2	4
2	13 ME 302	Machine Tool Engineering	3-0-2	4
3	13 ME 305	Finite Element Methods	3-0-2	4
4	13 ME 203	Metallurgy	3-0-2	4
5	13 ME 303	Operations Research	3-0-2	4
6		Open Elective - 1	3-0-0	3
7	13 AC 202	Employability Skills(Audit Course)	1-0-1	0
	Total			23

VI Semester				
S.NO	**Course Code**	**Course Title**	**L - T - P**	**Credits**
1	13 ME 306	Mechanical Engineering Design	3-0-2	4
2	13 ME 304	Metrology & Instrumentation	3-0-2	4
3	13 ME 401	Heat Transfer	3-0-2	4
4		Professional Elective - 1	3-0-0	3
5		Professional Elective - 2	3-0-0	3
6	13 AC 301	Advanced Employability Skills(Audit Course)	1-0-1	0
7	13 NC 201	Certificate Course - 1	0-0-2	0
8	13 TP 401	Term Paper	0-0-4	2
9	13 AC 204	NCC/CEA (Audit Course)	0-0-2	0
	Total			20

VII Semester				
S.NO	**Course Code**	**Course Title**	**L - T - P**	**Credits**
1	13 ME 402	Machine Design	3-0-2	4
2	13 ME 403	Industrial Engineering Techniques	3-0-2	4
3		Professional Elective - 3	3-0-0	3
4		Professional Elective - 4	3-0-0	3
5		Professional Elective - 5	3-0-0	3
6		Management Elective	3-0-0	3
7	13 NC 202	Certificate Course - 2	0-0-2	0
	Total			20

VIII Semester				
S.NO	**Course Code**	**Course Title**	**L - T - P**	**Credits**
1	13 PS 401 13 PW 401	Practice School or Final Year Project	0-0-24	12
2		Open Elective - 2	3-0-0	3
3		Open Elective - 3	3-0-0	3
	Total			18

171