ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

ELECTRONICS AND COMMUNICATION ENGINEERING

B.Tech Four Year Degree Course

(Applicable for the batches admitted from 2017-18)

GUDLAVALLERU ENGINEERING COLLEGE

(An Autonomous Institute with Permanent Affiliation to JNTUK, Kakinada)

Seshadri Rao Knowledge Village

GUDLAVALLERU - 521 356, Krishna District, Andhra Pradesh

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VISION & MISSION OF THE COLLEGE

Vision

To be a leading institution of engineering education and research, preparing students for leadership in their fields in a caring and challenging learning environment.

Mission

* To produce quality engineers by providing state-of-the-art engineering education.
* To attract and retain knowledgeable, creative, motivated and highly skilled individuals whose leadership and contributions uphold the college tenets of education, creativity, research and responsible public service.
* To develop faculty and resources to impart and disseminate knowledge and information to students and also to society that will enhance educational level, which in turn, will contribute to social and economic betterment of society.
* To provide an environment that values and encourages knowledge acquisition and academic freedom, making this a preferred institution for knowledge seekers.
* To provide quality assurance.
* To partner and collaborate with industry, government, and R and D institutes to develop new knowledge and sustainable technologies and serve as an engine for facilitating the nation's economic development.
* To impart personality development skills to students that will help them to succeed and lead.
* To instil in students the attitude, values and vision that will prepare them to lead lives of personal integrity and civic responsibility.
* To promote a campus environment that welcomes and makes students of all races, cultures and civilizations feel at home.
* Putting students face to face with industrial, governmental and societal challenges.

VISION & MISSION OF THE DEPARTMENT

Vision

To be a leading centre of education and research in Electronics and Communication Engineering, making the students adaptable to changing technological and societal needs in a holistic learning environment.

Articulations

* To be a leading centre of education and research hub in Electronics and Communication Engineering with holistic learning environment.
* Students to be adaptable for the changes in technology and societal needs.

* Students to be recognized and valued for their commitment to excellence and enthusiasm for learning.

Mission

* To produce knowledgeable and technologically competent engineers for providing services to the society.
* To have a collaboration with leading academic, industrial and research organizations for promoting research activities among faculty and students.
* To create an integrated learning environment for sustained growth in electronics and communication engineering and related areas.

Articulations

* To craft the graduates knowledge and technologically competent engineers for providing services to the society.
* To have alliance with leading academicians, industries and research organizations and encourage the faculty and students for performing research activities.
* To develop a multidiscipline learning environment for continuous growth in electronics and communication engineering and its associated fields.

III. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of the Electronics and Communication Engineering program will

* demonstrate a progression in technical competence and leadership in the practice/field of engineering with professional ethics.
* Communicate effectively and manage resources skillfully as members and leaders of the profession.
* continue to learn and adapt to evolving technologies for catering to the needs of the society.

IV. PROGRAM OUTCOMES (POs)

The ECE Graduates will be equipped with the ability of

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

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

V. PROGRAM SPECIFIC OUTCOMES (PSOs)

The ECE Graduates will be equipped with the ability of

- designing electronics and communication systems in the domains of VLSI, embedded systems, signal processing and RF communications, and applying modern tools.
- applying the contextual knowledge of Electronics an Communication Engineering to design, develop, analyze, and test systems containing hardware and software components taking into societal, environmental, health, safety, legal, cultural, ethical and economical consideration.

VI. ACADEMIC REGULATIONS

Applicable for the students of B.Tech from the Academic Year 2017-18.

1. UG – B.Tech Programs

The following B.Tech Programs are offered at present

i. Civil Engineering (CE)
ii. Electrical and Electronics Engineering (EEE)
iii. Mechanical Engineering (ME)
iv. Electronics and Communication Engineering (ECE)
v. Computer Science and Engineering (CSE)
vi. Information Technology (IT)

2. Duration of the Program

The duration of the program is four academic years consisting of eight semesters. However, a student is permitted to complete the course work of B.Tech program in the stipulated time frame of **EIGHT** years from the date of joining. Students admitted into third semester of B.Tech program directly, through Lateral Entry (LE), shall have to complete the course work of B.Tech program in the stipulated time frame of **SIX** years from the date of joining.

3. Minimum Instruction Days

Each semester consists of a minimum of ninety instruction days.

4. Program Credits

i) Each discipline of the B.Tech program is designed to have a total of **160** credits and the student shall have to complete the four year course work and earn all the **160** credits for the award of B.Tech Degree.

ii) Students joining the B.Tech program into the II year 1st semester directly through Lateral Entry (LE) Scheme shall have to complete the three year course work and earn **120** credits for the award of B.Tech degree.

iii) Students may register for optional elective courses beyond 160 (120 for Lateral Entry) credits for a maximum of 20 credits from II year 2nd semester to IV year 1st semester, five credits in each semester, subject to the condition that there shall not be any backlogs up to previous semester with CGPA not less than 7.5. Optional elective courses shall be treated on par with self study courses, but performance in optional elective courses shall not be included in calculating the SGPA.

iv) Student shall register for a course only once in any semester in the entire program. He shall not register that course as open elective or optional elective or professional elective further.

v) Students with no backlogs up to III year 1st semester with CGPA not less than 7.5 may register for two professional elective courses offered in IV year 2nd semester in advance i.e. one in III year 2nd semester and another one in IV year 1st semester so as to have exclusive project work during the IV year 2nd semester.

5. Attendance Regulations

5.1 A student shall be eligible to appear for End Semester Examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects.

5.2 Condoning of shortage of attendance in aggregate upto 10% (65% and above and below 75%) in each semester will be considered for genuine reasons such as medical grounds and participation in co-curricular and extra-curricular activities and shall be granted only after approval by a committee duly appointed by the college. The student should submit application for medical leave along with medical certificate from a registered medical practitioner within three days from reporting to the class work after the expiry of the Medical Leave. In case of participation in co-curricular and extra-curricular activities, either in the college or other colleges, students must take prior written permission from HoD concerned and should also submit the certificate of participation from the organizer of the event within three days after the completion of the event. Only such cases will be considered for condoning attendance shortage.

5.3 A student shall be eligible to claim for condonation of attendance shortage for a maximum of two times during the four year (eight semesters) course work of B.Tech / three year (six semesters) course work of B.Tech, Lateral Entry. However, additional one time condonation exclusively during IV Year shall be considered on genuine valid reasons.

5.4 A student will not be promoted to the next semester unless he satisfies the attendance requirement of the current semester. He may seek re-admission for that semester when offered next.

5.5 Shortage of Attendance below 65% in aggregate shall in *NO* case be condoned.

5.6 Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class and their registration shall stand cancelled.

5.7 A fee stipulated by the college shall be payable towards condonation of attendance shortage.

5.8 A student is required to put up a minimum of 75% of attendance in the mandatory non-credit courses such as Sports & Games /Cultural and Fine Arts/ Yoga /Self Defence /NSS despite satisfactory performance / participation in the activities organized under each event for getting the satisfactory grade.

6. Examinations and Scheme of Evaluation

6.1 Theory / Elective / Self Study Courses (2 or 3 or 4 credits):

Each theory course shall be evaluated for a total of 100 marks, consisting of 40 marks for internal assessment and 60 marks for semester end examination.

Internal Assessment:

i) Of 40 marks for internal assessment, 10 marks are for continuous assessment in the form of two quiz or subjective tests and 30 marks are based on two mid-term examinations. The first mid-term examination shall be from the first three units of syllabus and second mid-term from the last three units of syllabus, conducted during the semester.

ii) Two quiz or subjective tests, one before first mid-term examination from I & II units of syllabus and another before second mid-term examination from IV & V units of syllabus, each for 10 marks, with 45 minutes duration, are conducted in a semester and the average marks of the two tests are taken as the marks for the continuous evaluation process.

iii) Each mid-term examination is conducted for 40 marks with two hours duration. Each mid-term examination consists of five questions, each for 10 marks and four questions need to be answered. First question shall have 5 short questions from all the three units, each of two marks or 10 objective questions each of one mark and is compulsory, three questions are of descriptive type, one from each unit of syllabus and the fifth question is from all the three units of syllabus.

iv) Sum of the 75% marks of better scored mid-term examination and 25% marks of less scored mid-term examination are scaled down for 30 marks.

v) For the subjects such as Engineering Graphics, Engineering Drawing, Machine Drawing, Design & Drawing of R.C., Structures, Steel Structures, Irrigation Structures, Estimation Cost and Valuation, Building Planning and Drawing etc., the distribution of 40 marks for internal evaluation shall be 20 marks for day-to-day work, and 20 marks based on two mid-term examinations. Each mid-term examination is conducted for 40 marks with two hours duration. Sum of the 75% marks of better scored mid-term examination and 25% marks of less scored mid-term examination are scaled down for 20 marks.

vi) For subjects like Functional English and Professional Communication, the pattern of mid-term examination is given along with the syllabus of respective subject.

vii) For the integrated course with theory and laboratory, the distribution of 40 marks for internal evaluation shall be 20 marks for theory based on two mid-term examinations and 20 marks for laboratory. Each mid-term examination is conducted for 40 marks with two hours duration. Each mid-term examination consists of five questions, each for 10 marks and four questions need to be answered. First question shall have 5 short questions from all the three units, each of two marks or 10 objective questions each of one mark and is compulsory, three questions are of descriptive type, one from each unit of syllabus and the fifth question is from all the three units of syllabus. Sum of the 75% marks of better scored mid-term examination and 25% marks of less scored mid-term examination are scaled down for 20 marks. Of 20 marks for laboratory, 10 marks for day-to-day performance and 10 marks for semester end internal examination.

viii) For the project based theory course, the distribution of 40 marks for internal evaluation shall be 20 marks for theory, based on two mid- term examinations and 20 marks for project. Each mid-term examination is conducted for 40 marks with two hours duration. Each mid-term examination consists of five questions, each for 10 marks and four questions need to be answered. First question shall have 5 short questions from all the three units, each of two marks or 10 objective questions each of one mark and is compulsory, three questions are of descriptive type, one from each unit of syllabus and the fifth question is from all the three units of syllabus. Sum of the 75% marks of better scored mid-term examination and 25% marks of less scored mid-term examination are scaled down for 20 marks.

External Assessment:

i) Semester End Examination will have six questions with internal choice, one question from each unit. All questions carry equal marks of 10 each.

ii) For the integrated theory and laboratory course, the pattern of examination is same as above. There will not be any external assessment for laboratory component.

iii) For the project based theory course, semester end examination will have three questions, each for 20 marks, with internal choice. All the questions need to be answered. There will be no external assessment for project component.

iv) For subjects like Functional English, Professional Communication, Building Planning & Drawing, etc, the pattern of semester end examination is given along with the syllabus of respective subject.

6.2 Laboratory Courses (1 or 2 credits) :

i) For practical courses the distribution shall be 40 marks for Internal Evaluation and 60 marks for the semester end examinations. There shall be continuous evaluation by the internal subject teacher during the semester for 40 internal marks of which 25 marks shall be for day-to-day performance (15 marks for day-to-day evaluation and 10 marks for Record) and 15 marks shall be evaluated by conducting an internal laboratory test towards the end of semester.

ii) Semester end examination shall be conducted by the teacher concerned and external examiner for 60 marks.

6.3 Mandatory Non-Credit Courses:

A student is required to take up two Non-Credit courses, viz. Sports & Games / Cultural and Fine Arts/Yoga,/Self Defence/NSS, one in II year 1st semester and the other in II year 2nd semester. Marks are awarded based on the day-to-day participation and performance in the activities organized under each event. A student is required to score 40 marks out of 100 marks despite putting up a minimum of 75% attendance to be declared satisfactory in each mandatory non-credit course. The B.Tech degree shall only be awarded if a student gets satisfactory grade in each of the two mandatory non-credit courses and besides acquiring 160 (120 for Lateral Entry) credits of the B.Tech degree course.

A student whose shortage of attendance is condoned in the case of credit courses in that semester shall also be eligible for condoning shortage of attendance up to 10% in the case of mandatory non-credit courses also.

A student has to repeat the course if he does not get satisfactory grade in each non-credit course for getting the degree awarded.

6.4 Internship / Industrial Training / Practical Training:

Industrial / Practical training shall be evaluated for a total of 100 marks. Of 100 marks, 40 marks shall be awarded by an internal committee consisting of two faculty members based on the presentation given and work carried out by a student and the remaining 60 marks are for final Viva–Voce examination conducted by the committee consisting of an External Examiner and the Head of the Department at the end of IV B.Tech 1st semester.

6.5 Mini Project / Field Work :

Mini Project / field work shall be evaluated for a total of 100 marks.

i) Of 100 marks, 40 marks shall be awarded by the project supervisor based on student's involvement in carrying out the project and the remaining 60 marks are based on presentation and viva-voce before a committee consisting of supervisor and a senior faculty of the department.

ii) There will be no external assessment for mini project / field work.

6.6 Project work:

i) The final project work shall be carried out during the IV year 2nd semester and will be evaluated for 100 marks.

ii) Of 100 marks, 40 marks shall be for Internal Evaluation and 60 marks for the project evaluation and semester end viva-voce examination.

iii) Each student needs to give two seminars on the topic of his project, and each seminar is evaluated for 20 marks by a committee consisting of the supervisor and a senior faculty of the department. The sum of the mark of two seminars is taken as internal marks for 40.

iv) The project evaluation and semester end Viva–Voce shall be conducted by the committee consisting of an External Examiner, Head of the Department and the supervisor of the project. The evaluation of project work shall be conducted at the end of the fourth year second semester.

7. Criteria for Passing a Course and Award of Grades:

7.1 Criteria for Passing a Course:

i) A candidate shall be declared to have passed in individual theory / integrated theory and laboratory / Project based theory / drawing course if he secures a minimum of 40% aggregate marks (internal & semester end examination marks put together), subject to securing a minimum of 35% marks in the semester end examination.

ii) A candidate shall be declared to have passed in individual laboratory/ project / mini project / field work / industrial intership / practical training course if he secures a minimum of 50% aggregate marks (internal & semester end examination marks put together), subject to securing a minimum of 40% marks in the semester end examination.

iii) On passing a course of a program, the student shall earn the credits assigned to that course.

7.2 Method of Awarding Letter Grade and Grade Points for a Course:

A letter grade and grade points will be awarded to a student in each course based on his performance, as per the grading system given below.

Theory / Drawing / Elective / Self Study Course (%)	Laboratory / Industrial / Practical Training / Mini Project / Project Work (%)	Grade Points	Letter Grade
≥ 90	≥ 90	10	O (Outstanding
≥ 80 & < 90	≥ 80 & < 90	9	A+ (Excellent)
≥ 70 & < 80	≥ 70 & < 80	8	A (Very Good)
≥ 60 & < 70	≥ 60 & < 70	7	B+ (Good)
≥ 50 & < 60	≥ 50 & < 60	6	B (Above Average)
≥ 45 & < 50	–	5	C (Average)
≥ 40 & < 45	–	4	P (Pass)
< 40	< 50	0	F (Fail)

7.3 Calculation of Semester Grade Point Average (SGPA)* for semester:

The performance of each student at the end of the each semester is indicated in terms of SGPA. The SGPA is calculated as given below:

SGPA = $\frac{\sum (CR\ X\ GP)}{\sum CR}$ for each semester.

where CR = Credits of a course
GP = Grade Points awarded for a course

* SGPA is calculated for a candidate who passed all the courses in that semester.

* Performance in optional elective courses shall not be included in calculating the SGPA.

7.4 Eligibility for Award of B.Tech Degree:

A student will be declared eligible for the award of the B.Tech. Degree if he fulfills the following academic regulations.

i) 4 Year B.Tech Course:

(a) Pursued a course of study for not less than four academic years and not more than eight academic years.

(b) Registered for prescribed **160** credits and secured **160** credits.

(c) Students, who fail to complete their Four years Course of study within Eight years or fail to acquire the **160** Credits for the award of the degree within eight academic years from the year of their admission shall forfeit their seat in B.Tech course and their admission shall stand cancelled.

ii) 3 Year B.Tech Course under Lateral Entry:

(a) Pursued a course of study for not less than three academic years and not more than six academic years.

(b) Registered for prescribed **120** credits and secured **120** credits.

(c) Students, who fail to complete their Three years Course of study within Six years or fail to acquire the **120** Credits for the award of the degree within six academic years from the year of their admission shall forfeit their seat in B.Tech course and their admission shall stand cancelled.

7.5 Calculation of Cumulative Grade Point Average (CGPA) for Entire Program:

The CGPA is calculated as given below:

CGPA = $\frac{\sum (CR\,X\,GP)}{\sum CR}$ for entire program.

where CR = Credits of a course

GP = Grade points awarded for a course

7.6 Award of Division:

After satisfying the requirements prescribed for the completion of the program, the student shall be eligible for the award of B.Tech Degree and shall be placed in one of the following grades:

CGPA	Class
≥ 7.5	First Class with Distinction
≥ 6.5 & < 7.5	First Class
≥ 5.5 & < 6.5	Second Class
< 5.5	Pass Class

7.7 Consolidated Grade Card

A consolidated grade card containing credits & grades obtained by the candidate will be issued after completion of the four year B.Tech program.

8. Supplementary Examinations

i) Supplementary examinations will be conducted twice in a year at the end of odd and even semesters.

ii) Semester end supplementary examinations shall be conducted till next regulation comes into force for that semester, after the conduct of the last set of regular examinations under the present regulation.

iii) Thereafter, supplementary examinations will be conducted in the equivalent courses as decided by the Board of Studies concerned.

iv) There is no makeup examination in case of supplementary examinations.

9. Conditions for Promotion

i) A student shall be eligible for promotion to next Semester of B.Tech program, if he satisfies the conditions as stipulated in Regulation 5.

ii) The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in Regulation 5 for promotion into III Year I semester and IV year I semester.

a) 4 Year B.Tech Program:

i) A student shall be promoted from II year to III year only if he acquires the academic requirement of a minimum of 50% credits up to second year second semester as shown below.

1. Two regular and two supplementary examinations of I year I semester,
2. Two regular and one supplementary examinations of I year II semester,
3. One regular and one supplementary examinations of II year I semester
4. One regular examination of II year II semester,

irrespective of whether the candidate takes the examination or not.

ii) A student shall be promoted from III year to IV year only if he acquires the academic requirement of a minimum of 50% of credits upto third year second semester as shown below.

1. Three Regular and three supplementary examinations of I year I sem.,
2. Three Regular and two supplementary examinations of I year II sem.,
3. Two Regular and two supplementary examinations of II year I semester,
4. Two Regular and one supplementary examinations of II Year II semester,
5. One Regular and one supplementary examinations of III Year I semester,
6. One regular examination of III Year II semester,

irrespective of whether the candidate takes the examination or not.

b) 3 Year B.Tech Program under Lateral Entry Scheme:

i) A student shall be promoted from III to IV year only if he acquires the academic requirement of a minimum of 50% credits up to third year second semester as shown below.

1. Two regular and two supplementary examinations of II year I semester,
2. Two Regular and one supplementary examinations of II year II semester,
3. One regular and one supplementary examinations of III year I semester
4. One regular examination of III year II semester,

irrespective of whether the candidate takes the examination or not.

10. Revaluation

i) Students can submit the applications for revaluation, along with the prescribed fee receipt for revaluation of his answer script(s) of theory course(s) as per the notification issued by the Controller of Examinations.

ii) The Controller of Examinations shall arrange for revaluation of such answer script(s).

iii) An examiner, other than the first examiner, shall revaluate the answer script(s).

iv) If the variation in marks of two evaluations is less than 15% of total marks, the best mark of two evaluations shall be taken into consideration.

v) If the variation in marks of two evaluations is more than 15% of total marks, there shall be third evaluation by an examiner other than the first two examiners. The best marks of two evaluations (which are nearer) shall be taken into consideration.

11. Re-admission Criteria

i) A candidate, who is detained in a semester due to lack of attendance has to obtain written permission from the Principal for readmission into the same semester after duly fulfilling the required norms stipulated by the college and by paying the required tuition fee and special fee in addition to paying an administrative fee of Rs.1,000/-.

ii) A candidate, who is not promoted either to III year or IV year due to lack of required credits can seek admission into III / IV year in subsequent years after obtaining the required credits as stipulated in regulation 10 by paying the required tuition fee and special fee in addition to paying an administrative fee of Rs. 1,000/-.

12. Break in Study

Student, who discontinues the studies for what-so-ever reason, can get readmission into appropriate semester of B.Tech program only with the prior permission of the Principal of the College, provided such candidate shall follow the transitory regulations applicable to the batch he joins. An administrative fee of Rs.2,000/- per each year of break in study in addition to the prescribed tuition and special fees should be paid by the candidate to condone his break in study.

13. Transitory Regulations

A candidate, who is detained or discontinued in a semester, on readmission shall be required to do all the courses in the curriculum prescribed for the batch of students in which the student joins subsequently. However, exemption will be given to those candidates who have already passed such courses in the earlier semester(s) he was originally admitted into and substitute subjects are offered in place of them as decided by the Board of Studies. However, the decision of the Board of Studies will be final.

Transfer candidates (from an autonomous college affiliated to JNTUK)
A student who has secured the required credits upto previous semesters as per the regulations of other autonomous institutions shall only be permitted to be transferred to this college. A student who is transferred from the other autonomous colleges to this college in second year first semester or subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the courses in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the courses of the semester(s) of the batch which he had passed earlier and substitute subjects are offered in their place as decided by the Board of Studies. The total number of credits to be secured for the award of the degree will be the sum of the credits up to previous semester as per the regulations of the college from which he is transferred and the credits prescribed for the semester in which a candidate joined after transfer and subsequent semesters under the autonomous stream. The class will be awarded based on the academic performance of a student in the autonomous pattern.

14. Withholding of Results

If the student has not paid the dues, if any, to the College or if any case of indiscipline is pending against him, the result of the student will be withheld. His degree will also be withheld in such cases.

15. Malpractices

i) The Principal shall refer the cases of malpractices in internal assessment tests and semester end examinations to a malpractice enquiry committee constituted by him for the purpose. Such committee shall follow the approved levels of punishment. The Principal shall take necessary action against the erring students based on the recommendations of the committee.

ii) Any action by the candidate trying to get undue advantage in the performance or trying to help another, or derive the same through unfair means is punishable according to the provisions contained hereunder.

DISCIPLINARY ACTION FOR MALPRACTICES/IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices / Improper conduct	Punishment
If the candidate		
1.a	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination.)	Expulsion from the examination hall and cancellation of the performance in that subject only.
b	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through Cell phones with any candidates or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The hall ticket of the candidate shall be cancelled.

3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for the examinations of the remaining subjects of that semester. The candidate is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the impostor is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or takes out or arranges to send out the question paper during the examination or answer book during or after the examination.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidate is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of performance in that subject.

6.	Refuses to obey the orders of the Chief Superintendent/Assistant Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in or around the examination hall or organises a walkout or instigates others to walkout or threatens the officer-in-charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the Officer-in-charge or any person on duty in or outside the examination hall of any of his relations or indulges in any other act of misconduct or mischief which results in damage to or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the Officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidate is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidate is also debarred and forfeits the seat.

9	If student of the college who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the college will be handed over to the police and a police case is registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be referred to the Chief Superintendent of Examinations for future action towards suitable punishment.	

iii) The involvement of the staff, who are in charge of conducting examinations, valuing examination papers and preparing / keeping records of documents related to the examinations in such acts (inclusive of providing incorrect or misleading information) that infringe upon the course of natural justice to one and all concerned at the examination shall be viewed seriously and appropriate disciplinary action will be taken after thorough enquiry.

16. Other Matters

i) Physically challenged candidates who have availed additional examination time and a scribe during their Intermediate/EAMCET examinations will be given similar concessions on production of relevant proof/documents. Students who are suffering from contagious diseases are not allowed to appear either for internal or semester end examinations.

ii) The students who participated in coaching / tournaments held at State / National / International levels through University / Indian Olympic Association during semester end external examination period will be promoted to subsequent semesters as per the guidelines of University Grants Commission Letter No. F.1-5/88 (SPE/PES), dated 18-08-1994.

iii) The Principal shall deal in an appropriate manner with any academic problem which is not covered under these rules and regulations, in consultation with the Heads of the Departments and subsequently such actions shall be placed before the Academic Council for ratification. Any emergency modification of regulation, approved in the meetings of the Heads of the Departments shall be reported to the Academic Council for ratification.

17. General

i) The Academic Council may, from time to time, revise, amend or change the regulations, schemes of examination and /or syllabi.

ii) The academic regulations should be read as a whole for the purpose of any interpretation.

iii) In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Chairman of the Academic Council is final.

iv) Wherever the word he, him or his occurs, it will also include she, her and hers.

VII. CURRICULAR COMPONENTS

Sl. No.	Course Work - Subject Areas	Total No.of Credits	% of Total Credits	% of Credits as per UGC
1	Baisc Sciences (BS)	21	13.13	15 - 20
2	Humanities and Social Sciences (HSS)	14	8.75	10 - 15
3	Engineering Sciences (ES)	24	15.00	10 - 20
4	Professional Core (PC)	57	35.62	25 - 35
5	Professional Electives (PE)	18	11.25	8 - 12
6	Open Electives (OE)	12	7.50	5 - 10
7	Others (Project, Survey Camp, Internship, etc.)	14	8.75	8 - 10
8	Mandatory Non-Credit Courses	-	-	-

COURSE STRUCTURE

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SYLLABUS

VIII. COURSE STRUCTURE

I Year - I Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	EG2501	Functional English	4	-	-	3
2	MA2501	Linear Algebra & Differential Equations	4	1	-	4
3	EN2502	Engineer & Society	3	-	-	2
4	PH2504	Solid State Physics	4	-	-	3
5	CT2502	Problem Solving through Computer Programming	4	-	-	3
6	EG2502	Functional English Lab	-	-	2	1
7	PH2505	Solid State Physics Lab	-	-	2	1
8	CT2503	Computer Programming Lab	-	-	4	2
		Total	**19**	**1**	**8**	**19**

I Year - II Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	EG2503	Professional Communication	3	-	-	2
2	MA2504	Integral Transforms and Vector Calculus	4	1	-	4
3	CH2503	Applied Chemistry	3	-	-	2
4	EN2501	Environmental Studies	3	-	-	2
5	EE2504	Linear Electrical Networks	3	-	-	2
6	MA2505	Numerical Methods & Complex Analys	3	1	-	3
7	ME2501	Engineering Drawing	1	-	4	3
8	EG2504	Professional Communication Lab	-	-	4	2
9	CH2504	Applied Chemistry Lab	-	-	2	1
		Total	**20**	**2**	**10**	**21**

L : Lecture **T : Tutorial** **P : Practical**

II Year - I Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	EC2524	Probability Theory and Stochastic Process	3	1	-	3
2	EC2525	Electronic Devices	4	-	-	3
3	EC2508	Signals and Systems	3	1	-	3
4	BA2501	Engineering Economics and Project Management	3	-	-	2
5	EC2526	Electromagnetic Field Theory	4	-	-	3
6	EE2505	Elements of Electrical Engineering	3	-	-	2
7	EC2527	Electronic Devices Lab	-	-	4	2
8	EE2507	Networks and Electrical Technology Lab	-	-	2	1
		Total	**20**	**2**	**6**	**19**
9	NS2501	NSS / Fine Arts / Yoga / Self Defense (Mandatory Non-Credit Course)	-	-	2	-

II Year - II Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	EC2528	Transmission Lines and Waveguides	4	-	-	3
2	EC2529	Analog Circuits	4	-	-	3
3	EC2530	Analog Communications	3	-	-	2
4	EC2505	Digital Circuit Design	3	1	-	3
5	CS2501	Fundamentals of Data Structures	3	-	-	2
6		**Open Elective-I** (see list of Open Electives)	4	-	-	3
7	EC2533	Analog Circuits Lab	-	-	4	2
8	EC2506	Digital Circuit Design Lab	-	-	4	2
		Total	**21**	**1**	**8**	**20**
9	SG2501	Sports and Games / Cultural (Mandatory Non-Credit Course)	-	-	2	-
10	CS2502 CT2513 EC2534	**Optional Elective - I** i) Introduction to Python Programming ii) Database Managemnent Systems iii) Electronic Switching Systems	-	-	-	3
11	EC2535	**Optional Elective - II (MOOCs)** Student shall opt from teh list of MOOCs given by the Department)	-	-	-	2

L : Lecture **T : Tutorial** **P : Practical**

III Year - I Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week L	T	P	No.of Credits
1	EC2536	Linear Integrated Circuits Applications	3	1	-	3
2	EC2537	Digital Communications	3	-	-	2
3	EC2538	Antennas and Wave Propagation	4	-	-	3
4	EC2539	Principles of VLSI Design	3	-	-	2
5		**Professional Elective - I**	4	-	-	3
6		**Open Elective-II** (see list of Open Electives)	4	-	-	3
7	EC2545	Linear Integrated Circuits Applications Lab	-	-	4	2
8	EC2546	Analog and Digital Communications Lab	-	-	4	2
		Total	**21**	**1**	**8**	**20**
9	 CT2528 ME2549 EC2544	**Optional Elective - III** i) Data Warehousing and Data Mining ii) Mechatronics iii) Introduction to MEMS	-	-	-	3
10	EC2547	**Optional Elective - IV (MOOCs)** Students shall opt from the list of MOOCs given by the Department)	-	-	-	2

III Year - II Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week L	T	P	No.of Credits
1	EC2511	Digital Signal Processing	4	-	-	3
2	EE2512	Control Systems	3	1	-	3
3	EC2510	Microprocessors, Microcontrollers and Applications**	3	-	1	3
4	EC2548	Microwave and Optical Communications	3	-	-	2
5		**Professional Elective - II**	4	-	-	3
6		**Open Elective-III**(see list of Open Electives)	4	-	-	3
7	EC2515	Microprocessor and Microcontroller Interfacing Lab	-	-	4	2
8	EC2552	Digital Signal Processing Lab	-	-	4	2
9	EC2553	VLSI Lab	-	-	4	2
		Total	**21**	**1**	**13**	**23**
10	 CT2534 EC2554 CT2533	**Optional Elective - V** i) Big Data Analytics ii) Cognitive Radio Networks iii) Cryptography and Network Security	-	-	-	3
10	EC2555	**Optional Elective - VI (MOOCs)** Students shall opt from the list of MOOCs given by the Department)	-	-	-	2

** **Project Based Theory Course**

L : Lecture **T : Tutorial** **P : Practical**

IV Year - I Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week L	T	P	No.of Credits
1	EC2517	CMOS Digital IC Design	4	-	-	3
2	EC2512	Embedded System Design	3	-	-	2
3	EC2556	Electronic Measurements and Instrumentation	3	-	-	2
4		**Professional Elective - III**	4	-	-	3
5		**Professional Elective - IV**	4	-	-	3
6		**Open Elective-IV**(see list of Open Electives)	4	-	-	3
7	EC2564	Microwave and Optical Communications Lab	-	-	4	2
8	EC2565	Mini Project on Smart Applications	-	-	4	2
9	EC2566	Internship / Industrial Training / Practical Training	-	-	-	2
		Total	**22**	**-**	**8**	**22**
9		**Optional Elective - VII**	-	-	-	3
	EE2554	i) Digital Control Systems				
	CT2521	ii) Artificial Intelligence				
	EC2567	iii) Transform Techniques				
10	EC2568	**Optional Elective - VIII (MOOCs)**	-	-	-	2
		Students shall opt from the list of MOOCs given by the Department)				

IV Year - II Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week L	T	P	No.of Credits
1		**Professional Elective - V**	4	-	-	3
2		**Professional Elective - VI**	4	-	-	3
3	EC2577	**Project**	-	-	20	10
		Total	**8**	**-**	**20**	**16**

L : Lecture **T : Tutorial** **P : Practical**

Open Elective - I

Sl. No.		Title of the Subject	Department Offering the Subject	No.of Periods per week L	T	P	No.of Credits
1	CE2515	Elements of Civil Engineering (Other than CE)	CE	4	-	-	3
2	CE2516	Building Services	CE	4	-	-	3
3	EE2515	Electrical Materials	EEE	4	-	-	3
4	EE2516	Control Systems Engineering (Other than EEE & ECE)	EEE	4	-	-	3
5	ME2520	Elements of Manufacturing Processes (Other than ME)	ME	4	-	-	3
6	ME2521	Automotive Engineering (Other than ME)	ME	4	-	-	3
7	EC2531	Introduction to MPMC (Other than ECE/EEE/CSE/IT)	ECE	4	-	-	3
8	EC2532	Fundamentals of Communications (Other than ECE)	ECE	4	-	-	3
9	CT2514	Computer Graphics (Other than IT)	CSE	4	-	-	3
10	CT2507	Object Oriented Programming through Java (other than CSE & IT)	CSE	4	-	-	3
11	CT2515	Systems Software	IT	4	-	-	3
12	IT2502	Web Programming(Other than CSE & IT)	IT	4	-	-	3
13	MA2516	Mathematical Cryptography(Other than CSE)	BS&H	4	-	-	3
14	PH2508	Semiconductor Physics (Other than ECE)	BS&H	4	-	-	3

Open Elective - II

Sl. No.		Title of the Subject	Department Offering the Subject	No.of Periods per week L	T	P	No.of Credits
1	CE2530	Geoinformatics (other than CE)	CE	4	-	-	3
2	CE2531	Environmental Sanitation	CE	4	-	-	3
3	EE2523	Modeling & Simulation of Engineering Systems	EEE	4	-	-	3
4	EE2524	Power Systems Engineering (Other than EEE)	EEE	4	-	-	3
5	ME2532	Elements of Mechanical Transmission (Other than ME)	ME	4	-	-	3
6	ME2533	Material Handling Equipment	ME	4	-	-	3
7	EC2543	Automotive Electronics	ECE	4	-	-	3
8	EC2544	Introduction to MEMS (other than ECE)	ECE	4	-	-	3
9	CS2508	Data Science	CSE	4	-	-	3
10	CT2524	Virtual and Augmented Reality (other than IT)	CSE	4	-	-	3
11	IT2505	Open Source Software	IT	4	-	-	3
12	IT2506	Cyber Laws	IT	4	-	-	3
13	MA2517	Quality, Reliability and Operations Research	BS&H	4	-	-	3

L : Lecture **T : Tutorial** **P : Practical**

Open Elective - III

Sl. No.		Title of the Subject	Department Offering the Subject	No.of Periods per week			No.of Credits
				L	T	P	
1	CE2543	Hydrology (Other than CE)	CE	4	-	-	3
2	CE2544	Planning for Sustainable Development	CE	4	-	-	3
3	EE2531	Electrical and Hybrid Vehicles	EEE	4	-	-	3
4	EE2532	Power Plant Instrumentation	EEE	4	-	-	3
5	ME2541	Material Science (Other than ME)	ME	4	-	-	3
6	ME2542	Renewable Energy Sources (Other than ME)	ME	4	-	-	3
7	EC2523	Assistive Technologies (Other than ECE)	ECE	4	-	-	3
8	EC2507	Bio-Medical Engineering (Other than EEE & ECE)	ECE	4	-	-	3
9	CS2512	Node and Angular JS	CSE	4	-	-	3
10	CS2513	Cyber Security	CSE	4	-	-	3
11	CT2529	Scripting Languages (Other than CSE)	IT	4	-	-	3
12	CT2531	Software Project Management (Other than CSE)	IT	4	-	-	3
13	MA2518	Elements of Stochastic Processes	BS&H	4	-	-	3
14	EG2505	Academic Communication	ENGLISH	4	-	-	3

Open Elective - IV

Sl. No.		Title of the Subject	Department Offering the Subject	No.of Periods per week			No.of Credits
				L	T	P	
1	CE2562	Disaster Management (Other than CE)	CE	4	-	-	3
2	CE2563	Repair and Retrofitting Techniques	CE	4	-	-	3
3	EE2542	Modern Optimization Techniques	EEE	4	-	-	3
4	EE2543	Electrical Power Utilization (Other than EEE)	EEE	4	-	-	3
5	ME2553	Green Engineering	ME	4	-	-	3
6	ME2554	Non Destructive Evaluation (Other than ME)	ME	4	-	-	3
7	EC2563	Cyber Physical Systems	ECE	4	-	-	3
8	EC2508	Signals and Systems (Other than EEE & ECE)	ECE	4	-	-	3
9	CS2521	Digital Forensics	CSE	4	-	-	3
10	CS2522	Business Intelligence & Decision Support Systems	CSE	4	-	-	3
11	IT2521	Adhoc and Sensor Networks	IT	4	-	-	3
12	CT2537	Information Retrieval Systems (Other than CSE)	IT	4	-	-	3
13	MA2514	Fuzzy Logic (Other than EEE, ME & CSE)	BS&H	4	-	-	3

L : Lecture **T : Tutorial** **P : Practical**

Professional Electives

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week L	T	P	No.of Credits
		Professional Elective - I	4	-	-	3
	EC2540	i) CAD for VLSI				
	EC2541	ii) Computer Organization				
	EC2542	iii) Computer and Communication Networks				
	EC2507	iv) Biomedical Engineering				
		Professional Elective - II	4	-	-	3
	EC2549	i) Analog IC Design				
	EC2516	ii) Nano Electronics				
	EC2550	iii) Smart Antennas				
	EC2551	iv) Coding Theory				
		Professional Elective - III	4	-	-	3
	EC2557	i) Mixed Signal IC Design				
	EC2558	ii) Cellular and Mobile Communications				
	EC2559	iii) Digital TV Engineering				
	EC2514	iv) DSP Processors and Architectures				
		Professional Elective - IV	4	-	-	3
	EC2560	i) System on Chip Design				
	EC2561	ii) Wireless Sensor Networks				
	EC2562	iii) Satellite Communication				
	EC2518	iv) Digital Image Processing				
		Professional Elective - V	4	-	-	3
	EC2569	i) Low Power VLSI Circuits				
	EC2570	ii) Real Time Operating Systems				
	EC2571	iii) Speech Processing				
	EC2572	iv) Adaptive Signal Processing				
		Professional Elective - VI	4	-	-	3
	EC2573	i) ASIC Design				
	EC2574	ii) Embedded C				
	EC2575	iii) RADAR Engineering				
	EC2576	iv) Multi Rate Signal Processing				

L : Lecture **T : Tutorial** **P : Practical**

IX. SYLLABUS

FUNCTIONAL ENGLISH
(Common to All Branches)
I Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives:

To equip the students for their present and future academic pursuits involving the following:

- listening to (and viewing) classroom lectures and other academic presentations with a reasonable degree of accuracy, understanding, and appreciation, and responding to them appropriately;
- Speaking in academic (e.g. classroom discussions) and social contexts with a fair degree of fluency, accuracy and intelligibility, and with due attention to factors such as purpose, audience, context, and culture;
- reading a wide range of informational and functional texts, including course books and reference materials, from print and non-print sources and using them for a variety of purposes; and
- writing for academic purposes (e.g. assignments, examination answers) in an organized way following the rules of discourse and using vocabulary and grammar appropriately and accurately; and
- To develop in them the communication strategies and social graces necessary for functioning effectively in social, academic, and other situations in which they may be called upon to use English.

Learning Outcomes

Upon successful completion of Functional English, the students will be able to

- speak with a reasonable degree of fluency using communication strategies as well as conventions of politeness and courtesy;
- listen to short audio and video clips in both standard Indian accent and native English accent and gain both understanding of messages and sensitivity to native- speaker accents;
- read fluently comprehending texts of different kinds;
- write coherent paragraphs and technical reports; and
- guard against mistakes Indians typically make in their speech and writing in English

Course Content

LEVEL - I: Intermediate (for the first mid-semester)

1. **(a) From the textbook "Innovate with English": Unit II**

Listening	: Conversations using Communicative functions.
Reading Comprehension	: Text: 'Concerning the Unknown Engineer'
Remedial Grammar	: Simple Present, Present Continuous, Use of *have to* structure and Indianism.
Writing	: Paragraph Writing

(b) From the textbook "Innovate with English": Unit III

Listening	: Conversations using Communicative functions (Narrating Events)
Reading Comprehension	: Text: 'Man and his endangered home'
Remedial Grammar	: Simple past tense, Present Perfect, articles.
Writing	: Organization: coherence

2. ***From the textbook "Vocabulary Builder for Students of Engineering and Technology"***

   The following portions only:

GRE Words (Unit 1.1)	One-Word Substitutes (Unit 4.1)
Collocations (Unit 2.1)	Idioms (Unit 5.1)
Commonly Confused Words (Unit 3.1)	Phrasal Verbs (Unit 6.1)

3. ***From Great Stories in Easy English***

   "The Adventures of Huckleberry Finn" by Mark Twain

LEVEL - II: Advanced (for the second mid-semester)

1. **From the textbook "Innovate with English": Unit IV**

Listening	: Interacting with faculty members
Reading Comprehension	: Text: 'Clutter'
Remedial Grammar	: Futurity
Writing	: Clutter-free writing

2. **From Department-produced materials**

   Technical report writing

3. ***From the textbook "Vocabulary Builder for Students of Engineering and Technology"***

   The following portions only:

GRE Words (Unit 1.2)	One-Word Substitutes (Unit 4.2)
Collocations (Unit 2.2)	Idioms (Unit 5.2)
Commonly Confused Words (Unit 3.2)	Phrasal Verbs (Unit 6.2)

4. ***From Great Stories in Easy English***

   "More Tales from Shakespeare" by Charles and Mary Lamb

Text books

a) Samson, T. (2010). *Innovate with English*. Hyderabad: Foundation
   - Units TWO, THREE and FOUR only

b) Vijayalakshmi, M. et al (2014). *Vocabulary Builder for Students of Engineering and Technology*. Hyderabad: Maruthi Publications.

c) The following simplified classics, one for each mid-semester, from the series, *Great Stories in Easy English*, published by S. Chand & Company Limited:
   - *The Adventures of Huckleberry Finn* by Mark Twain
   - *More Tales from Shakespeare*

d) Audio and video clips carefully selected by the Department in order to sensitize the students to native-speaker accents

e) Department-produced material on technical report writing

Testing Pattern

First Mid-Term Examination

The paper consists of four questions. All questions are compulsory; there is no choice.

I. Reading an unseen passage and answering two sets of questions on it:

a) Ten comprehension questions. Critical questions requiring analysis, inference, prediction, evaluation, etc. are to be set. Five of the ten questions will be multiple-choice questions. In case of non-multiple-choice questions, the length of each answer should not exceed 50 words. **Marks: 10 x ½ = 5**

b) Writing a discussion either on an aspect related to the ideas expressed in the passage but not explicitly dealt with in it, or on an idea not fully dealt with, allowing scope for discussion. **Marks: 1 x 5 = 5**

II. Ten contextualized questions of the following from *Vocabulary Builder*: GRE Words: 1.1; Collocations: 2.1; Commonly confused words: 3.1; One-word substitutes: 4.1; Idioms: 5.1; and Phrasal verbs: 6.1 **Marks: 10 x 1 = 10**

III.

a) Correction of grammatical errors: ten sentences with grammatical errors of the following types (dealt with in Units 2 and 3 of *Innovate with English*) will be given: simple present, present continuous, use of *have to* structure and Indianism **Marks: 10 x ½ = 5**

b) Ten objective-type questions based on one retold classic: *The Adventures of Huckleberry Finn*. **Marks: 10 x ½ = 5**

IV.

a) Completing a conversation (in which informational and interactional functions are performed) with appropriate expressions. **Marks: 10 x ½ = 5**

b) Reading two poorly-written paragraphs and performing the following tasks:

i. Identifying the topic sentence of paragraph (a) and the sentences that do not support the topic sentence, and writing in the answer book the topic sentence and the irrelevant sentences. **Marks: 5 x ½ = 2½**

ii. Re-writing paragraph (b), which is poorly organized, into a coherent paragraph choosing appropriate sequence signals or connectives. **Marks: 5 x ½ = 2½**

Second Mid-Term Examination

The paper consists of four questions All questions are compulsory; there is no choice.

I.a) Ten contextualized questions on the following from *Vocabulary Builder*: GRE Words: 1.2; Collocations: 2.2; Commonly confused words: 3.2; One- word substitutes: 4.2; Idioms: 5.2; and Phrasal verbs: 6.2. **Marks: 10 x ½ = 5**

b) Analyzing a service encounter – an interaction, either a direct personal one, or over the telephone (e.g. *making enquires at the reception counter in a hotel, an interaction with a salesman at a mall, asking for information on the telephone)* – and

i. identifying the reasons for the failure or breakdown of communication in the conversation. **Marks: 5 x ½ = 2½**

ii. rewriting the conversation making the communication successful. In the rewritten conversation, the partners in the conversation must sound polite and positive, using the communication strategies listed in the question.**Marks: 5 x ½ = 2½**

II. Reading an unseen passage and answering two sets of questions on it:

a) Ten comprehension questions. Critical questions requiring analysis, inference, prediction, evaluation, etc. are to be set. Five of the ten questions will be multiple-choice questions. In case of non-multiple-choice questions, the length of each answer should not exceed 50 words. **Marks: 10 x ½ = 5**

b) Writing a discussion either on an aspect related to the ideas expressed in the passage but not explicitly dealt with in it, or on an idea not fully dealt with, allowing scope for discussion. **Marks: 1 x 5 = 5**

III.

a) Writing a technical report on the given situation. The report must:

follow the conventions of technical report writing

use language and style appropriate to technical report writing

Marks: 5 x 1 = 5

b) Writing a paragraph of 100 - 150 words on the given topic (e.g. *Should there be a dress code in colleges?*). The paragraph must have:

adequate and relevant ideas on the topic with the ideas properly organized using strategies such as coherence and cohesion;

a topic sentence; and

proper choice of vocabulary and grammatical accuracy.**Marks: 5 x 1 = 5**

IV.

a) Correction of grammatical errors: ten sentences with grammatical errors of the following types (dealt with in Unit 4 of *Innovate with English*) will be given: futurity and Indianism. **Marks: 10 x ½ = 5**

b) Ten objective-type questions based on one retold classic: *More Tales from Shakespeare.* **Marks: 10 x ½ = 5**

Semester End Examination

Answer any five questions. Question one is compulsory.

I. Reading an unseen (unfamiliar) passage, preferably one taken from a newspaper or a magazine, on a topical event or situation and answering three sets of questions on it:

a. Ten comprehension questions:
- Critical questions requiring analysis, inference, prediction, evaluation, etc. are to be set; 'information' questions involving a mere reproduction of the content should be avoided.
- Three of the ten questions should be multiple-choice questions.
- In case of non-multiple-choice questions, the length of each answer should not exceed 50 words. **Marks: 10 x ½ = 5**

b. Finding four one-word substitutes in the passage for the expressions given. **Marks: 4 x ½ = 2**

c. Writing a discussion either on an aspect related to the ideas expressed in the passage but not explicitly dealt with in it, or on an idea not fully dealt with, allowing scope for discussion. **Marks: 1 x 5 = 5**

II. Reading a dialogue (in which informational and interactional functions are performed) and answering two questions on it:

a. Completing the dialogue with appropriate expressions**Marks: 10 x ½ = 5**

b. Extending the scope of the dialogue using at least five of the given communication strategies/functions. **Marks: 1 x 7 = 7**

III. Analysing a service encounter – an interaction, either a direct personal one, or over the telephone, e.g. *making enquiries at the reception counter in a hotel, an interaction with a salesman at a mall, asking for information on the telephone* – and

a. identifying the reasons for the failure or breakdown of communication in the onversation **Marks: 1 x 5 = 5**

b. rewriting the conversation making the communication successful. In the rewritten conversation, the partners in the conversation must sound polite and positive, using the communication strategies listed in the question. **Marks: 1 x 7 = 7**

IV. Reading two badly-written paragraphs and performing the following tasks:

a. Identifying the topic sentence of paragraph (a) and the sentences that do not support the topic sentence, and writing in the answer book the topic sentence and the irrelevant sentences. **Marks: 1 x 6 = 6**

b. Re-writing paragraph (b), which is poorly organized, into a coherent paragraph choosing appropriate sequence signals or connectives **Marks: 1 x 6 = 6**

V.

a. Writing two paragraphs of 150 words each on the given topics (e.g. *Should there be a dress code in colleges?, Women are better administrators than men*). Each paragraph must have:

- adequate and relevant ideas on the topic with the ideas properly organized using strategies such as coherence and cohesion;
- a topic sentence; and
- proper choice of vocabulary and grammatical accuracy. **Marks: 1 x 6 = 6**

b. Writing a technical report on the given situation. The report must:

- follow the conventions of technical report writing
- use language and style appropriate to technical report writing

Marks: 1 x 6 = 6

VI. Contextualized vocabulary questions with two items on each one of the following from *Vocabulary Builder* (listed as 2 under F. TEXTBOOKS above):

- GRE Words (Units 1.1 and 1.2)
- Collocations (Units 2.1 and 2.2)
- Commonly Confused Words (Units 3.1 and 3.2)
- One-Word Substitutes (Units 4.1and 4.2)
- Idioms (Units 5.1 and 5.2)
- Phrasal Verbs (Units 6.1 and 6.2)

For example, in the question on idioms, two sentences/contexts with an idiom in each may be given, and the examinee will have to identify the most appropriate meaning of the idiom from among the four options given.**Marks: 12 x 1 = 12**

VII. Correction of grammatical errors:

- Either a conversation with twelve grammatical errors of the types dealt with in Textbook 1 (listed under F. TEXTBOOKS in Section 2), or isolated sentences with twelve grammatical errors will be given.

- The errors will include at least six typical instances of Indianism widely believed to be inappropriate in standard English.
- If isolated sentences with errors are given, they are not to be given in isolation from their contexts; a conversation with errors of the kind specified above will serve the purpose better.
- The examinees are expected to rewrite the sentences in the answer book, correcting them. **Marks: 12 x 1 = 12**

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LINEAR ALGEBRA & DIFFERENTIAL EQUATIONS
(Common to CE, EEE, ME & ECE)

I Year – I Semester

Lecture	: 4	Tutorial	: 1	Internal Marks	: 40
Credits	: 4			External Marks	: 60

Course Objectives

- To understand the concepts of eigenvalues and eigenvectors.
- To know the procedures to find the solutions of first and second order differential equations.
- To understand different procedures to solve first order linear & non-linear partial differential equations.

Learning Outcomes

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

- use the concepts of eigenvalues and eigenvectors in solving **e**ngineering problems.
- apply 1^{st} & 2^{nd} order differential equations to solve various engineering problems.
- apply the techniques of partial differentiation to find maxima and minima of two/three variables.
- solve first order linear & non-linear partial differential equations.

Course Content

UNIT– I: System of Linear Equations

Rank of a matrix - Echelon form, Normal form, System of equations - consistence and inconsistence, solving non-homogeneous system of equations by LU-Decomposition.

UNIT– II: Eigenvalues and Eigenvectors

Eigenvalues and Eigenvectors, Properties of Eigenvalues and Eigenvectors (without proof), Cayley –Hamilton theorem (without Proof) –finding inverse and power of a matrix.

UNIT– III: First order ordinary Differential Equations

Exact and non-exact differential equations, Applications- Newton's Law of cooling and Orthogonal trajectories.

UNIT– IV: Higher Order Linear ordinary Differential Equations

Solving Homogeneous differential equations, solving Non-Homogeneous differential equations when RHS terms are of the form e^{ax} *sin ax, cos ax, polynomial in x,* e^{ax} *v(x), xv(x)* and Euler-Cauchy equation.

UNIT– V: Partial Differentiation

Total derivative, chain rule, Jacobian, Application- finding maxima and minima (two & three variables).

UNIT– VI: First order P.D.E

Forming PDE by eliminating arbitrary functions. Solutions of linear PDE (by Lagrange's subsidiary equation). Solutions of Non-linear PDE by Charpit's method.

Text Books

1. B.S.Grewal, Higher Engineering Mathematics, 42nd edition, Khanna Publishers, New Delhi, 2012.
2. B. V. Ramana, Higher Engineering Mathematics, Tata-Mc Graw Hill Company Limited.

Reference Books

1. U.M.Swamy, A Text Book of Engineering Mathematics – I & II, 2nd Edition, Excel Books, New Delhi, 2011.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 8th edition, Maitrey Printech Pvt. Ltd, Noida, 2009.

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ENGINEER AND SOCIETY
(Common to CE, EEE & ECE)

I Year – I Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To understand the Ethics and Human Values.
- To equip the students to have a basic awareness on environmental and socio-economic factors.
- To familiarize with the rights and responsibilities of an engineer.
- To elucidate the rules and regulations of patents and trade laws.

Learning Outcomes

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

- comprehend different moral perspectives and one's own Ethical standards.
- understand the concept of safety and risk.
- explain different initiatives to protect nature.
- identify the role of Information Technology.
- understand different types of infringement of Intellectual Property Rights.
- analyze the importance of Entrepreneurship.

Course Content

UNIT–I: Human Values

What is engineering – who is an engineer - Morals, Values and Ethics – Integrity – Work Ethics – Service Learning – Civic Virtue -Value time – Co-operation – Commitment – Empathy–Self-confidence –Character.

UNIT–II: Engineer's Responsibilities and Rights

Safety and risk –Types of risks – Voluntary vs. Involuntary risk –Short Term vs. Long Term Consequences – Expected Probability – Reversible Effects –Threshold Levels for Risk – Delayed vs. Immediate Risk – Collegiality – Techniques for achieving Collegiality- Two senses of Loyalty –Rights – Professional Responsibilities – Confidential and Proprietary information.

UNIT–III: Global climatic issues and mitigation strategies

Greenhouse effect – global warming – acid rain – ozone layer depletion – International efforts-key initiatives of Montreal protocol, Rio declaration, Kyoto protocol, Johannesburg summit.

UNIT–IV: Future challenges to society

Sustainable development – Measures for sustainable development – Water conservation practices – Rain water harvesting methods- Watershed management – Resettlements and Rehabilitation of people- waste land reclamation – Role of information technology- Role of an engineer in mitigating societal problems.

UNIT–V: Patent law, Trade Marks and Copyrights

Introduction, Types of IPR – Patent requirements - Application process

– Ownership – Transfer – Infringement – Litigation.

Trade Mark and Copyrights: Introduction – Registration Process – Transfer – Infringement.

UNIT–VI: Entrepreneurship

Meaning, definition& concept of Entrepreneurship, characteristics &skills of entrepreneur, Role of an entrepreneur in economic development.

Text Books

1. Professional ethics and human values by Ddharanikota Suyodana, Maruti publications(unit 1,2).
2. Environmental studies" by Deeksha Dave, P. Udaya Bhaskar,Cengage Learning.(unit 3,4).
3. "Intellectual Property" by Deborah E.Bouchoux, Cengage Learning, New Delhi.(unit 5).
4. "Entrepreneurship", by Narayana Reddy, Cengage Learning.(unit 6)

Reference Books

1. Professional Ethics and Human Values, by A. Alavudeen, R. KalilRahman and M.Jayakumaran- University Science Press.
2. Environmental Studies by R. Rajagopalan 2nd Edition 2011, Oxford University Press.
3. Intellectual Property Rights, R.Radha Krishnan, S.Balasubramanian Excel Books, New Delhi.
4. Intellectual Property Rights, Prabhuddha Ganguli. Tata McGrawHill, New Delhi.
5. Fundamentals of Entrepreneurship by P H.Nandan, PHI Learning, New Delhi.

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SOLID STATE PHYSICS

I Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

The course is designed to make the students to learn the conditions for propagation of laser light in guided medium understand principles of solid state materials for use in the engineering applications

Learning Outcomes

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

- explain construction and working of laser
- relate the principles of propagation of light in optical fibers for applications in communications.
- identify conductivity mechanism in semiconductors
- determine types of polarization and classius-mossoti relation
- Differentiate classical and quantum free electron theories
- derive orbital and spin contribution for magnetism

Course Content

UNIT– I: Laser

Spontaneous and stimulated emission - Einstein’s coefficient and their relations - basic characteristics of laser - Basic Requirements of laser - Helium-Neon laser - Semiconductor laser - CO_2 laser - Applications of Laser

UNIT– II: Optical fiber

Basic principle of optical fiber - Construction of optical fiber - Acceptance angle, Acceptance cone - Numerical Aperture - Types of optical fiber - Light wave communication by using optical fiber

UNIT– III: Physics of Semiconductor

Properties of Fermi Dirac energy distribution function - Concentration of carriers in conduction band , valance band - Intrinsic carrier concentration - Drift and diffusion currents - Einstein’s relations - Hall effect - Applications of hall effect

UNIT– IV: Dielectrics

Expression for local field - Classius mosotti relation - Types of polarization - Frequency response curve of dielectics - Dielectric loss - Dielectric strength - Loss tangent

UNIT– V: Free electron and band theory of metals

Classical free electron theory - Drawbacks of classical free electron theory – Fermi level and Fermi Dirac energy distribution function - Quantum free electron theory – Band theory-Bloch function - Kronig -penney model

UNIT– VI: magnetic materials

Permeability, magnetization - Origin of magnetism - Classification of magnetic materials - Domain theory (qualitative) – Hystyresis - Soft and hard magnetic - Applications

Text Books

1. S.O.Pillai, Solid state physics, (7th Edition), New Age International. (unit - 3,4,5,6)
2. Dr.M.N. Avadhanulu,Dr. P.G.Kshirsagar, Engineering Physics (9th Edition), S.Chand Publications (unit-1,2)

Reference Books

1. A.J.Dekker, Solid state physics, Published by Macmillan India.
2. Charles Kittel, Introduction to solid state physics, Wiley India Pvt. Ltd.
3. B.B. Laud, Laser and Non-Linear Optics, New Age international publishers
4. P.K. Palanisamy, Engineering Physics , SciTech publications

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PROBLEM SOLVING THROUGH COMPUTER PROGRAMMING
(Common to ECE, CSE & IT)
I Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To emphasize the use of flowcharts and pseudo code in problem solving.
- To gain knowledge in C language.
- To apply C language in problem solving.

Learning Outcomes

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

- outline problem solving steps, c-tokens and data types.
- design algorithm and flowchart for solving problem.
- use control statements for writing the programs.
- apply the concepts of arrays and strings in problem solving.
- use pointers and funtions to develop C programs.
- distinguish structures and unions and develop programs using structures.
- demonstrate the operations on files.

Course Content

UNIT–I

Problem Solving Steps – Understanding problem, developing algorithm, flowchart, coding, debugging and testing.

General form of a C program, C Tokens, basic data types, type conversion, variable declarations, console I/O statements, order of evaluation.

Sample problems such as evaluating formulae.

UNIT–II

Control Statements: Selection Statements – if, if-else, nested if, else-if, switch and conditional operator.

Iteration Statements – for, while and do-while.

Jump Statements – return, goto, break, exit and continue.

Problem Solving - Factorial computation, generation of Fibonacci sequence, reversing digits of an integer, generating prime numbers.

UNIT–III

Arrays and Strings– Declaring, initializing, accessing and display of one dimensional and two dimensional arrays.

Problem Solving – Computing mean and variance of a set of numbers, reverse the elements in an array, addition of two matrices.

UNIT–IV

Pointers – Declarations, initialization and operations.

Functions – General form of functions, passing parameters by value and by address, recursive functions, dynamic memory allocation functions, pointers and arrays, pointers and functions, and string handling functions.

Problem solving - Print the sum of all elements of the array using pointers, swapping of two numbers, calculate the GCD of two non-negative integers using recursion.

UNIT–V

Structures -Definition, declaration, initialization, accessing structure members, nested structures, structures and functions, unions.

Problem solving- Implement a structure to read and display the Name, Date of Birth and Salary of Employees, Functions to perform read, add and write two complex numbers using Structures.

UNIT–VI

File Handling - Text and binary files, file handling functions, file processing operations – inserting, deleting, searching and updating a record and displaying file contents, random access to files.

Problem solving – Copy the contents of one file to another, count the number of characters, words and lines in a file.

Text Books

1 Programming in C, Second Edition Pradip Dey and Manas Ghosh, OXFORD Higher Education.

2 C Programming, E Balaguruswamy, 3rd edition, TMH.

Reference Books

1 Programming in C, Reema Thareja, OXFORD.

2 C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE.

3 R G Dromey, How to Solve it by Computer, Prentice-Hall of India, 1999.

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FUNCTIONAL ENGLISH LAB
(Common to All Branches)
I Year – I Semester

Practical	: 2	Internal Marks	: 40
Credits	: 1	External Marks	: 60

Course Objectives

Functional English (Lab) seeks to develop in the students

- the communication strategies and social graces necessary in order to function effectively in social and other situations in which they may be called upon to speak in English; and
- a greater awareness of English pronunciation and provides for focused practice with the sounds of English and intonation patterns improve their pronunciation skills and to enable them to speak with a reasonable degree of intelligibility.

Learning Outcomes

Upon successful completion of Functional English (Lab), the students will be able to

- give short impromptu speeches with confidence and fluency and take part in conversations in different functional contexts using English following appropriate communication strategies.
- check the pronunciation of words in a dictionary using their knowledge of phonemic symbols.
- speak English with adequate attention to stress, rhythm, and intonation; and
- speak without their pronunciation being marred by regional peculiarities, achieving thereby greater intelligibility in their communication with non-Telugu speakers of English.

Course Content

UNIT–I

a. Greeting, introducing and taking leave   b. Pure vowels

UNIT–II

a. Giving information and asking for information   b. Diphthongs

UNIT–III

a. Inviting, accepting and declining invitations   b. Consonants

UNIT–IV

a. Commands, instructions and requests   b. Accent and rhythm

UNIT–V

a. Suggestions and opinions   b. Intonation

Text Books

1. Hari Prasad, M., Salivendra Raju, J., and Suvarna Lakshmi, G. (2013). *Strengthen Your Communication Skills*. Hyderabad: Maruthi Publications.
2. Handouts produced by the Department on "difficult sounds," consonant clusters, the other problems of Telugu learners of English, listening comprehension, and oral reading
3. The following pieces of software:
   - 'Multimedia Language Lab' provided by K-Van Solution, Hyderabad
   - 'Foundation Course in Communication Skills' provided by the Andhra Pradesh State Council of Higher Education (APSCHE), Government of Andhra Pradesh.
4. Audio and video clips such as 'BBC English'

Testing Pattern

I.	**Internal**	**40 marks**
a.	Regular performance in the Language/Communications Lab	15 marks
b.	Completing the tasks in the lab manual	10 marks
c.	Testing of listening : Listening to a short audio clip of a speech/conversation in British accent and answering questions at the 'information' level.	05 marks
d.	Test of reading: Role-playing a dialogue with proper pronunciation and with reasonable attention to tone groups, stress, rhythm and intonation.	10 marks
II.	**External**	**60 marks**
a.	Test of writing	
	Writing a dialogue on the situation set	10 mark
	Answering 'Yes/No' questions on pronunciation	05 mark
	Marking sentence stress and intonation	05 marks
b.	Test of speaking	20 marks
	Role-playing a situational dialogue (e.g. 'At the railway station,' 'At the restaurant') with proper pronunciation and with reasonable attention to tone groups, stress, rhythm, and intonation	
c.	Viva voce (with an external examiner)	20 marks
	Speaking for one minute on a given topic	

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SOLID STATE PHYSICS LAB

I Year – II Semester

Practical	: 2	Internal Marks	: 40
Credits	: 1	External Marks	: 60

Course Objectives

- To draw the relevance between the theoretical knowledge and to imply it in a practical manner with respect to analyze various electronic circuits and its components.
- Understand the behaviour and characteristics of various active and passive components.
- To learn utilization of laser source for optical fiber communication

Learning Outcomes

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

- identify energy gap of a semiconductor
- draw characteristic curves to estimate thermal coefficient of a thermsitor
- observe self timer and tuning nature of passive components like RC,LCR
- verify magnetic field along the axis of a circular coil.
- determine frequency of AC and unknown tuning fork
- calculate light gathering power of optical fiber
- estimate wavelength of unknown source

List of Experiments

S.No.	Name of the experiment- Aim
1	Determination of bending losses in optical fiber
2	Determination of numerical aperture of an optical fiber
3	Determination of energy band gap of a semiconductor
4	Determination of thermal resistance by thermistor
5	Determination of time constant of RC circuit
6	Determination of resonance frequency of LCR circuit in series and parallel
7	Study of the characteristics of a zenar diode.
8	Determination of magnetic field along the axis of circular disc by using Stewart and Gee's Apparatus
9	Study normal modes in string using forced vibrations in rods-Melde's experiment.
10	Determination of Frequency of A.C supply by sono meter.
11	Determination of Hall coefficient by Hall effect
12	Draw Hysteresis curve of a ferro magnetic material

Reference Books

1. Vijay Kumar & T. Radha Krishna, Practical Physics for engineering students.
2. Dr. Y.Aparna and Dr. K.Venkateswara Rao, Lab manual of Engineering Physics, VGS Books links, Vijayawada.
3. R.Jayaraman,V.Umadevi,S.Maruthamuthu,B.Saravana Kumar, Engineering Physics laboratory manual(1^{st} edition) Pearson publishers.

COMPUTER PROGRAMMING LAB
(Common to ECE, CSE & IT)
I Year – I Semester

Practical	: 4	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To familiarize with the discrete components of a computer, MS Office
- To develop C Programs to solve problems.

Learning Outcomes

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

- Identify discrete components of computers.
- Prepare applications using MS Office.
- Apply problem solving steps to solve a problem.
- Develop a C program for a given problem.

List of Exercises

Exercise 1:

a. Identifying the discrete components of a computer.
b. Creating a document using MS Word.

Exercise 2:

a. Familiarizing with the usage and applications of MS Excel.
b. Creating a presentation using MS PowerPoint.

Exercise 3: Basics of C

a. Write a C program to calculate the area of triangle using the formula area = $(s (s-a) (s-b)(s-c))^{1/2}$ where s= (a+b+c)/2
b. Write a C program to find the largest of three numbers using ternary operator.

Exercise 4: Selection Statements

Implement a C program for the following:

a. Find the roots of a quadratic equation.
b. Calculate electricity bill for the consumed units – assume suitable constraints.
c. Read two integer operands and one operator form the user, perform the operation and then print the result. (Consider the operators +,-,*, /, % and use Switch Statement)

Exercise 5: Iterative statements

Develop a C program for the following:

a. Display first N natural numbers.
b. Check whether given number is Prime (or) not.
c. Find the reverse of a given number.

Exercise 6: Arrays

Design a C program for the following :

a. To Search whether the given element is in the array.
b. To Perform Addition and multiplication of two Matrices.

Exercise 7: Strings

Develop a C program for the following:

a. To Check whether the given String is a Palindrome (Without using String Handling functions).
b. To Illustrate string handling functions-strlen(), strcmp(), strcat(), strcpy(), strrev()

Exercise 8: Functions

Implement a C program for the following:

a. To Sort a given set of numbers in ascending order using functions.
b. To find the factorial of a given integer using recursive function.
c. To generate Fibonacci series using non-recursive function

Exercise 9: Pointers

Implement a C program for the following:

a. Function to exchange (Swap) values of two integers using call by reference.
b. Illustrate the usage of dynamic memory management functions.

Exercise 10: Structures

Develop a C program for the following:

a. To implement a structure to read and display the Name, date of Birth and salary of an Employee.
b. To display the Name, Marks in five subjects and total marks of given number of students. (Using array of structures).
c. Functions to perform the following operations using Structure:
   i) Addition of two complex numbers
   ii) Multiplication of two complex numbers.

Exercise 11: Files

Implement a C program for the following:

a. To copy contents of one file to another.
b. To count the number of characters, words and lines in a file.

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PROFESSIONAL COMMUNICATION
(Common to All Branches)
I Year – II Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To equip the students with common employability skills (the skills required for gaining employment and performing successfully in different careers) which can enable them to perform communication tasks of increasing length and complexity.
- To develop in them the interactional communication strategies and social graces which have the potential to add to the effectiveness of professional communication.

Learning Outcomes

Upon successful completion of Professional Communication, the students will be able to

- speak with a reasonable degree of fluency and accuracy in professional communication situations (such as arriving at a consensus through discussion, making a presentation, and taking part in a telephone conversation)
- listen to short audio and video clips in native English accent (British and American), and gain both understanding of messages and sensitivity to native-speaker accents
- read fluently, comprehending texts of different kinds using multiple strategies and higher-order skills
- produce written discourses of different kinds;
- guard against grammatical errors Indians typically make in their speech and writing in English

Course Content

LEVEL - I: Intermediate (for the first mid-semester)

1. From the textbook "Innovate with English": Unit VII

Listening	: Conversations using Communicative functions
Reading Comprehension	: Text: 'Priming the Pump'
Remedial Grammar	: *if*-clause and Indianism
Writing	: Email writing

2. From the textbook "Vocabulary Builder for Students of Engineering and Technology"

The following portions only:

GRE Words (Unit 1.3)	One-Word Substitutes (Unit 4.3)
Collocations (Unit 2.3)	Idioms (Unit 5.3)
Commonly Confused Words (Unit 3.3)	Phrasal Verbs (Unit 6.3)

3. From Great Stories in Easy English

"Pride and Prejudice" by Jane Austen

LEVEL - II: Advanced (for the second mid-semester)

1. From the textbook "Innovate with English": Unit VIII

Listening	: Conversations using communicative functions
Reading Comprehension	: Text: 'Bionics'
Remedial Grammar	: Articles and Indianism
Writing	: Email writing

2. From the textbook "Vocabulary Builder for Students of Engineering and Technology"

The following portions only:

GRE Words (Unit 1.4)
Collocations (Unit 2.4)
Commonly Confused Words (Unit 3.4)
One-Word Substitutes (Unit 4.4)
Idioms (Unit 5.4)
Phrasal Verbs (Unit 6.4)

3. From Great Stories in Easy English

"Gulliver's Travels" by Jonathan Swift

Textbooks

1. Samson, T. (2010). *Innovate with English*. Hyderabad: Foundation
   - Unit SEVEN and EIGHT only
2. Vijayalakshmi, M. et al (2014). *Vocabulary Builder for Students of Engineering and Technology*. Hyderabad: Maruthi Publications.
3. The following simplified classics, one for each mid-semester, from the series, *Great Stories in Easy English*, published by S. Chand & Company Limited:
   - *Pride and Prejudice* by Jane Austen
   - *Gulliver's Travels* by Jonathan Swift
4. Audio and video clips carefully selected by the Department in order to sensitize the students to native-speaker accents.

Testing Pattern

First Mid-Term Examination

The paper consists of four questions. All questions are compulsory; there is no choice.

I. Reading an unseen passage and answering two sets of questions on it:

a) Ten comprehension questions. Critical questions requiring analysis, inference, prediction, evaluation, interpretation of the writer's ideas, etc. are to be set. Five of the ten questions will be multiple-choice questions. In case of non-multiple-choice questions, the length of each answer should not exceed 50 words. **Marks: 10 x ½ = 5**

b) Writing an essay expressing a point of view on one or more of the issues flagged up in the question and making a convincing case for the standpoint. Length: 100 – 150 words. **Marks: 1 x 5 = 5**

II. Reading a poorly-written e-mail message and doing the following tasks:

a) Analyzing the reasons for the e-mail failing to meet the standards of professional e-mail communication. The analysis must identify and discuss at least five reasons. (Length: 100 – 150 words) **Marks: 1 x 5 = 5**

b) Rewriting the e-mail using the standards of professional e-mail communication. **Marks: 1 x 5 = 5**

III.

a) Ten contextualized questions on the following from *Vocabulary Builder*: GRE Words: 1.3; Collocations: 2.3; Commonly confused words: 3.3; One- word substitutes: 4.3; Idioms: 5.3; and Phrasal verbs: 6.3 **Marks: 10 x ½ = 5**

b) Correction of grammatical errors: ten sentences with grammatical errors of the following types (dealt with in Unit 7 of *Innovate with English*) will be given: *if*-clause and Indianism **Marks: 10 x ½ = 5**

IV.

a) Completing a conversation (where informational and interactional functions are performed) with suitable expressions. **Marks: 10 x ½ = 5**

b) Answering ten 'true-or-false' questions on communication strategies and functions given in form of short dialogues. **Marks: 10 x ½ = 5**

Second Mid-Term Examination

The paper consists of four questions. All questions are compulsory; there is no choice.

I. Reading a poorly-written e-mail message and doing the following

a) Analyzing the reasons for the e-mail failing to meet the standards of professional e-mail communication. The analysis must identify and discuss at least five reasons. (Length: 100 – 150 words) **Marks: 1 x 5 = 5**

b) Rewriting the e-mail using the standards of professional e-mail communication **Marks: 1 x 5 = 5**

II. Reading an unseen passage and answering two sets of questions on it.

a) Ten comprehension questions. Critical questions requiring analysis, inference, prediction, evaluation, interpretation of the writer's ideas, etc. are to be set. Five of the ten questions will be multiple-choice questions. In case of non-multiple-choice questions, the length of each answer should not exceed 50 words. **Marks 10 x ½ = 5**

b) Writing an essay expressing a point of view on one or more of the issues flagged up in the question and making a convincing case for the standpoint. Length: 100 – 150 words. **Marks: 1 x 5 = 5**

III.

a) Ten contextualized questions on the following from *Vocabulary Builder*: GRE Words: 1.4; Collocations: 2.4; Commonly confused words: 3.4; One- word substitutes: 4.4; Idioms: 5.4; and Phrasal verbs: 6.4 **Marks: 10 x ½ = 5**

b) Correction of grammatical errors: ten sentences with grammatical errors of the following types (dealt with in Unit 8 of *Innovate with English*) will be given: articles and Indianism. **Marks: 10 x ½ = 5**

IV. Reading an expository text and doing two tasks:

a) Making notes (identifying the main points of the text and writing them down in note form)

b) Summarizing the text using the notes already made **Marks: 1 x 5 = 5**

Semester End Examination

Answer any five questions: **Question I is compulsory.**

I. Reading a poorly-writen e-mail message and doing the following task:**(**Compulsory)

a. Analyzing the reasons for th email failing to meet the standards of professional email communication. The analysis must identify and discuss at least five reasons. (Length: 100-150 words) **Marks: 1 x 5 = 5**

b. rewriting the email using the standards of professional email communication. **Marks: 1 x 7 = 7**

II. Reading the text of a presentation made in a professional context and answering the following questions:

a. Analysing the passage from the point of view of language and style and identifying the reasons for the presentation falling short of the standards of professional presentations (Length of the answer: 100 – 150 words) **Marks: 1 x 5 = 5**

b. Rewriting the text of the presentation in the light of the analysis made in (a) above and following the conventions of professional presentations as far as language and style are concerned. **Marks: 1 x 7 = 7**

III. Reading an unseen (unfamiliar) passage on an issue related to engineering and technology or on a professional issue or situation and answering two sets of questions on it:

a. Ten comprehension questions:

- Critical questions requiring analysis, inference, prediction, evaluation, interpretation of the writer's ideas, pinpointing the writer's attitude/bias, etc. are to be set; 'information' questions involving a *mere* reproduction of the content should be avoided.
- At least three of the ten questions should be multiple-choice questions.
- In case of non-multiple-choice questions, the length of each answer should not exceed 50 words. **Marks: 10 x ½ = 5**

a. Writing an essay expressing a point of view on one or more of the issues flagged up in the question and making a convincing case for the standpoint. Length: 200 – 250 words. **Marks: 1 x 7 = 7**

IV. Filling in blanks in sentences using GRE words, collocations, one-word substitutes, commonly-confused words, idioms, and phrasal verbs. The contexts will be clearly given for each expression, and the questions will be multiple-choice ones.

- GRE Words (Units 1.3 and 1.4)
- Collocations (Units 2.3 and 2.4)
- Commonly Confused Words (Units 3.3 and 3.4)
- One-Word Substitutes (Units 4.3 and 4.4)
- Idioms (5.3 and 5.4)
- Phrasal Verbs (Units 6.3 and 6.4) **Marks: 12 x 1 = 12**

V. Reading a dialogue (in which informational and interactional functions are performed) and answering two questions on it:

a. Completing the dialogue with appropriate expressions **Marks: 10 x ½ = 5**

b. Extending the scope of the dialogue using at least five of the given communication strategies/functions. **Marks: 1 x 7 = 7**

VI. Correction of grammatical errors:

- Either a conversation with twelve grammatical errors (in the areas of articles, modal verbs, prepositions, phrasal verbs, and Indianism), or isolated sentences with twelve grammatical errors will be given.
- If isolated sentences with errors are given, they are not to be given in isolation from their contexts; a conversation with errors of the kind specified above will serve the purpose better.

The examinees are expected to rewrite the sentences in the answer book, correcting hem. **Marks: 12 x 1 = 12**

VII. Reading an expository text and doing two tasks:

a. Making notes (identifying the main points of the text and writing them down in note form) **Marks: 4 x 1 = 4**

b. Summarizing the text using the notes already made **Marks: 1 x 8 = 8**

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INTEGRAL TRANSFORMS AND VECTOR CALCULUS
(Common to EEE & ECE)
I Year – II Semester

Lecture	: 4	Tutorial	: 1	Internal Marks	: 40
Credits	: 4			External Marks	: 60

Course Objectives

- To gain the knowledge of Laplace and inverse transforms.
- To understand the concepts of Fourier series and Fourier Transforms.
- To find the solutions of integral problems using vector concepts.

Learning Outcomes

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

- apply Laplace transforms to find the solutions of ordinary differential equations.
- express a function in Fourier series and in Fourier integral form.
- apply the concepts of vector differentiation and integration to the surface and volume integrals.

Course Content

UNIT–I: Laplace Transforms

Laplace transforms of standard functions – Shifting Theorems - Multiplication and division by t, transforms of derivatives and inproper integrals – Unit step function – Dirac Delta function.

UNIT– II: Inverse Laplace Transforms

Inverse Laplace transforms – by partial fractions – Convolution theorem (without proof).

Application: Solution of ordinary differential equations.

UNIT–III: Fourier Series

Fourier series: Determination of Fourier coefficients (without proof) – Fourier series – Fourier series in an arbitrary interval– Half-range sine and cosine series

UNIT– IV: Fourier Transforms

Fourier integral theorem (only statement) – Fourier transform – sine and cosine transforms – properties (without proofs) – inverse Fourier transforms.

UNIT–V: Vector Differentiation

Vector Differentiation: Gradient- Divergence- Curl - Laplacian operator

UNIT–VI: Vector Integration

Line, surface and volume integrals.

Integral theorems: Greens - Stokes - Gauss Divergence Theorems (Without proof) and related problems. Applications: Work done, flux across the surface

Text Books

1. B.S.Grewal, Higher Engineering Mathematics : 42nd edition, Khanna Publishers,2012 , New Delhi.
2. B.V.Ramana, Higher Engineering Mathematics, Tata-Mc Graw Hill company Ltd.

Reference Books

1. U.M.Swamy, A Text Book of Engineering Mathematics – I & II : 2nd Edition, Excel Books, 2011, New Delhi.
2. Erwin Kreyszig, Advanced Engineering Mathematics: 8th edition, Maitrey Printech Pvt. Ltd, 2009, Noida.
3. Dr. T.K.V.Iyengar, Dr. B.Krishna Gandhi, S.Ranganatham and Dr.M.V.S.S.N.Prasad, Engineering Mathematics, Volume-I , II, III: 11th edition, S. Chand Publishers, 2012, New Delhi.

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APPLIED CHEMISTRY

I Year – II Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To impart the knowledge of batteries, solar cells, sensors and bio-sensors and boiler troubles with hard water.
- To impart the knowledge of advanced materials viz., LCD, nano materials, polymers and instrumental methods of analysis.

Learning Outcomes

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

- explain the working of lead acid battery, nickel – cadmium battery, lithium ion battery and fuel cells and to explain the applications of sensors and bio-sensors.
- explain about new generation photo voltaic cells.
- apply a suitable method of water treatment depending on the quality requirement.
- explain the methods of synthesis of liquid crystals, nano materials properties and applications of CNTs and quantum dots.
- explain properties and engineering applications of fibre reinforced plastics, conducting polymers and bio degradable polymers.
- explain the principles and working of spectrophotometer and flame photometer for the determination of a given ion in a given solution.

Course Content

UNIT–I: Electrochemical Energy Systems and Sensors

(a) Differences between primary cells and secondary cells, Construction, electro chemical reactions and applications of secondary cells- Ni-Cd battery, Lithium ion battery, Pb-acid storage battery, maintenance free lead acid battery. Construction, electro chemical reactions and applications of Fuel cells - H_2-O_2 fuel cell, Methanol-oxygen fuel cell.

(b) Sensors and Bio-Sensors – principle, description of electro chemical sensor –applications – working of glucometer – applications of bio-sensors.

UNIT–II: Solar Energy Devices

Photo Voltaic cells – Working principle – Applications – New generation Solar cells (Thin film Solar cells, organic solar cell, dye sensitized solar cells) – Solar reflectors – Solar trough, Solar dish, Solar tower - Solar water heater.

UNIT–III: Hard Water and Boiler Troubles

Hardness of water – calculation of hardness- disadvantages of using hard water in boilers – priming and foaming – sludge and scale formation – caustic embrittlement – boiler corrosion. Treatment of boiler feed water – Zeolite process, Ion exchange process – Internal treatment – Calgon conditioning – Phosphate conditioning – Colloidal conditioning – Desalination of Brackish water by RO method.

UNIT–IV: Nano Materials and Liquid Crystals

Nano materials : Concept of Nano materials - synthesis of nano materials – Sol-gel, Thin film preparation by Chemical vapour deposition method, carbon nano tubes (CNTs) – types, properties, applications of CNTs, quantum dots – applications.

Liquid crystals - types, properties, applications, working of LCD

UNIT–V: Polymers

Fibre reinforced plastics – Definition of matrix and reinforcement – Glass Fibres, Carbon fibres, aramid fibres – preparation methods – hand layup method, matched metal die moulding method – properties – applications. Conducting Polymers - types, properties, applications- OLED, poly aniline, Bio-Degradable Polymers— PHBV.

UNIT–VI: Instrumental Methods of Analysis

Electronic transition in molecules – Absorption Spectra, Beer Lambert's Law, UV spectrophotometer - principle and working – determination of Ferric Iron by spectrophotometry - Flame photometry – principle and working, estimation of sodium by flame photometry.

Text Books

1. Text book of Engineering Chemistry by Jain & Jain. Dhanpat Rai Publishing Company, 16th Edn., 2015.
2. A Text book of Engineering Chemistry by Shashi Chawla. Dhanpat Rai Publications, 3rd Edn., 2013.

Reference Books

1. A Text book of Engineering Chemistry by S.S.Dara. S.Chand&Company Ltd., 12th Edn.,2010.
2. Engineering Chemistry by J.C.Kurisascose and J.Rajaram. volumes 1 & 2, Tata Mc Graw-Hill Publishing.

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ENVIRONMENTAL STUDIES
(Common to CE, EEE & ECE)
I Year – II Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To impart the basic knowledge about the environment and ecology.
- To develop an attitude of concern for biodiversity and its conservation.
- To assess the environmental impacts of developmental activities.
- To create awareness on environmental pollution and waste management.

Learning Outcomes

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

- understand the role of a citizen in protection of environment.
- analyze functional attributes of an ecosystem.
- enumerate the values of biodiversity.
- identify appropriate processes to control pollution
- identify waste management practices
- understand various stages of Environmental Impact Assessment (EIA)

Course Content

UNIT–I : Multidisciplinary Nature of Environmental Studies

Definition – Scope – Importance - Need for Public Awareness – Multidisciplinary nature of Environmental Studies – Awareness activities-Role of a citizen in protection of environment

UNIT–II: Ecosystem

Concept of an Ecosystem – Structural features of Ecosystem – Food Chain – Food Web – Ecological Pyramids – Energy Flow – Biogeochemical Cycles – Ecological Succession-Major ecosystems.

UNIT–III: Biodiversity &Its Conservation

Definition – Levels of Biodiversity – Bio-geographical zones of India – Values of biodiversity (Consumptive use, productive use, Social, Ethical, Aesthetic, Option values, Ecosystem service values) – India as a mega diversity nation – Threats to biodiversity – Endangered &Endemic species of India – Conservation of biodiversity (In-situ & Ex-Situ)-Biodiversity Act,2002.

UNIT–IV: Environmental Pollution

Definition – Causes – Effects & Control measures of – Air pollution – Water pollution – Noise pollution – Soil pollution –Radioactive pollution.

UNIT–V: Environmental Management

Environmental Impact Assessment – Environmental Impact Statement – Environmental Management Plan – Environmental Audit – Ecotourism – Green building – Green Development – Mechanism-Environmental legislations-Wild life (protection) Act,1972-Water (prevention and control of pollution) Act, 1974-Forest (conservation) Act,1980-Air (prevention and control of pollution) Act, 1981-Environmental(protection) Act,1986.

UNIT–VI: Waste Management

Liquid waste: Industrial waste water treatment -Municipal water treatment-Drinking water treatment

Solid waste: Municipal solid waste- Biomedical waste- Hazardous waste- E-waste

Text Books

1. Environmental studies:AnubhaKaushik,C.P.Kaushik: New age international publishers (UNIT-1,2,3,5).
2. Environmental Science &Engineering :P.Anandan, R.Kumaravelan, Scitech Publications (India) Pvt. Lted.(UNIT-4,5,6)

Reference Books

1. “Environmental Studies” by Shashichawala:TataMcgraw hill education private limited.
2. “Environmental Studies” by Deeshita Dave & P. UdayaBhaskar, Cengage Learning.
3. “Society and Environmen” by Dr.SureshK.Dhameja:S.K.Kataria and sons
4. “Environmental studies” by Benny Joseph:Tata Mc Graw-Hill publishing company limited.

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LINEAR ELECTRICAL NETWORKS

I Year – II Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To understand basic laws and theorems of Electrical circuits.
- To familiarize with the steady state behaviour of DC and single phase AC circuits.
- To familiarize the concepts of electrical resonance.
- To familiarize the students to two port networks.

Learning Outcomes

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

- apply various circuit laws to analyze the electrical circuits.
- analyze the steady state behavior of DC and AC circuits.
- apply network theorems to analyze the electrical circuits.
- analyze the behavior of electrical resonance
- evaluate different two port network parameters.

Course Content

UNIT–I: Introduction To Electrical Engineering

Network elements classification, Circuit concepts –Resistor(R) - Inductor(L) - Capacitor(C) -Voltage and Current Sources (Ideal and Non-Ideal)- Independent and Dependent Sources- Voltage - Current relationship for passive elements.

UNIT–II: Methods Of Analysis

Ohm's law - Kirchhoff's laws – Source transformation - Network reduction techniques series, parallel, series parallel, star-to-delta or delta-to-star transformation, Nodal analysis, mesh analysis, super node and super mesh for D.C excitations.

UNIT–III: Introduction To Single Phase Ac Circuits

Generation of alternating sinusoidal quantities - R.M.S, Average values and form factor for different periodic wave forms – sinusoidal alternating quantities – Phase and Phase difference – Complex and polar forms of representations, J Notation,

UNIT–IV: Sinusoidal Steady State Analysis & Resonance

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-Power Factor and significance of Real and Reactive power, Complex Power.

Resonance - series, parallel circuits, concept of band width and Q factor.

UNIT– V: Network Theorems

Superposition, Reciprocity, Thevenin's, Norton's, Maximum Power Transfer, Millman's, Tellegen's and compensation theorems for D.C and sinusoidal excitations.

UNIT–VI: Two Port Networks

Two port network parameters – Z, Y, ABCD, hybrid, Inverse transmission and inverse hybrid parameters and their relations, Cascaded networks.

Text Books

1. Engineering Circuit Analysis by William Hayt and Jack E.Kemmerley, Mc Graw Hill Company, 6th edition
2. Theory & Problems of Electric Circuits by Joseph A Edminister- schaum series, 6th edition.
3. Fundamentals of Electric Circuits by Alexander & Sadiku, 2nd edition.

Reference Books

1. Network Analysis by Van Valkenburg, Prentice-Hall of India Private Ltd., 8th edition.
2. Network Analysis and Synthesis by Kuo, Franklin. F, John Wiley Publishers, 2nd edition.

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NUMERICAL METHODS & COMPLEX ANALYSIS

I Year – II Semester

Lecture	: 3	Tutorial	: 1	Internal Marks	: 40
Credits	: 3			External Marks	: 60

Course Objectives

- To understand the various numerical techniques.
- To introduce the complex functions, complex differentiation and complex integration
- To introduce the concepts of conformal and bilinear transformations of standard functions.

Learning Outcomes

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

- apply numerical techniques for solutions of Algebraic, transcendental and ordinary differential equations.
- compute interpolating polynomial for the given data.
- find derivatives and integrals by using numerical techniques.
- test the differentiability(analyticity) of a complex function
- find the complex integration with the use of Cauchy's integral formula.
- apply the concepts of conformal and bilinear transformations of standard functions.

Course Content

UNIT–I: Algebraic and Transcendental Equations

Solution of Algebraic and Transcendental Equations- Introduction –Bisection Method – Method of False Position – Newton-Raphson Method.

UNIT–II: Interpolation

Interpolation- Introduction – Finite differences- Forward Differences – Backward differences –Central differences – Symbolic relations – Newton formulae for interpolation – Lagrange's interpolation.

UNIT–III: Numerical differentiation and integration

Approximation of derivative using Newton's forward and backward formulas. Integration using Trapezoidal and simpon's rules.

UNIT–IV: Numerical Solutions of Ordinary Differential Equations

Taylor's Series Method, Euler Method, Modified Euler Method, Runge – Kutta Fourth order Method

UNIT–V: Complex differentiation & Integration (without proofs)

Introduction of the complex functions, derivative of f(z), analytic functions, C-R equations in polar coordinates, harmonic functions and orthogonal systems.

Introduction of line integral and evaluation along the path, Cauchy's integral theorem-statement, Cauchy's generalized integral formula.

UNIT–VI: Conformal mapping

Transformation by e^Z, lnz, $Z^2, Z^n (n \in Z^+)$, SinZ, Cos Z, $Z + \frac{1}{Z}$, Translation, rotation, Inversion and Bilinear transformation, Fixed points, Cross-ratio properties.

Text Book

1. B.S.Grewal, Higher Engineering Mathematics : 42nd edition, Khanna Publishers,2012 , New Delhi.
2. B.V.Ramana, Higher Engineering Mathematics, Tata-Mc Graw Hill company Ltd.

Reference Books

1. U.M.Swamy, A Text Book of Engineering Mathematics – I & II : 2nd Edition, Excel Books, 2011, New Delhi.
2. Erwin Kreyszig, Advanced Engineering Mathematics: 8th edition, Maitrey Printech Pvt. Ltd, 2009, Noida.
3. Dr. T.K.V.Iyengar, Dr. B.Krishna Gandhi, S.Ranganatham and Dr.M.V.S.S.N.Prasad, Engineering Mathematics, Volume-I , II, III: 11th edition, S. Chand Publishers, 2012, New Delhi.
4. S. Armugam, A. Thangapandi Isac, A. Soma Sundaram, Numerical Methods, Scitech Publications.

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ENGINEERING DRAWING

I Year – II Semester

Lecture : 1	Practical : 4	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To highlight the significance of universal language of engineers.
- To introduce the concepts of drawing 3-D objects in 2-D planes and vice versa with proper dimensioning and scaling.

Learning Outcomes

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

- apply principles of drawing in representing dimensions of an object.
- construct polygons and conical curves.
- draw projections of points, lines and planes.
- draw projections of solids in different positions.
- convert orthographic views into isometric views and vice-versa.

Course Content

UNIT–I: Introduction

Geometrical Constructions

Conic Sections: Ellipse, parabola, hyperbola – general method.

UNIT–II: Orthographic Projections

Introduction to Orthographic Projections, Projections of Points, Projections of Straight Lines parallel to both planes, Projections of Straight Lines-Parallel to one and inclined to other plane.

UNIT–III: Projections of Straight Lines

Projections of Straight Lines inclined to both planes.

UNIT–IV: Projections of Planes

Regular Planes Perpendicular / parallel to one Reference Plane and inclined to other Reference Plane, inclined to both the Reference Planes.

UNIT–V: Projections of Solids

Regular solids with axis perpendicular to one reference plane, axis inclined to one reference plane and perpendicular to other reference plane.

UNIT–VI: Transformation of Projections

Conversion of Isometric Views to Orthographic Views and orthographic to Isometric Views.

Semester End Examination Pattern

Semester end examination paper consists of eight questions out of which five questions are to be answered. All questions carry equal marks.

Text Books

1. N.D. Bhatt (2014), Engineering Drawing, 53rd edition , Chariot Publications.
2. K.VenuGopal (2016), Engineering Drawing and Graphics, 5th edition , New Age International (p) Ltd Publishers.

Reference Books

1. B.V.R.Gupta and M.Raja Roy(2016),Engineering Drawing with Autocad,3rd edition , I.K. Publishers.
2. M. B. Shah and B. C. Rana(2009),Engineering Drawing , 2nd edition,Pearson Education.
3. Dhanunjay A Jolhe (20014),Engineering Drawing , 2nd edition,Tata Mc GrawHill Publishers.

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PROFESSIONAL COMMUNICATION LAB
(Common to All Branches)
I Year – II Semester

Practical	: 4	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- Professional Communication (Lab) is a career-oriented programme. It seeks to develop in the students the competence required to perform professional communication tasks of increasing length and complexity, which can help them secure employment and perform successfully in their careers.

Learning Outcomes

Upon successful completion of Professional Communication Lab, the students will be able to

- enhance the effectiveness of their communication through body language;
- take part in interactional communication (i.e. communication that serves the purpose of social interaction or small talk) with fluency
- take part in transactional communication (i.e. communication that serves the purpose of carrying out functions such as giving directions, complaining, and apologizing) with fluency
- speak professionally in telephone conversations;
- make effective presentations using a range of strategies, including a good organization of the content, impressive opening and closing, the use of suitable visual aids, the use of stories/anecdotes to illustrate a point, effective use of body language, and good handling of the question-and-answer session;
- take part in group discussions and debates successfully;
- answer questions at an elementary level in job interviews; and
- use team-building skills with impact in different situations.

Course Content

UNIT–VI : Body Language

UNIT–VII : Dialogues

UNIT–VIII : Presentation Skills

UNIT–IX : Group Discussion

UNIT–X : Interviews and Telephonic Interviews

UNIT–XI : Debates

Text Books

1. Hari Prasad M., Salivendra Raju J., and Suvarna Lakshmi G., (2013). *Strengthen Your Communication Skills*. Hyderabad: Maruthi Publications.

2. The following pieces of software:
   - ‘Multimedia Language Lab’ provided by K-Van Solution, Hyderabad
   - ‘Foundation Course in Communication Skills’ provided by the Andhra Pradesh State Council of Higher Education (APSCHE), Government of AndhraPradesh.

Testing Pattern

1. Internal **40 marks**

a. Regular performance in the Communications Lab 15 marks

b. Completing the tasks in the lab manual 10 marks

c. Making a PowerPoint presentation (Pair/Group) 15 marks

(Note: A hard copy of the presentation is to be submitted)

2. External **60 marks**

a. Test of writing

A telephone conversation 08 marks

The minimum number of exchanges to be specified

- Writing a resume 10 marks

The length (1page / 2 pages) is to be specified. The features to be included in the resume are also to be specified; the examinees will, however, have the option of including more features within the length specified.

- Answering 3 job-interview questions 12 marks

Questions at an elementary level. In other words, questions that require candidates to talk about themselves, their ambitions, their personality, their hobbies and interests, and their key skills.

Sample questions:

Can you tell us something about yourself?
What kinds of things do you worry about?
What are your key skills?
What skills do you need to improve?
What do you see as your strengths?
What do you like doing in your spare time?
How would you describe the way you work?
Tell us about a time when you showed strong leadership skills.
Tell us about a time when you had to make a difficult decision.
How do you see yourself in five years’ time?

b. Test of speaking

Group discussion 15 marks

Time: 10-15 minutes (approx.) per group

c. Viva voce with an external examiner 15 marks

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APPLIED CHEMISTY LAB

I Year – II Semester

Practical	: 2	Internal Marks	: 40
Credits	: 1	External Marks	: 60

Course Objectives

- To impart the skill on chemical and instrumental methods of analysis of various parameters for determining the quality of water.
- To impart the skill on preparation of synthetic materials.

Learning Outcomes

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

- test the quality parameters of water by volumetric and instrumental methods.
- to operate the sensors for testing the water quality.
- synthesize phenol – formaldehyde resin (Bakelite).
- operate spectrophotometer and determine the concentration of Ferric Iron in a given solution.

Course Content

Introduction to Chemistry Lab (the teachers are expected to teach fundamentals like Primary, Secondary Standard Solutions, Normality, Molarity, Molality etc and laboratory ware used, error, accuracy, precision, Theory of indicators, use of volumetric titrations).

1. Practice experiment-Determination of the amount of HCl using standard Na_2CO_3.
2. Determination of alkalinity of a given water sample.
3. Determination of acidity of a given water sample.
4. Determination of total hardness of the water sample by EDTA method.
5. (a) Determination of pH of different water samples by using pH meter.
   (b) Determination of conductivity of different water samples by digital conductivity meter.
6. Determination of concentration of the given acid by using standard base conductometrically.
7. Construction of an Electro Chemical Cell.
8. Determination of rate of corrosion of carbon steel metal in acid medium in the absence and presence of Thiourea inhibitor by gravimetric method.
9. Preparation of polyaniline.
10. (a) Preparation of Printed Circuit Board. (b) Preparation of Phenol - Formaldehyde resin.
11. Determination of concentration of Ferric Iron in a given solution spectrophotometrically.

Lab Manual

1. Vogel's Textbook of Quantitative Chemical Analysis, Fifth edition, John Wiley & Sons, Inc., New York
2. Engineering chemistry laboratory manual & record by Srinivasulu .D, Parshva publications.
3. Engineering Chemistry Lab Manual by K.Mukkanti, B.S publications,2009.

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PROBABILITY THEORY AND STOCHASTIC PROCESS

II Year – I Semester

Lecture	: 3	Tutorial	: 1	Internal Marks	: 40
Credits	: 3			External Marks	: 60

Course Objectives

- To familiarize concepts of probability and random variables.
- To impart the moment generating and characteristic functions.
- To introduce the concepts of correlation functions and power spectral density.

Learning Outcomes

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

- determine and understand probability, statistics of random variables and their functions.
- decide statistics of random vectors and their functions.
- calculate statistics of random sequences, random processes, and their input and output relationships and statistics in linear systems.
- apply the concepts of probability, random variables / processes to analyze statistical problems in Electronics and communication Engineering field.
- apply the concepts of filtering and prediction of a random process

Course Content

UNIT - I: Review Of Probability

Sets and set operations and events, probability space, axiomatic definition of probability, joint, conditional, total probabilities and Bayes theorem.

UNIT - II: Random Variables

Random variables, probability distribution of a random variable, discrete and continuous random variables, and functions of a random variable,moments of a distribution function, generating functions and characteristic function.

UNIT - III: Multiple Random Variables

Multiple random variables, independent random variables, functions of random variables, covariance, correlation, moments, central limit theorem.

UNIT - IV: Random Process (Temporal Characteristics)

Discrete and continuous time processes with examples, mean, autocorrelation and auto covariance functions, Stationary: strict-sense stationary (SSS) and widesense stationary (WSS) processes, autocorrelation function of a real WSS process and its properties, cross-correlation function, ergodicity and its importance.

UNIT - V: Random Process (Spectral Characteristics)

Power spectral density, properties of power spectral density, cross-power spectral density and properties, auto-correlation function and power spectral density of a WSS random sequence, relationship between power spectral density and auto correlation functions.

UNIT - VI: Linear Systems With Random Inputs

Linear time-invariant system with a WSS process as an input: stationary of the output, auto-correlation and power-spectral density of the output, examples with white-noise as input.

Text Books

1. P. Peebles Jr. "Probability, Random Variables, and Random Signal Principles", 4thEdition, McGraw-Hill.
2. Henry Stark and John W. Woods, "Probability, Statistics, and Random Processes for Engineers", Prentice Hall, 4th Edition.

Reference Books

1. A.Papoulis and S.UnnikrishanaPillai, ''Probability, Random Variables and Stochastic Processes'', 2ndEdition, McGraw Hill.
2. B.P.Lathi , ''Modern Analog and Digital Communications'', Oxford University Press.

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ELECTONIC DEVICES

II Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the operation and characteristics of electronic devices.
- To learn about the use of diodes for various applications.
- To know about the biasing of MOSFETs and BJTs, their small-signal operation.

Learning Outcomes

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

- analyze the carrier transport in junctions.
- analyze the behaviour of electronic devices.
- study the models for diodes and use them for various applications.
- design power supply using junction diode and Zener voltage regulator.
- characterize the current flow in BJTs and MOSFETs.
- bias the BJTs and MOSFETs for amplifier applications.
- analyze the behaviour of BJTs and MOSFETs under small-signal conditions.

Course Content

UNIT - I: Junctions

Diffusion and recombination, the continuity equation, equilibrium conditions, forward and reverse-biased junctions, reverse-bias breakdown, the ideal diode, terminal characteristics of junction diodes, metal-semiconductor junctions, ideal MOS capacitor, MOS capacitance-voltage analysis, special diodes.

UNIT - II: Diode Models and Applications

Modelling the diode forward characteristic, Zener diode model, use of the Zener as a shunt regulator, temperature effects, design of Zener voltage regulator, the spice models for junction and Zener diodes, diode logic gates, diode as a rectifier, design of power supply using bridge rectifier; limiting and clamping circuits.

UNIT - III: MOS Field-Effect Transistors (MOSFETS)

Device structure and physical operation, current-voltage characteristics, MOSFET operation as a switch and as a linear amplifier, the depletion type MOSFET.

UNIT - IV: Bipolar Junction Transistors (BJTS)

Device structure and physical operation, current-voltage characteristics, BJT operation as a switch and as an amplifier.

UNIT - V: Biasing Of MOSFET and BJT

Biasing of BJTs, bias stabilization, design of voltage-divider bias circuit from bias stability considerations, biasing of MOSFETs, design of voltage-divider bias circuit.

UNIT - VI: Small - Signal Models of MOSFET and BJT

MOSFET small-signal models, SPICE MOSFET models, BJT small-signal models, SPICE Ebers-Moll model and Gummel-Poon model.

Text Books

1. Ben G. Streetman and Sanjay Kumar Banerjee, "Solid State Electronic Devices", PHI Learning Private Limited, Sixth Edition, 2009 (Unit- I).
2. Adel S. Sedra and Kenneth C. Smith, "Microelectronic Circuits", Oxford University Press Inc., Fifth Edition, 2004 (Units- I, II, III, IV & VI).
3. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education Inc., Eleventh Edition, 2013 (Unit-V).

Reference Books

1. J. Millman and A. Grabel, "Microelectronics", McGraw Hill International, 1987.
2. D. A. Neamen, "Semiconductor Physics and Devices" (IRWIN), Times Mirror High Education Group, Chicago, 1997.
3. R.T. Howe and C.G. Sodini, "Microelectronics: An Integrated Approach", Prentice Hall International, 1997.
4. K. Radha Krishna Rao, "Electronics for Analog Signal Processing - I", NPTEL Video Course.
5. S. Karmalkar, "Solid State Devices", NPTEL Video Course.

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SIGNALS AND SYSTEMS

II Year – I Semester

Lecture	: 3	Tutorial	: 1	Internal Marks	: 40
Credits	: 3			External Marks	: 60

Course Objectives

- To familiarize with the basic concepts of signals and systems.
- To introduce various transform techniques on signals.
- To develop an understanding of sampling and correlation techniques on signals.

Course Outcomes

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

- classify the signals and various operations on signals.
- perform Fourier analysis on the signals.
- analyze the various systems.
- perform correlation operational on signals.
- apply the various sampling techniques on continuous time signals.
- analyze the various continuous time signals through transformation (Fourier and Laplace) techniques.

Course Content

UNIT - I: Signal Analysis

Classification of signals, basic operations on signals-amplitude and time scaling, time shifting, addition and multiplication, introduction to elementary signals-unit step, impulse, ramp, parabolic, rectangular, triangular, sinusoidal, exponential, signum, sinc and gaussian functions.

UNIT - II: Fourier Series Representation of Continuous Time Signals

Trigonometric and exponential Fourier series, relationship between trigonometric and exponential Fourier series, representation of a periodic function by the Fourier series over the entire interval, convergence of Fourier series, alternate form of trigonometric series, symmetry conditions-even and odd, complex Fourier spectrum.

UNIT - III: Fourier Transform

Representation of an arbitrary function over the entire interval: Fourier transform, Fourier transform of some useful functions and periodic function, properties of Fourier transform, energy density spectrum, Parseval's theorem.

Sampling: Sampling theorem for band limited signals- explanation, reconstruction of signal from samples, aliasing, sampling techniques- impulse, natural and flat top sampling.

UNIT - IV:LTI Systems

Properties of systems, Linear Time Invariant (LTI) system, response of LTI system-convolution integral, properties of LTI system, transfer function and frequency response of LTI system.

Signal Transmission Through LTI Systems: Filter characteristics of LTI systems, distortion less transmission through LTI system, signal bandwidth, System bandwidth, ideal LPF, HPF and BPF characteristics, causality and physical realizability- Paley-Wiener criterion, relationship between bandwidth and rise-time.

UNIT - V: Correlation of Continuous Time Signals

Cross correlation and auto correlation of continuous time signals (finite and nonfinite energy signals), relation between convolution and correlation, properties of cross correlation and autocorrelation, power density spectrum, relation between auto correlation function and energy/power spectral density function.

UNIT - VI: Laplace Transform

Laplace transform of signals, properties of Region of Convergence (ROC), unilateral Laplace transform, properties of unilateral Laplace transform, inversion of unilateral and bilateral Laplace transform, relationship between Laplace and Fourier Transforms.

Text Books

1. B.P.Lathi, “Signals, Systems &Communications”, BS Publications, 2003 (Units I-VI).
2. A.V. Oppenheim, A.S. Willsky and S.H.Nawab, “Signals and Systems”,PHI, 2nd Edition (Units I, III, VI)

Reference Books

1. Simon Haykin and Van Veen, “Signals &Systems”, Wiley, 2nd edition
2. Michel J. Robert , “Fundamentals of Signals and Systems”, TMGH Int. Edition, 2008
3. C.L.Philips, J.M. Parr and Eve A. Riskin, “Signals, Systems and Transforms”, Pearson Education, 3rd Edition, 2004.

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ENGINEERING ECONOMICS AND PROJECT MANAGEMENT

II Year – I Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To illustrate the importance of Managerial Economics and know its significant role in achieving business objectives.
- To understand and articulate the importance of Project Management in any business project

Learning Outcomes

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

- Apply economic concepts in business decision making.
- Identify the influencing factors of Demand for a given product.
- Establish the suitable business organization with available resources.
- Analyze BEP for a project and adopt appropriate pricing strategies.
- Understand the importance of project management.
- Apply network concepts in business decision making.

Course Content

UNIT - I: Introduction to Engineering Economics

Definition,nature and scope of managerial economics – relation of managerial economics with other disciplines, concept of engineering economics.

Demand Analysis: Demand determinants, law of demand and its exceptions, significance & types of elasticity of demand. factors governing demand forecasting-methods of demand forecasting.

UNIT - II: Theory of Production and Cost Analysis

Production Function – Isoquants and Isocosts, MRTS, least cost combination of inputs, cobb-douglas production function. production function, laws of returns, internal and external economies of scale.

Cost Analysis: Cost concepts & BEP Analysis, break-even point (simple problems)

UNIT - III: Introduction to Markets & Pricing strategies

Market structures: Types of competition, features of perfect competition, monopoly and monopolistic competition and oligopoly.

Pricing strategies: Methods of pricing: cost based pricing, demand based pricing, competition based pricing and strategy based pricing.

UNIT - IV: Introduction to Business Organizations

Characteristic features of business, features and evaluation of sole proprietorship, partnership, joint stock company.

UNIT - V: Project Management Concepts

Concept and characteristics of a project, importance of project management. project planning: project evaluation, financial sources, feasibility studies.

UNIT - VI: PERT and CPM

Introduction, development of project network, time estimation, determination of the critical path, PERT model, measures of variability, CPM model, network cost system (simple problems)

Text Books

1. Aryasri, “Managerial Economics and Financial Analysis”, TMH,2/e 2005.
2. K.Nagarajan, “Project Management”, New Age International , New Delhi,2010

Reference Books

1. Ambrish Gupta, “Financial Accounting for Management”, Pearson Education, New Delhi.
2. H. Craig Peterson & W. Cris Lewis, “Managerial Economics”, PHI, 4th Ed.
3. Suma Damodaran, “Managerial Economics”, Oxford University Press.
4. Clifford F Gray, Erik W Larson, “Project Management-The Managerial Process”, Tata Mcgraw-Hill Publishing Co Ltd
5. John M Nicholas,”Project Management For Business And Technology” Prentice Hall of India Pvt Ltd

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ELECTROMAGNETIC FIELD THEORY

II Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the concepts of Electrostatics and Magneto statics.
- To familiarize with the concepts of Electromagnetic Waves and their Propagation.

Learning Outcomes

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

- apply the concepts of electric fields and magnetic fields in different applications.
- analyze the electric and magnetic fields for different charge distributions.
- derive the wave equations in perfect dielectric and conducting media.
- calculate the energy stored in electric and magnetic fields.
- understand reflection and refraction of electromagnetic waves in different media.
- determine the power flow in electromagnetic waves.

Course Content

UNIT - I: Electrostatics-I

Coulomb's Law, charge distributions, electric field intensity, electric fields due to point charge, line charge, surface charge, volume charge, electric flux density, Gauss's law, applications of Gauss law: point charge, infinite line charge.

UNIT - II: Electrostatics-II

Energy expended in moving a point charge in an electric field, electric potential difference and potential, potential due to different charge configurations, potential gradient, electric dipole and energy density in electrostatic field,conduction and convection current, current density.

UNIT - III: Electrostatics-III

Continuity equation for current and relaxation time, conductor properties, boundary conditions for dielectric–dielectric and conductor-dielectric interfaces, capacitance-parallel plate, coaxial capacitors, Poisson's and Laplace's equations.

UNIT - IV: Magnetostatics-I

Current distributions, Biot-Savart's law, Ampere's circuital law-applications of Ampere's circuital law ; infinite line current, infinite sheet of current, magnetic flux and magnetic flux density, magnetic scalar and vector potentials, force on a moving charge- Lorentz Force equation, force on a current element.

UNIT - V: Magnetostatics-II

Magnetic dipole and dipole moment, magnetic boundary conditions, magnetic energy.

Time Varying Fields And Maxwell's Equations: Faraday's law, transformer EMF and motional EMF, inconsistency of Ampere's law, displacement current, Maxwell's equations, time harmonic fields, Maxwell's equations using phasor notation.

Electromagnetic Waves-I:Wave equations for perfect dielectrics and conducting medium, uniform plane wave propagation, relation between E and H in a uniform plane wave.

UNIT - VI: Electromagnetic waves-II

Wave propagation in lossless medium and conducting medium, conductors and dielectrics-characterization, polarization, skin depth, Poynting's theorem and Poynting's Vector. reflection and refraction of plane waves – normal and oblique incidences for perfect conductor and perfect dielectrics- horizontal and vertical polarization, total internal reflection and Brewster angle.

Text Books

1. Mathew NO Sadiku "Elements of Electromagnetics", Oxford University Press, 2015.
2. EC Jordan and KG Balmain "Electromagnetic Waves and Radiating Systems", PHI 2003.

Reference Books

1. W H Hayt and J A Buck "Engineering Electromagnetics", 7th Edition TMH, 2011.
2. Joseph A Edminister "Theory and Problems of Electromagnetics", Schaum's Outline Series, McGraw Hill International.
3. Nathan Ida "Engineering Electromagnetics", Springer (India) Pvt. Ltd., New Delhi, 2nd Edition.

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ELEMENTS OF ELECTRICAL ENGINEERING

II Year – I Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To familiarize with the constructional details, working principle and characteristics of DC, AC machines and electrical Instruments.
- To impart knowledge on performance of AC and DC machines.

Learning Outcomes

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

- describe the performance of DC, three phase, single-phase AC machines and measuring instruments.
- determine the emf equation of DC and AC machines
- realize magnetization and load characteristics of DC machines.
- determine the characteristics of three phase and single phase induction motor.
- find the losses and efficiency of AC and DC machines.

Course Content

UNIT - I: D.C. Machines

Principle of operation of DC machines- EMF equation – types of generators

DC Motors – types of DC motors – characteristics of DC motors – 3-point starters for DC shunt motor – losses and efficiency – speed control of DC shunt motor – flux and armature voltage control methods.

UNIT - II: Transformers

Principle of operation of single phase transformer – types – constructional features –EMF equation, equivalent circuit-losses and efficiency of transformer and regulation - simple problems.

UNIT - III: Three Phase Induction Motor

Principle of operation of three-phase induction motors –slip ring and squirrel cage motors – slip-torque characteristics – efficiency calculation.

UNIT - IV: Alternators

Alternators – constructional features – principle of operation – types - EMF equation – distribution and coil span factors - regulation using synchronous impedance method.

UNIT - V: Single Phase Induction Motors

Principle of operation -shaded pole motors – capacitor motors, AC servomotor, stepper motors – characteristics.

UNIT - VI: Electrical Instruments

Basic principles of indicating instruments – moving coil and moving iron Instruments (Ammeters and Voltmeters)

Text Books

1. P.S.Bimbra, "Electrical Machines", Khanna Publications.
2. J.B.Gupta, "Electrical machines", S.K.Kataria & sons.

Reference Books

1. D P.Kothari, I.J.Nagarth, "Electrical machines", Mc GrawHill Publications, 4th Edition.
2. M.S.Naidu and S.Kamaksiah, "Basic electrical engineering",TMH Publications.

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ELECTRONIC DEVICES LAB

II Year – I Semester

Practical	: 4	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

To make the students familiarize with

- various electronic components and basic electronic lab instruments.
- conduct of experiments to obtain the characteristics of diodes, MOSFETs, and BJTs.
- the use of diodes for various applications and biasing of MOSFETs and BJTs.

Learnng Outcomes

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

- identify various electronic components and basic electronic measuring instruments and other lab equipment.
- perform experiment, take observations, present the results in proper form, analyze and interpret results, draw conclusions by correlating with theory.
- use modern tools for simulation.
- verify the I-V characteristics of junction diode, Zener diode, LED, photodiode, MOSFET, BJT, and obtain their parameters.
- design, simulate, hardware implement, and test - DC power supply, Zener voltage regulator, diode clipper, clamper, and BJT and MOSFET voltage-divider bias circuits.
- verify the switching action of transistor.
- make oral presentations and prepare written reports.

List of Experiments

PART-A: Orientation of electronic components and basic electronic lab instruments.

PART-B:

1. I-V characteristics of Junction diode and breakdown characteristics of Zener diode.
2. LED and photodiode I-V characteristics.
3. DC power supply (design, simulation, hardware implementation and testing).

4. Zener voltage regulator (design, simulation, hardware implementation and testing).
5. Diode clipper – transfer characteristics / waveform generation (design, simulation, hardware implementation and testing).
6. Diode clamper (design, simulation, hardware implementation and testing).
7. MOSFET characteristics (drain, transfer characteristics and measurement of device parameters).
8. BJT characteristics (input, output characteristics and measurement of device parameters).
9. Transistor switch.
10. BJT voltage-divider bias circuit with stabilization (design, simulation, hardware implementation and testing).
11. MOSFET voltage-divider bias circuit (design, simulation, hardware implementation and testing).
12. Open-ended experiment.

Reference Books

1. Adel S. Sedra and Kenneth C. Smith, "Microelectronic Circuits", Oxford University Press Inc., 2004.
2. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education Inc., 11th Edition, 2013.
3. K. Radha Krishna Rao, "Electronics for Analog Signal Processing - I", NPTEL Video Course.
4. User manuals for basic electronic lab equipment.
5. Data sheets for electronic components.

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NETWORKS AND ELECTRICAL TECHNOLOGY LAB

II Year – I Semester

Practical	: 2	Internal Marks	: 40
Credits	: 1	External Marks	: 60

Course Objectives

- The ability to conduct testing and experimental procedures on Circuits.
- The capability to analyze the behavior of circuits
- The ability to conduct testing and experimental procedures on Machine.

Course Outcomes

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

- verify the applicability of network theorems to practical electrical circuits.
- specify and test RLC series and parallel resonant circuits.
- interpret /correlate physical observations and measurements involving electrical circuits to theoretical principles
- predict the efficiency of DC Shunt motor by conducting No-Load Test and able to draw performance curves by conducting brake test.

List of the Experiments

Any 10 of the following experiments are to be conducted:

1. Serial and Parallel Resonance – Timing, Resonant frequency, Bandwidth and Q-factor determination for RLC network.
2. Two port network parameters – Transmission ,Hybrid Parameters.
3. Two port network parameters – Z, Y Parameters.
4. Verification of Superposition and Reciprocity theorems.
5. Verification of maximum power transfer theorem
6. Verification of Thevenin's Theorem.
7. Verification of Norton's Theorem
8. Magnetization characteristics of DC Shunt generator. Determination of critical field resistance.
9. Swinburne's Test on DC shunt machine (Predetermination of efficiency of a given DC Shunt machine working as motor and generator).
10. Brake test on DC shunt motor. Determination of performance characteristics.
11. OC & SC tests on Single-phase transformer (Predetermination of efficiency and regulation at given power factors and determination of equivalent circuit).
12. Speed control of DC Shunt Motor.

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TRNSMISSION LINES AND WAVEGUIDES

II Year – II Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with the transmission line concepts.
- To introduce the concepts of various wave guides for practical applications.

Learning Outcomes

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

- apply the knowledge of network theory in analyzing the concepts of transmissions lines.
- analyze the transmission lines at different frequencies.
- measure the transmission line parameters using smith chart.
- demonstrate the knowledge of wave guides and fundamental principles.
- understand different modes of propagation in wave guides.
- select an appropriate wave guide to meet specified requirements.

Course Content

UNIT - I: Transmission Lines I

Types, primary constants of transmission line, equivalent circuit of transmission line, transmission line equations, infinite length transmission line, secondary constants- characteristic impedance, propagation constant, phase and group velocities, wave length, line with any termination, input impedance, line impedance, lossless line concepts.

UNIT - II: Transmission Lines II

Distortion in transmission lines, distortion less line, telephone cable, inductance loading of telephone cables-loading types, short circuit and open circuit lines, voltage and current variations, reflection coefficient, $\lambda/4$, $\lambda/2$, $\lambda/8$ transmission lines, T and π equivalent sections of lines.

UNIT - III: Transmission Line at Higher Frequencies

Open wire line at higher frequencies- secondary constants at higher frequencies, Voltage Standing Wave Ratio, location of voltage maxima and minima. Smith chart – configuration. calculation of reflection coefficient, VSWR, input impedance using Smith chart, impedance matching- quarter wave transform technique, single stub matching design and double stub matching (designing not required).

UNIT - IV: Guided Waves

Waves between parallel planes, transverse electric waves, transverse magnetic waves. characteristics of TE, TM, TEM waves- modes, cut-off frequencies, phase, group velocities, free space, cutoff, guided wavelengths, wave impedances.

UNIT - V: Rectangular Wave Guides

Rectangular waveguide-, transverse electric waves (TE), transverse magnetic (TM) waves. characteristics of TE, TM waves- modes, cut-off frequencies, phase, group velocities, free space, cutoff, guided wavelengths, wave impedances.

UNIT - VI: Circular Wave Guides

Solution of the field equations in cylindrical co-ordinates, transverse electric waves (TE), transverse magnetic (TM) waves. characteristics of TE, TM waves- modes, velocities, wavelengths, wave Impedance.

Text Books

1. Nathan Ida "Engineering Electromagnetics", Springer (India) Pvt. Ltd., New Delhi, 2nd Edition.
2. C Jordan and K.G Balmain, "Electromagnetic Waves and Radiating Systems", PHI 2nd Edition.

Reference Books

1. Samuel Y.Liauo,"Microwave Devices and Circuits" 3rd Edition, Pearson publications.
2. M. N. O. Sadiku, "Elements of Electromagnetics", 6th Edition, Oxford University Press, 2011
3. Joseph Edminister, "Electromegnetics", Schaum's Series TMH,
4. John D Ryder, "Networks Lines and Fields", PHI, 2003.

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ANALOG CIRCUITS

II Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with circuit configuration and analysis of single-stage amplifiers, differential amplifiers, tuned amplifiers, feedback amplifiers, oscillators, and power amplifiers.
- To introduce inverting and non-inverting operation of op amps.
- To design op amp RC oscillators and class-B output stage.

Learning Outcomes

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

- draw, analyse, and characterize the MOS and BJT single-stage amplifiers at low and high frequencies.
- design CS and CE amplifiers at low frequencies.
- draw, analyze, and characterize - cascode, darlington, differential, feedback, power amplifiers and oscillators.
- draw and analyze the behaviour of tuned amplifiers and op amp under inverting and non-inverting configurations.

Course Content

UNIT - I: Low-Frequency Single-Stage Amplifiers

MOS amplifiers, low-frequency response of the common-source (CS) amplifier, design of CS amplifier, BJT amplifiers, low-frequency response of the common-emitter (CE) amplifier, design of CE amplifier.

UNIT - II: High-Frequency Single-Stage Amplifiers

General considerations, high-frequency response of CS and CE amplifiers, cascode amplifier, Darlington configuration.

UNIT - III: Differential Amplifiers

MOS differential pair, small-signal operation of the MOS differential pair, frequency response of resistively loaded MOS differential amplifier, BJT differential pair.

UNIT - IV: Introduction to OP-AMPS and Tuned Amplifiers

Ideal op amp, inverting and non-inverting configurations, Tuned amplifiers.

UNIT - V: Feedback Amplifiers and Oscillators

General feedback structure, some properties of negative feedback, four basic feedback topologies, series-shunt feedback amplifier, series-series feedback amplifier, shunt-shunt and shunt-series feedback amplifiers, determining the loop gain, stability problem, Basic principles of sinusoidal oscillators, op amp - RC oscillator circuits, design of op-amp RC oscillators, LC and crystal oscillators.

UNIT - VI: Output Stages and Power Amplifiers

Classification of output stages, class A output stage, class B output stage, design of class B output stage, class AB output stage, biasing the class AB circuit, power BJTs.

Text Book

1. Adel S. Sedra and Kenneth C. Smith, "Microelectronic Circuits", Oxford University Press Inc., Fifth Edition, 2004.

Reference Books

1. R.T. Howe and C.G. Sodini, "Microelectronics: An integrated Approach", Prentice Hall International, 1997.
2. J. Millman and A. Grabel, "Microelectronics", McGraw Hill International, 1987.
3. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuit Theory", Pearson Education Inc., Eleventh Edition, 2013.
4. K. Radha Krishna Rao, "Electronics for Analog Signal Processing - I", NPTEL Video Course.
5. K. Radha Krishna Rao, "Electronics for Analog Signal Processing - II", NPTEL Video Course.

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ANALOG COMMUNICATIONS

II Year – II Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To familiarize students with fundamentals of analog communication systems and various techniques for analog modulation and demodulation schemes.
- To describe the impact of noise on analog modulation schemes.

Learning Outcomes

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

- disseminate the fundamentals of analog modulation schemes.
- differentiate DSB-SC and SSB modulation schemes.
- understand the functioning of AM and FM transmitters and receivers.
- determine power relations for various modulation schemes and evaluate the impact of noise in AM and FM modulation schemes.
- compare and contrast TDM and FDM techniques.

Course Content

UNIT - I: Continuous Wave Modulation-I

Introduction, need for modulation, amplitude modulation-definition, description in time and frequency domains, power relations, generation and detection.

UNIT - II: Continuous Wave Modulation-II

DSB-SC- time-domain and frequency-domain description, generation and coherent detection, costas loop; AM SSB modulated waves- time-domain and frequency-domain descriptions, generation and demodulation;

noise in AM systems; comparison of various AM techniques.

UNIT - III: AM Transmitters

Classification of transmitters, AM transmitters: high level and low level AM transmitters. FDM.

UNIT - IV: AM Receivers

Receiver types- tuned radio frequency receiver, super heterodyne receiver; image frequency and rejection ratio, RF section and receiver characteristics, AGC.

UNIT - V: FM Generation

Introduction to angle modulation, relation between frequency and phase modulations, Single tone frequency modulation, narrow band FM, wide band FM, constant average power, transmission bandwidth of FM wave, generation of FM waves: direct FM and Armstrong method.

UNIT - VI: FM Detection

Detection of FM waves: balanced frequency discriminator, FM transmitters, FM receivers,noise in FM system, pre-emphasis and de-emphasis in FM. TDM.

Text Books

1. Simon Haykin, John Wiley, "Principles of Communication Systems", 2nd Edition.
2. George Kennedy and Bernard Davis, "Electronics & Communication Systems", TMH 2004.

Reference Books

1. H Taub & D. Schilling, Gautam Sahe, "Principles of Communication Systems", TMH, 2007 3rd Edition.
2. B.P. Lathi, "Communication Systems", BS Publication, 2006
3. John G. Proakis, Masond, Salehi, "Fundamentals of Communication Systems", PEA, 2006.

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DIGITAL CIRCUIT DESIGN

II Year – II Semester

Lecture	: 3	Tutorial	: 1	Internal Marks	: 40
Credits	: 3			External Marks	: 60

Course Objectives

- To familiarize with the concepts of different number systems and Boolean algebra.
- To introduce the design techniques of combinational, sequential logic circuits.
- To give a model of combinational and sequential circuits using HDLs.

Course Outcomes

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

- design various logic circuits using Boolean laws.
- design combinational and sequential logic circuits.
- gain the knowledge of PLDs.
- develop digital circuits using HDL

Course Content

UNIT - I: Boolean Algebra and Logic Gates

Number systems - binary numbers, octal, hexadecimal, other binary codes; complements, signed binary numbers, digital logic operations and gates, basic theorems and properties of Boolean algebra, Boolean functions, canonical and standard forms, complements of Boolean functions, two-level NAND and NOR Implementation of Boolean functions.

UNIT - II: Combinational Logic Circuits

The map method (upto four variables), don't care conditions, design procedure, adders, subtractors, 4-bit binary adder/ subtractor circuit, BCD adder, carry look-a-head adder, decoders and encoders, multiplexers, demultiplexers.

UNIT - III: Sequential Logic Circuits

Design procedure, flip-flops, truth tables and excitation tables, conversion of flip-flops, design of counters, ripple counters, synchronous counters, ring counter, Johnson counter, registers, shift registers, universal shift register.

UNIT - IV: Finite State Machines

Types of FSM, capabilities and limitations of FSM, state assignment, realization of FSM using flip-flops, Mealy to Moore conversion and vice-versa, reduction of state tables using partition technique.

UNIT - V: Programmable Logic Devices & HDL

Types of PLD's: PROM, PAL, PLA, basic structure of CPLD and FPGA, advantages of FPGA's. Introduction to Verilog - structural Specification of logic circuits, behavioral specification of logic circuits, hierarchical Verilog Code.

UNIT - VI: Digital Design Using HDLs

Verilog for combinational circuits - conditional operator, if-else statement, case statement, for loop; using storage elements with cad tools-using Verilog constructs for storage elements, blocking and non-blocking assignments, non-blocking assignments for combinational circuits, flip-flop with clear capability, using Verilog constructs for registers and counters.

Text Books

1. M. Morris Mano, "Digital Design", 3rd Edition, PHI. (Unit I to IV)
2. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design", 3rd Edition, McGrawHill (Unit V, VI)

Reference Books

1. Charles H. Roth, Jr, "Fundamentals of Logic Design", 4th Edition, Jaico Publishers.
2. Zvi Kohavi and Niraj K.Jha, "Switching and Finite Automata Theory, 3rd Edition, Cambridge University Press, 2010.
3. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", 2nd Edition, Prentice Hall PTR.
4. D.P.Leach, A.P.Malvino, "Digital Principles and Applications", TMH, 7th Edition.

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FUNDAMENTALS OF DATA STRUCTURES

II Year – II Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To impart knowledge of linear and non-linear data structures.
- To familiarize with different sorting and searching techniques.

Learning Outcomes

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

- demonstrate the working process of sorting (bubble, insertion, selection and heap) and searching (linear and binary) methods using a programming language.
- design algorithms to create, search, insert, delete and traversal operations on linear and non-linear data structures.
- evaluate the arithmetic expressions using stacks.
- compare array and linked list representation of data structures.

Course Content

UNIT - I: Linked lists

Introduction- Concept of data structures, overview of data structures, implementation of data structures.

Linked Lists- Single linked list, Circular linked list, Double linked list, Circular double linked list.

UNIT - II: Stacks

Representation using arrays and linked list, operations on stack, factorial calculation, evaluation of arithmetic expression.

UNIT – III: Queues

Representation using arrays and linked list, operations on queue, circular queue, queue using stack.

UNIT - IV: Trees

Binary Trees: Basic tree concepts, properties, representation of binary trees using arrays and linked list, binary tree traversals, threaded binary tree.

Binary search trees: Basic concepts, BST operations: search, insertion, deletion and traversals, creation of binary search tree from in-order and pre (post)order traversals.

UNIT - V: Sorting and Searching

Searching: Linear search, Binary search, Fibonacci search.

Sorting (Internal): Basic concepts, sorting by: insertion (Insertion sort), selection (selection sort), exchange (Bubble sort, quick sort), distribution (radix sort) and merging (merge sort).

UNIT - VI: Graphs

Basic concepts, representations of graphs, operations on graphs- vertex insertion, vertex deletion, find vertex, edge addition, edge deletion, graph traversals (BFS & DFS).

Text Books

1. Debasis samanta, Classic Data Structures, PHI, 2nd edition, 2011.
2. Richard F, Gilberg , Forouzan, Data Structures, 2nd edition, , Cengage.

Reference Books

1. Seymour Lipschutz, Data Structure with C, TMH.
2. G. A. V. Pai, Data Structures and Algorithms, TMH, 2008.
3. Horowitz, Sahni, Anderson Freed, Fundamentals of Data Structure in C, University Press, 2nd edition.

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Open Elective - I

ELEMENTS OF CIVIL ENGINEERING

II Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce basics of Civil Engineering concepts in the fields of surveying, building materials, water resources,Water Supply, Sanitary ,Electrical Works in Building and Highway engineering.

Learning Outcomes

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

- familiarizewith basics of civil engineering and concepts of surveying.
- identify the various properties of building materials and various types of building.
- get acquainted with fundamentals of Water Resources, Water Supply, Sanitary and Electrical Works in Building.
- enumerate the fundamental concepts highway engineering.

Course Content

UNIT - I: Introduction.

Introduction of Civil Engineering, Scope of Civil Engineering, Role of Civil Engineer in Society.Impact of infrastructural development on economy of country.

UNIT - II: Surveying

Introduction: Definition of Surveying, Fundamental principles of surveying, Classification of surveying

Linear Measurement: Methods, Instruments used in chain surveying, Selection of stations, Chaining and Ranging

Angular Measurement: Instruments used, Types of compass, Types of meridians and bearings, Measurement of bearings, computation of angles. Compass traversing local attraction.

Levelling: Objectives and applications-terminology-Instruments,component parts of dumpy level,Types of levelling ,levelling staff

UNIT - III: Building Materials and Construction

Materials: Introduction to construction materials - Stones, Bricks, Lime, Cement, Timber, Sand, Aggregates, Mortar, Concrete and bitumen.

Construction: Classification of buildings, Building components and their functions.

UNIT - IV: Water Resources

Hydrologic cycle, water use and its conservation, Introduction to dams, barrages and check dams.

UNIT - V: Water Supply, Sanitary and Electrical Works in Building

Introduction, water supply system, water supply layout of a building, housedrainage, traps, electrical works in building.

UNIT - VI: Transportation Engineering

classification of roads, Introduction of flexible and rigid pavements, Introduction to road traffic and traffic control mechanism.

Text Books

1. Elements of Civil Engineering, Mimi Das Saikia, Bhargab Mohan Dasand Madan Mohan Das Publisher: PHI Learning Private Limited New Delhi.
2. Elements of Civil Engineering, Dr. R.K. Jain and Dr. P.P. Lodha, Publisher: McGraw Hill Education, India Pvt. Ltd.
3. Surveying Vol. I, Dr. B. C. Punmia, Ashokkumar Jain, ArunkumarJain, 16th Edition Publisher: Laxmi Publication Delhi.

Reference Books

1. Surveying Theory and Practice, James M Anderson andEdward, 7th Edition, M Mikhail Publisher: McGraw Hill Education, India Pvt. Ltd.
2. Surveying and Leveling, R. Subramanian Publisher, Oxford University.
3. Building drawing, M.G.Shah, C.M.Kale and S.Y.Patki Publisher: TataMcGraw Hill.

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Open Elective - I

BUILDING SERVICES

II Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To impart knowledge on water supply, treatments and water distribution for all type of buildings
- To acquire principles and best practices for Solid waste management in residential units.
- To create awareness about the importance of electrical and mechanical services in buildings and fire safety

Learning Outcomes

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

- describe water supply, treatments, distribution and plumbing systems for all type of buildings.
- study waste water treatments, Sewer lines for all types of buildings.
- appraise the refuse collections, disposal, composting, landfill, bio gas for a town and city.
- acquaint with distribution of electricity to all units of the project.
- adopt fire protection units at service points.

Course Content

UNIT - I: Water Quality, Treatments and Distribution

Sources of water supply – Water Quality - Water requirements for all type of residential, commercial, Industrial buildings and for town – Water treatment methods – Screening, aeration, Sedimentation, Filtration, Disinfection, Softening, conveyance of water – Distribution of water – Choice of pipe materials - Types of fixtures and fittings – System of plumbing in all type of buildings.

UNIT - II: Waste Water, Treatments and Disposal

Waste water – Sewage disposal, primary treatment.Secondary treatment, Biological treatment and Modern types of Sewage Treatment Plants - Sewer line fixtures and traps, Manholes, Septic tank.

UNIT - III: Room Acoustics

Key terms & Concepts, Introduction, Acoustic principles, Sound power and pressure levels, Sound pressure level, absorption of sound, Reverberation time, Transmission of sound. Sound pressure level in a plant room, outdoor sound pressure level, Sound pressure level in intermediate space, noise rating, Data requirement, output data.

UNIT - IV: Electrical Services

Electrical systems – Basic of electricity – single/Three phase supply – protective devices in electrical installation – Earthing for safety – Types of earthing – ISI Specifications. Electrical installations in buildings – Types of wires, Wiring systems and their choice – planning electrical wiring for building – Main and distribution boards –Principles of illumination

UNIT - V: Heat Ventilation and Air Conditioning (HVAC)

Behaviour of heat propagation, thermal insulating materials and their co-efficient of thermal conductivity.

General Methods of Thermal Insulation: Thermal insulation of roofs, exposed walls.

Ventilation: Definition and necessity,system of ventilation. Principles of air conditioning, Air cooling, Different systems of ducting and distribution, Essentials of air-conditioning system.

UNIT - VI: Fire Fighting Services

Fire, causes of fire and spread of fire, Classification of fire, fire safety and fire fighting method, fire detectors, heat detector, smoke detectors, fire dampers, fire extinguishers.

Text Books

1. Water supply and sanitary engineering, S.C.Rangwala, Charotar publishing house.
2. Environmental Engineering, A. Kamala & DL Kantha Rao, Tata McGraw – Hill Publishing company Limited

Reference Books

1. Water supply and sanitary engineering, Charangith shah, Galgotia publishers.
2. Fire Safety in Building, V.K.Jain, Newage publishers (2010)
3. Heat pumps and Electric Heating, E.R.Ambrose, John and Wiley and Sons Inc.
4. Handbook for Building Engineers in Metric systems, NBC,New Delhi.
5. National Building Code (2016).

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Open Elective - I

ELECTRICAL MATERIALS

II Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the concepts of dielectric and ferro magnetic materials.
- To impart knowledge on semiconductor materials.
- To familiarize with the required materials used for electrical applications.

Learning Outcomes

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

- describe various insulating, conducting and magnetic materials used in electrical applications.
- analyze the properties of liquid, gaseous and solid insulating materials.
- describe various semiconductor materials.
- select appropriate material for electrical and special purpose applications

Course Content

UNIT - I: Dielectic Materials

Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics.

UNIT - II: Ferromagnetic Materials

Properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

UNIT - III: Magnetic Materials

Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. factors effecting permeability and hysteresis.

UNIT - IV: Semiconductor Materials

Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale integration techniques (VLSI).

UNIT - V: Materials for Electrical Applications

Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid Liquid and Gaseous insulating materials. Effect of moisture on insulation.

UNIT - VI: Special Purpose Materials

Refractory Materials, Structural Materilas, Radiaoactive Materials, Galvonization and Impregnation of materials, Processing of electronic materials, Insulating varnishes and coolants, Properties and applications of mineral oils, Testing of Transformer oil as per ISI.

Text Books

1. R K Rajput: A course in Electrical Engineering Materials, Laxmi Publications. 2009.
2. T K BasaK: A course in Electrical Engineering Materials:, New Age Science Publications 2009 .

Reference Books

1. TTTI Madras: Electrical Engineering Materials
2. Adrianus J.Dekker: Electrical Engineering Materials , THM Publication

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Open Elective - I

CONTROL SYSTEMS ENGINEERING

II Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the basic concepts of control systems by developing mathematical models for physical systems.
- To familiarize with the time domain behavior of linear control systems.
- To impart knowledge on analytical and graphical methods to quantify stability of linear control systems.
- To introduce concepts on the state variable theory.

Learning Outcomes

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

- develop mathematical models for physical systems.
- employ the time domain analysis to quantify the performance of linear control systems and specify suitable controllers.
- quantify time and frequency domain specifications to determine stability margins.
- apply state variable theory to determine the dynamic behavior of linear control systems.

Course Content

UNIT - I: Introduction

Concepts of Control Systems- Open Loop and closed loop control systems and their differences- Different examples of control systems- Classification of control systems, Feed-Back Characteristics, Effects of feedback. Mathematical models – Differential equations, Impulse Response and transfer function.

UNIT - II: Control Systems Components

Transfer Function of DC Servo motor - AC Servo motor-, Block diagram representation of systems considering -Block diagram algebra – Representation by Signal flow graph - Reduction is using Mason's gain formula- simple problems

UNIT - III: Time Response Analysis

Standard test signals - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems - Time domain specifications – Steady state response - Steady state errors and error constants- simple problems.

UNIT - IV: Stability Analysis in S-Domain

The concept of stability – Routh's stability criterion – qualitative stability and conditional stability – limitations of Routh's stability.

Root Locus Technique: The root locus concept - construction of root loci – simple problems

UNIT - V: Frequency Response Analysis

Introduction, Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications- Phase margin and Gain margin-Stability Analysis from Bode Plots. Polar Plots- simple problems.

UNIT - VI: State Space Analysis of Continuous Systems

Concept of state, state variables and state model, derivation of state models from physical systems, solving the Time invariant state Equations- State Transition Matrix and its Properties – simple problems.

Text Books

1. Control Systems Engineering – by I. J. Nagrath and M. Gopal, New Age International Limited Publishers, 2nd edition.
2. Automatic control system – B.C.Kuo , john wiley and son's 8th edition, 2003.

Reference Books

1. Modern control engineering – K.Ogata , prentice Hall of India Pvt. Ltd., 5th Edition.
2. Control system – N.K.Sinha, New Age International (p) Limited Publishers, 3rd Edition, 1998.
3. Control system engineering – Norman S-Nice, Willey Studio Edition, 4th Edition. Feed back and control system – Joseph J Distefa

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Open Elective - I

ELEMENTS OF MANUFACTURING PROCESSES

II Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the principles of manufacturing processes to convert materials into desired shapes and sizes.

Learning Outcomes

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

- select appropriate casting method to impart geometry to the material.
- choose appropriate type of welding process for joining of metals
- list out various welding defects and propose remedial measures
- distinguish between hot working and cold working processes
- identify suitable metal forming technique to impart desired geometry to the product.

Course Content

UNIT - I

Introduction: Classification of manufacturing processes

Sand Casting: steps involved in making casting

Patterns: - Pattern Materials, Types of patterns, Pattern Allowances

Molding: – Molding sand, Types of molding sand and its properties, Methods of molding

UNIT - II

Special casting processes – Centrifugal casting, Investment casting, Die casting, Shell molding, Slush casting.

Casting defects – Cause and Remedies.

UNIT - III

Metal Joining Processes:- Classification of Metal joining processes

Welding:- Welding terminology, Types of weld joints and welds

Fusion Welding:- Principle of Oxy Acetylene welding, Equipment Setup, Types of flames.

Types of Arc Welding Processes: SMAW, TIG, MIG

UNIT - IV

Pressure welding: Principle of Resistance welding, Equipment set up, Different resistance welding methods.

Solid state welding: Friction welding, Induction welding and Explosive welding

Welding Allied Processes: Soldering, Brazing and Braze welding

UNIT - V

Metal Forming: Classification of metal working processes.

Rolling –Types of Rolling mills, Rolling defects and remedies.

Drawing – drawing of rod, wire and tube – Drawing defects.

Extrusion – Classification of Extrusion process, Impact Extrusion

UNIT – VI

Forging – Basic forging operations ,Open die forging, Closed die forging, press forging, Drop forging, Roll forging Defects

Sheet metal forming operations – Blanking and piercing, Bending Deep drawing, Stretch forming, Embossing, Coining.

Text Books

1. M.P.Groover "Fundamentals of Modern Manufacturing, Materials, processing and systems", John wiley & sons, inc,4th Edition
2. H.S.Shan ,"Manufacturing Processes", Cambridge, 2nd Edition.

Reference Books

1. Serope Kalpakjian and Steven R.Schmid, "Manufacturing Engineering & Technology", Pearson Education, Inc., 5th edition..
2. Lindberg/PE , "Process and materials of manufacturing ", PHI.
3. Heine, Roper, Rosenthal, "Principles of Metal Castings ", Tata Mc Graw Hill Publications, 2nd edition.
4. R.S.Paramar,"Welding Engineering and Technology ",khanna Publications,1st edition.

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Open Elective - I

AUTOMOTIVE ENGINEERING

II Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce various components of an automobile and engine sub systems.
- To familiarize with the various systems such as transmission system, steering system, suspension system, braking system, and safety systems.
- To impart knowledge on various safety systems of an automobile and emission norms.

Learning Outcomes

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

- describe the various components of an automobile
- classify various fuel supply, lubrication, cooling and ignition systems
- explain transmission, suspension, steering and braking systems of an automobile and their differences
- specify different safety norms for the operation of an automobile.

Course Content

UNIT - I

Introduction: classification of automobiles, Components of four wheeler automobile- chassis, body, power unit, power transmission- front wheel drive, rear wheel drive, four-wheel drive

Fuel supply systems: Carburettor-types, defects in carburettor, electronic injection system, multi point fuel injection system, fuel injection system in diesel engine, fuel injection pumps, fuel injector and nozzles.

UNIT - II

Lubricating System: Functions & properties of lubricants, methods of lubrication-splash, pressure, dry sump and wet sump lubrication, oil filters and oil pumps.

Cooling System: Necessity, methods of cooling - air cooling & water cooling, components of water cooling, radiator, thermostat.

UNIT - III

Ignition System: Functions, requirements, types of an ignition system, **b**attery ignition system - components, Magneto ignition system, Electronic ignition system.

Electrical System: charging circuit- generator, current-voltage regulator, stating System-Bendix drive mechanism, lighting system, indicating devices, horn.

UNIT - IV

Transmission system: Types and functions of the clutches- cone clutch, single plate clutch, multi plate clutch, centrifugal and semi centrifugal clutch, Types of gear boxes- Sliding mesh, Constant mesh, Synchromesh, propeller shaft, universal joint and differential. wheels and tyres.

Steering System: steering geometry, condition for correct steering, types of steering Mechanisms-Ackermann and Davis steering mechanism, steering gears, power steering.

UNIT - V

Suspension System: Objectives of suspension system, front suspension system-rigid axle suspension system, independent suspension system, rear axle suspension, torsion bar, shock absorber.

Braking System: Mechanical brakes, hydraulic brakes-master cylinder, wheel cylinder, tandem master cylinder, brake fluid, air brakes and vacuum brakes.

UNIT - VI

Emissions from Automobile: Emission norms - Bharat stage and Euro norms. Engine emissions - exhaust and non-exhaust.

Safety Systems: seat belt, air bags, bumper, antilock brake system(ABS), wind shield, suspension sensor, traction control, central locking, electric windows, speed control.

Text Books

1. Kirpal Singh, “Automobile Engineering Vol-1 & vol-2”, Standard Publishers Distributors, 11th edition.
2. William H Crouse & Donald L Anglin, Automotive Mechanics, Tata Mc Graw Hill Publications, 10th edition.

Reference Books

1. R.B Gupta , Automobile Engineering, Satya Prakashan Publications, 6th edition.
2. Newton steeds & Garrett, “The Motor vehicle”, Society of Automotive Engineers, 13th edition.
3. G.B.S. Narang, “Automotive Engineering”, Khanna Publishers, 5th edition.
4. Joseph Heitner, “Automotive Mechanics”, IPC Transport Press Ltd, 2nd Edition.
5. Harbons singh Reyat, “The Automobile”, S. Chand & company pvt. ltd., 6th edition.

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Open Elective - I

INTRODUCTION TO MICROPROCESSORS AND MICROCONTROLLERS

II Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with architecture of 8086 microprocessor and 8051 microcontroller.
- To introduce the assembly language programming concepts of 8086 processor.
- To expose with various interfacing devices with 8086 using 8255.

Learning Outcomes

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

- gain the knowledge of the architecture and instruction set of 8086. Microprocessor and 8051 micro controller.
- design and develop various interfacing circuits with 8086 using 8255.
- differentiate various Serial data transfer schemes.
- develop 8051 based different kinds of applications.

Course Content

UNIT - I: 8086 Microprocessor

Introduction 8086 processor, architecture-functional diagram, register organization, memory segmentation, physical memory organization, signal descriptions of 8086-common function signals, minimum and maximum mode signals, timing diagrams.

UNIT - II: Instruction Set and Assembly Language Programming of 8086

Addressing modes, instruction set, assembler directives, macros, simple programs involving logical, branch and call instructions, sorting, evaluating arithmetic expressions, string manipulations.

UNIT - III: Interfacing with 8086

8255 PPI architecture, modes of operation, keyboard, stepper motor, D/A and A/D converter, memory interfacing to 8086.

UNIT - IV: Interrupt Structure and Serial Communication

Interrupt structure of 8086, vector interrupt table, interrupt service routine, serial communication standards, serial data transfer schemes,8251 USART architecture and interfacing, RS- 232.

UNIT - V: Introduction to 8051 Microcontroller

Overview of 8051 microcontroller, Architecture, I/O Ports, Memory organization, Interrupts, timer/ Counter and serial communication.

UNIT - VI: Interfacing with 8051

Addressing modes and instruction set of 8051, interfacing 8051 to LED's, seven segment display, relays.

Text Books

1. D. V. Hall' "Microprocessors and Interfacing", TMH, 2nd edition 2006. (I to IV Units).
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinlay, "The 8051 Microcontrollers and Embedded Systems", Pearson, 2nd Edition. (IV to VI Units)

Reference Books

1. Barry B.Brey, "The Intel Microprocessors", PHI, 7th Edition, 2006.
2. Liu and GA Gibson, "Micro Computer System 8086/8088 Family Architecture. Programming and Design", PHI, 2nd Edition.
3. Kenneth. J. Ayala, "The 8051 Microcontroller", 3rd Edition, Cengage Learning, 2010.

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Open Elective - I

FUNDAMENTALS OF COMMUNICATIONS

II Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce various analog and digital modulation and demodulation techniques
- To familiarize with various multiplexing schemes and Data communication protocols
- To impart the standards and mechanisms of television systems.

Learning Outcomes

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

- . understand the concepts of various analog and digital modulation techniques.
- . analyze transmission mechanism in transmission lines and optical fiber.
- . compare different multiplexing techniques.
- . understand the principles of wireless communication systems.
- . differentiate the different telephone systems.
- . ascertain error detection and correction capabilities of various codes.

Course Content

UNIT - I: Signals, Noise, Modulation and Demodulation

Signal analysis, electrical noise and signal-to-noise ratio, analog modulation systems, information capacity, bits, bit rate, baud, and M-ary encoding, digital modulation.

UNIT - II: Metallic Cable Transmission Media

Metallic transmission lines, transverse electromagnetic waves, characteristics of electromagnetic waves

Optical Fiber Transmission Media: Advantages of optical fiber cables, disadvantages of optical fiber cables, electromagnetic spectrum, optical fiber communications system block diagram, propagation of light through an optical fiber cable, optical fiber comparison.

UNIT - III: Digital Transmission

Pulse modulation, pulse code modulation, dynamic range, signal voltage to-quantization noise voltage ratio, linear versus nonlinear PCM codes, companding, delta modulation, differential PCM.

UNIT - IV: Wireless Communications Systems

Electromagnetic polarization, electromagnetic radiation, optical properties of radio waves, terrestrial propagation of electromagnetic waves, skip distance, free-space path loss, microwave communications systems, satellite communications systems.

UNIT - V: Telephone Instruments and Signals

The subscriber loop, standard telephone set, basic telephone call procedures, call progress tones and signals, cordless telephones, caller ID, electronic telephones, paging systems.

Cellular Telephone Systems: First- generation analog cellular telephone, personal communications system, second-generation cellular telephone systems, digital cellular telephone, global system for mobile communications.

UNIT - VI: Data Communications Codes, Error Control and Data

Formats: Data communications character codes, bar codes, error control, error detection and correction, character synchronization.

Text Books

1. Wayne Tomasi "Introduction to Data Communications and Networking", Pearson Education.
2. Behrouz A Forouzan "Data Communications and Networking", 4th Edition. TMH.

Reference Books

1. William Stallings "Data and Computer communications", 8th Edition, PHI.
2. Gallow "Computer Communications and Networking Technologies", 2nd Edition.
3. Fred Halsll, Lingana Gouda Kulkarni "Computer Networking and Internet", 5th Edition, Pearson Education.

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Open Elective - I

COMPUTER GRAPHICS

II Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce computer graphics applications and functionalities of various graphic systems.
- To familiarize with 2D and 3D geometrical transformations.
- To disseminate knowledge on the visible surface detection and animation.

Learning Outcomes

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

- design a conceptual model for the mathematical model to determine the set of pixels to turn on for displaying an object.
- analyze the functionalities of various display devices and visible surface detection methods.
- analyze the performance of different algorithms to draw different shapes.
- choose different transformations and viewing functions on objects.
- apply raster animations for Engine oil advertisements.

Course Content

UNIT - I: Introduction

Introduction: Application of computer graphics, raster scan and random scan Displays.

Filled Area Primitives: Points and lines, inside and outside tests, line drawing algorithms, Scan line polygon fill algorithm.

UNIT - II: 2-D Geometrical Transforms

Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transformations.

UNIT - III: 2D Viewing

The viewing pipeline, window to view-port coordinate transformation, Cohen-Sutherland line clipping algorithm, Sutherland –Hodgeman polygon clipping algorithm.

UNIT - IV: 3D Geometric Transformations

Translation, rotation, scaling, reflection and shear transformations, composite transformations, types of projections.

UNIT - V: Visible Surface Detection Methods

Classification – types, back-face detection, depth-buffer, BSP tree, area sub-division method.

UNIT - VI: Computer Animation

Animations: General computer animation, raster animation, key frame systems, Graphics programming using OpenGL: Basic graphics primitives, drawing three dimensional objects, drawing three dimensional scenes.

Text Books

1. Donald Hearn, M.Pauline Baker, "Computer Graphics *C* version", 2nd Edition, Pearson Education.
2. Francis S. Hill, Stephen M. Kelley, "Computer Graphics using OpenGL", 3rd edition, Pearson Education.

Reference Books

1. Foley, VanDam, Feiner, Hughes, "Computer Graphics Principles and Practice", 2nd edition, Pearson Education.
2. Rajesh K Maurya, "Computer Graphics with Virtual Reality Systems", Wiley.

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Open Elective - I

OBJECT ORIENTED PROGRAMMING THROUGH JAVA

II Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the concepts of object oriented programming.
- To impart the knowledge of AWT components in creation of GUI.

Learning Outcomes

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

- apply Object Oriented approach to design software.
- create user defined interfaces and packages for a given problem.
- develop code to handle exceptions.
- implement multi tasking with multi threading.
- develop Applets for web applications
- design and develop GUI programs using AWT components.

Course Content

UNIT - I: Fundamentals of OOP and JAVA

Need of OOP, principles of OOP languages, procedural languages vs. OOP, Java virtual machine, java features.

Java Programming constructs: variables, primitive data types, identifiers, keywords, Literals, operators, arrays, type conversion and casting.

UNIT - II: Class Fundamentals and Inheritance

Class fundamentals, declaring objects, methods, constructors, this keyword, overloading methods and constructors, access control.

Inheritance- Basics, types, using super keyword, method overriding, dynamic method dispatch, abstract classes, using final with inheritance, Object class.

UNIT - III: Interfaces and Packages

Interfaces: Defining an interface, implementing interfaces, nested interfaces, variables in interfaces and extending interfaces.

Packages: Defining, creating and accessing a package.

UNIT - IV: Exception Handling and Multithreading

Exception Handling- exception-handling fundamentals, uncaught exceptions, using try and catch, multiple catch clauses, nested try statements, throw, throws, finally, user-defined exceptions.

Multi Threading - Introduction to multitasking, thread life cycle, creating threads, synchronizing threads, thread groups.

UNIT - V: Applets and Event Handling

Applets- Concepts of Applets, differences between applets and applications, life cycle of an applet, creating applets.

Event Handling- Events, event sources, event classes, event listeners, Delegation event model, handling mouse and keyboard events, adapter classes.

UNIT - VI: AWT

The AWT class hierarchy, user interface components- label, button, checkbox, checkboxgroup, choice, list, textfield, scrollbar, layout managers –flow, border, grid, card, gridbag.

Text Books

1. Herbert Schildt, "Java The Complete Reference", 7th edition, TMH.
2. Sachin Malhotra, Saurabh Choudhary, "Programming in Java", 2nd edition, Oxford.

Reference Books

1. Joyce Farrel, Ankit R.Bhavsar, "Java for Beginners", 4th edition, Cengage Learning.
2. Y.Daniel Liang, "Introduction to Java Programming", 7th edition, Pearson.
3. P.Radha Krishna, "Object Oriented Programming through Java", Universities Press.

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Open Elective - I

SYSTEMS SOFTWARE

II Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objective

- To familiarize with the implementation details of assemblers, loaders, linkers, and macro processors.

Learning Outcomes

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

- outline the relationship between system software and machine architecture.
- analyze working of assembler for a simplified Instructional computer.
- describe the important features of linkage Editors and Dynamic Linking .
- identify the mostly used macro processors algorithms and data structures.
- compare the functions of Absolute Loader , Bootstrap Loaders.

UNIT - I: Introduction

System software and machine architecture, The Simplified Instructional Computer (SIC), Machine architecture, Data and instruction formats, addressing modes, instruction sets, I/O and programming System.

UNIT - II: Assemblers

Basic assembler functions, SIC assembler, assembler algorithm and data structures, machine dependent assembler features.

UNIT - III: Implementation of Assemblers

Instruction formats and addressing modes, program relocation, machine independent assembler features, literals, symbol, defining statements, expressions, one pass assemblers, multi pass assemblers, implementation example, MASM assemble.

UNIT - IV: Loaders

Basic loader functions, design of an absolute loader, simple bootstrap loader, machine dependent loader features, relocation, loader options, loader design options, bootstrap loaders.

UNIT - V: Linkers

Program linking, algorithm and data structures for linking loader, machine independent loader features, automatic library search, linkage editors, dynamic linking, implementation example, MS DOS linkers.

UNIT - VI: Macro Processors

Basic macro processor functions, macro definition and expansion, macro processor algorithm and data structures, machine independent macro processor features, concatenation of macro parameters, generation of unique labels, conditional macro expansion.

Text Book

1. Leland L. Beck, "System Software – An Introduction to Systems Programming", 3rd edition, Pearson Education Asia, 2000.

Reference Book

1. D. M. Dhamdhere, "Systems Programming and Operating Systems", 2nd Revised edition, Tata McGraw-Hill, 1999.
2. John J. Donovan "Systems Programming", Tata McGraw-Hill Edition, 1972.

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Open Elective - I

WEB PROGRAMMING

II Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To develop real time web applications.
- To get acquainted with skills for creating websites and web applications by learning various technologies like HTML, CSS, JavaScript, XML, JSP and JDBC.

Learning Outcomes

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

- identify HTML tags with their purpose
- develop User Interface for web applications using HTML and CSS.
- design dynamic web pages using Java Script.
- use XML for storing data.
- design JSP applications
- apply the concept of sharing data between dynamic web pages
- create pure Dynamic web application using JDBC
- describe the usage of JDBC API

UNIT - I: HTML & CSS

HTML –HTML versions**,** Basic HTML Tags, working with Lists, Tables, Forms, Frames,div, Images, Navigation.

UNIT - II: Cascading Style sheets

CSS rules, Types of CSS, Selectors ,CSS Properties for Styling Backgrounds, Text, Fonts, Links, and Positioning.

UNIT - III: Java Script

Introduction to Java Script, Variables, Data types, Functions, Operators, Control flow statements, Objects in Java Script with examples.

UNIT – IV: XML

Basic building blocks, DTD and XML Schemas, XML Parsers- DOM and SAX, using CSS with XML and XML AJAX.

UNIT - V: JSP

Basic of a JSP Page, JSP Processing, Generating Dynamic Content-Using Scripting Elements, Implicit JSP Objects, Declaring Variables and Methods, Passing Control and Data between pages, creation of Session

UNIT - VI: Database Access

JDBC Drivers, Database Programming using JDBC, Accessing a database from a JSP Page.

Text Books

1. Web Technologies, “Black book”, Kogent Learning Solutions, Dreamtech press.
2. Chris Bates, “Web Programming: building internet applications”, WILEYDreamtech, 2nd edition.

Reference Books

1. Uttam K Roy, “Web Technologies”, Oxford.
2. John Duckett, “Beginning Web Programming”.
3. Wang Thomson, “An Introduction to web design and Programming”.

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Open Elective - I

MATHEMATICAL CRYPTOGRAPHY

II Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To give a simple account of classical number theory, prepare students towards the concepts of Network Security and to demonstrate applications of number theory (such as public-key cryptography).
- To students will have a working knowledge of the fundamental definitions and theorems of elementary number theory, be able to work with congruences.
- To solve congruence equations and systems of equations with one and more variables.
- To students will also have an exposure to cryptography.

Learning Outcomes

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

- understand the properties of divisibility and prime numbers, compute the greatest common divisor and least common multiples and handle linear Diophantine equations.
- understand the operations with congruences, linear and non-linear congruence equations.
- understand and use the theorems: Chinese Remainder Theorem, Lagrange theorem, Fermat's theorem, Wilson's theorem.
- use arithmetic functions in areas of mathematics.
- understand continue fractions and will be able to approximate reals by rationals.
- understand the basics of RSA security and be able to break the simplest instances.

Course Content

UNIT - I: Divisibility

Greatest common divisor, Fundamental theorem of arithmetic, Congruence, Residue classes and reduced residue classes, Euler's theorem, Fermat's theorem, Wilson Theorem, Chinese remainder theorem with applications.

UNIT - II: Polynomial Congruences

Primitive roots, Indices and their applications, Quadratic residues, Legendre symbol, Euler's criterion, Gauss's Lemma, Quadratic reciprocity law, Jacobi symbol.

UNIT - III: Arithmetic Functions

ϕ(x), d (x), μ(x), σ (x) , Mobius inversion formula, LinearDiophantine equations

UNIT - IV: Farey Series

Continued fractions, Approximations of reals by rationals, Pell's equation.

UNIT - V: Introduction to Cryptography

Encryption schemes, Cryptanalysis, Block ciphers, Stream ciphers.

UNIT - VI: Public Key Encryption

RSA cryptosystem and Rabin encryption.

Text Books

1. Jeffrey Hoffstein, Jill Pipher, Joseph H. Silverman, **An Introduction to Mathematical Cryptography**, springer, second edition (2014).
2. Gilbert Baumslag, Benjamin Fine, Martin Kreuzer, A Course in Mathematical Cryptography, Walter de Gruyter GmbH & Co KG(2015).

Reference Books

1. Hardy and Wright W.H., **Theory of Numbers**, Oxford University Press (1979).
2. Niven I., Zuckerman S.H. and Montgomary L.H., **An Introduction to Theory of Numbers**, John Wiley and Sons (1991).

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Open Elective - I

SEMICONDUCTOR PHYSICS

II Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To know the physics and applications of semi conductor.
- To understand fundamental principles and applications of the electronic and optoelectronic.

Learning Outcomes

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

- classify semi conductors.
- discuss photonic devices.
- Interpret formation of band structure.

Course Content

UNIT - I: Electronic Materials (8)

Free electron theory, Density of states and energy band diagrams, Kronig-Penny model (to introduce origin of band gap), Energy bands in solids, E-k diagram, Direct and indirecT bandgaps, Types of electronic materials: metals, semiconductors, and insulators.

UNIT - II: Semiconductors (10)

Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentrationand temperature (equilibrium carrier statistics), Carrier generation and recombination, Carrier transport: diffusion and drift

UNIT - III: Light-Semiconductor Interaction (6)

Optical transitions in bulk semiconductors: absorption, spontaneous emission, and stimulateD Emission.

UNIT - IV: Engineered Semiconductor Materials (6)

Density of states in 2D, 1D and 0D (qualitatively). Practical examples of low-dimensional systems such as quantum wells, wires, and dots: design, fabrication, and characterization techniques. Hetero junctions and associated band-diagrams

UNIT - V: Photo Detectors (6)

Types of semiconductor photo detectors -p-n junction, PIN, and Avalanche and their structure, materials, working principle, and characteristics, Noise limits on performance; Solar cells.

UNIT - VI: Semiconductor Light Emitting Diodes

Rate Equation for carrier density - Radiative and non-radiative recombination mechanisms in semiconductor - LED: device structure, material, characteristics and figures of merit.

Text Books

1. S. M. Sze, Semiconductor Devices: Physics and Technology, Wiley (2008).
2. J. Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Inc. (1995).

Reference Books

1. B. E. A. Saleh and M. C. Teich, Fundamentals of Photonics, John Wiley & Sons, Inc., (2007).
2. A. Yariv and P. Yeh, Photonics: Optical Electronics in Modern Communications, Oxford University Press, New York (2007).
3. P. Bhattacharya, Semiconductor Optoelectronic Devices, Prentice Hall of India (1997).
4. Online course: "Semiconductor Optoelectronics" by M R Shenoy on NPTEL
5. Online course: "Optoelectronic Materials and Devices" by Monica Katiyar and Deepak Gupta on NPTEL.

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ANALOG CIRCUITS LAB

II Year – II Semester

Practical	: 4		Internal Marks	:	40
Credits	: 2		External Marks	:	60

Course Objectives

To make the students familiarize with the

- design, simulation, and conduct of experiments to obtain the frequency response/ performance characteristics of single-stage, cascode, differential, tuned, feedback, and power amplifiers, RC and LC oscillators,.
- testing of op-amp in inverting and non-inverting configurations.

Learning Outcomes

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

- perform experiment, take observations, present the results in proper form, analyze and interpret results, draw conclusions by correlating with theory.
- use modern tools for simulation.
- design, simulate, hardware implement, test, and obtain performance characteristics of - CS, CE, BJT cascode, BJT differential, single-tuned, series-series feedback, shunt-shunt feedback, and class B complementary symmetry power amplifiers.
- verify the operation of op amp in inverting and non-inverting configurations.
- design, simulate, hardware implement, and test Wien-bridge and Colpitts oscillators.
- make oral presentations and prepare written reports.

List of Experiments

1. Common-source amplifier (design, simulation, hardware implementation and testing)
2. Common-emitter amplifier (design, simulation, hardware implementation and testing)
3. Cascode amplifier using BJTs
4. BJT differential amplifier
5. Op-amp operation in inverting and non-inverting configurations
6. Single-tuned amplifier (design, simulation, hardware implementation and testing)

7. Series-series feedback amplifier
8. Shunt-shunt feedback amplifier
9. Wien-bridge oscillator using op-amp (design, simulation, hardware implementation and testing)
10. Colpitts oscillator
11. Class -B complementary symmetry power amplifier (design, simulation, hardware implementation and testing)
12. Open-ended experiment

Reference Books

1. Adel S. Sedra and Kenneth C. Smith, “Microelectronic Circuits”, Oxford University Press Inc., 2004.
2. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, Pearson Education Inc., 11th Edition, 2013.
3. K. Radha Krishna Rao, “Electronics for Analog Signal Processing - I”, NPTEL Video Course.
4. K. Radha Krishna Rao, “Electronics for Analog Signal Processing - II”, NPTEL Video Course.
5. User manuals for basic electronic lab equipment.
6. Data sheets for electronic components.

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DIGITAL CIRCUIT DESIGN LAB

II Year – II Semester

Practical	: 4	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To get acquainted with the concepts of various Digital Circuits
- To familiarize with the CAD Tools.

Learning Outcomes

After the completion of course, students will be able to

- learn the digital circuit concepts.
- design the digital circuits.
- develop digital circuits using CAD tools.

List of Experiments

Part-A: To design and simulate using Electronic Workbench

1. Full adder.
2. 8:1 multiplexer.
3. SR and D flip-flop.
4. Shift register
5. Asynchronous counter.
6. Open Ended Experiment

Part B: To design and simulate using CAD tools

1. 8:3 priority encoder.
2. Ring counter.
3. Asynchronous counter.
4. Simple Datapath
5. ALU Design
6. Open Ended Experiment

Reference Books

1. M. Morris Mano, "Digital Design", 3rd Edition, PHI.
2. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design", 3rd Edition, McGrawHill.
3. Samir Palnitkar, "Verilog HDL: A Guide to Digital Design and Synthesis", 2nd Edition, Prentice Hall PTR.

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Optional Elective - I

INTRODUCTION TO PYTHON PROGRAMMING

II Year – II Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with Python Programming .

Learning Outcomes

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

- outline features, history of Python programming language.
- classify literal constants, data Types and operators in python.
- demonstrate the use of data structures like lists, tuples and dictionaries in python.
- use classes, objects, methods, and inheritance to write object oriented programs.
- differentiate mutable and immutable data types.
- analyze different ways of building logic for executing programs using decision control, iterative statements.
- develop applications/programs using standard data types in Python.

Course Content

UNIT - I: Basics of Python Programming

Features and history of Python, literal constants, data types, variables, operators, input operation.

UNIT - II: Decision Control and Looping Statements

Conditional and un-conditional branching, iterative statements, nesting of decision control statements and loops.

UNIT - III: Functions and Strings

Functions: Function definition, call, return statement, types of arguments recursive functions, modules.

Strings -Basic string operations, string formatting operator, built-in functions.

UNIT - IV: Tuples and Lists

Tuples: Creating, accessing values, updating, deleting elements in a tuple, basic tuple operations.

Lists: Accessing, updating values in lists, basic list operations, mutability of lists.

UNIT - V: Dictionaries

Dictionaries: Creating a dictionary, adding an item, deleting items, sorting items, looping over a dictionary, basic dictionary operations, built-in functions.

UNIT - VI: OOP in Python

Classes and objects, class method and self argument, _init_() method, calling a class method from another class method, inheriting classes in Python.

Text Books

1. Reema Thareja, “Python Programming – Using Problem Solving Approach“, Oxford University Press, 2014 Edition.
2. Dr. R. Nageswara Rao, “Core Python Programming”, 2017 Edition.

Reference Books

1. Martin C. Brown, “Python: The Complete Reference”, 2001 Edition, Tata McGraw Hill Publishing Company Limited.
2. Kenneth A. Lambert, ‘Fundamentals of Python – first programs”, 2012 Edition, Cengage.

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Optional Elective - I

DATABASE MANAGEMENT SYSTEMS

II Year – II Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize the concepts of database systems and different issues involved in the database design.
- To introduce how to write SQL for storage, retrieval and manipulation of data in a relational database.

Course Outcomes

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

- recognize the importance of database system over file processing system.
- analyze an information storage problem and derive an information model in the form of an entity relationship diagram.
- write simple and complex queries using Structured Query Language (SQL) for storage, retrieval and manipulation of data in a relational database.
- employ principles of normalisation for designing a good relational database schema.
- describe the issues and techniques relating to concurrency and database recovery in a multi-user database environment.

Course Content

UNIT - I: Introduction to Database

Introduction, advantages of using DBMS, data models, levels of abstraction, entity-relationship model: attributes and keys, relationship types, weak entity set, strong entity set, specialization and generalization, database design for banking enterprise, reduction to relational schemas.

UNIT - II: Relational Model and SQL

Relational Model: Basic concepts, schema and instances, keys, relational algebra, SQL: DDL, DML, integrity constraints,defining different constraints on a table, set operations, aggregate functions, group by and having clauses, nested queries.

UNIT - III: Database Design

Functional dependencies: Partial, full, transitive and trivial dependencies, axioms, decomposition: lossless join and dependency preserving decomposition, attribute closure, normal forms: 1NF, 2NF, 3NF and BCNF.

UNIT - IV: Transaction Management

Transaction concept, ACID properties, transaction state diagram, schedules-serial, concurrent and serializable schedules, serializability- conflict and view serializability, recoverability.

UNIT - V: Concurrency Control

Concurrency Control- Concurrent execution of transactions, anomalies due to concurrent execution, lock-based protocols-2PL, strict 2PL and rigorous 2PL, timestamp-based protocols, Thomas write rule, deadlock handling-deadlock prevention, deadlock detection and recovery.

UNIT - VI: Crash Recovery

Crash Recovery - Failure classification, different types of recovery techniques: deferred update, immediate update, shadow paging, checkpoints.

Text Books

1. Korth and Sudarshan, Database system concept, TMH,3rd edition.
2. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, 3rd edition,TMH.

Reference Books

1. Elmasri Navrate, Fundamentals of Database Systems,5th edition, Pearson Education
2. C.J.Date, Introduction to Database Systems, 8th edition,Pearson Education
3. Peter Rob and C Coronel, Database Systems design, Implementation, and Management, 7th Edition.

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Optional Elective - I

ELECTRONIC SWITCHING SYSTEMS

II Year – II Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the operational characteristics of switching techniques.
- To introduce the concepts of working of different Switching types and networks, Digital Subscriber Access.
- To familiarize with the digital transmission systems.

Learning Outcomes

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

- distinguish different switching systems
- differentiate transmission and multiplexing systems
- understand the concepts of digital switching systems
- decimate the knowledge of fiber optic transmission systems.
- compare different interfaces of ISDN
- analyze the traffic characterization in different networks.

Course Content

UNIT - I: Introduction to Switching and Transmission Systems

Analog network hierarchy, switching systems, transmission systems, signaling, analog interfaces, digital network evolution, advantages and disadvantages of digital voice networks.

UNIT - II: Digital Transmission and Multiplexing

Pulse transmission, asynchronous versus synchronous transmission, time division multiplexing, time division multiplex loops and rings.

UNIT - III: Digital Switching

Switching functions, space division switching, time division switching, 2-d switching, digital switching in an analog environment.

UNIT - IV: Fiber Optic Transmission Systems

Fibre optic transmission system elements, wavelength division multiplexing, SONET/SDH multiplexing, SONET frame format, payload framing, virtual tributaries, SONET optical standards, SONET networks, SONET rings.

UNIT - V: Digital Subscriber Access

ISDN basic rate access architecture, S/T interface, ISDN U interface, ISDN interface, digital subscriber loops, digital loop carrier systems, hybrid fiber coax systems, voice band modems.

UNIT - VI: Digital Mobile Telephony and Traffic Analysis

Digital cellular, global system for mobile communications, CDMA cellular, traffic characterization, network blocking probabilities.

Text Books

1. John C Bellamy, “Digital telephony”, 3rd Edition, Wiley 2009.
2. Marion cole, “Introduction to Telecommunications Voice, Data and the Internet”, 2nd Edition.

Reference Books

1. Wayne Tomasi, “Advanced electronic communication systems”, PHI,2004.
2. Tarmo Anttalainen , “Introduction to Telecommunications Network Engineering”, 2nd Edition, Artech house, INC. 2003.

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LINEAR INTEGRATED CIRCUITS APPLICATIONS

III Year – I Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To familiarize with the functioning of various linear ICs such as op-amp, timer, voltage regulator, voltage controlled oscillator and phase locked loop.
- To introduce the concepts of active filters, D/A and A/D convertors.

Learning Outcomes

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

- infer the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.
- elucidate and design linear and non-linear applications using op-amps.
- design and analyze comparators, waveform generators and multivibrators using functional ICs.
- design active filters and regulated power supplies for various applications.
- apply the concepts of VCO and PLL in the design of demodulator circuits.
- choose appropriate A/D and D/A converters for signal processing applications.

Course Content

UNIT - I: Introduction to Operational Amplifier

The operational amplifier-circuit symbol, terminals; ideal and practical op-amp specifications, block schematic, IC 741 pin configuration and internal circuit, DC and AC characteristics of op-amp.

UNIT - II: Applications of Op-amp

Review of inverting and non-inverting configurations; summing amplifier, difference amplifier, integrator and its design, differentiator, instrumentation amplifier and precision rectifiers.

UNIT - III: Comparators and Waveform Generators

Comparator, schmitt trigger and its design, square wave generator, triangular wave generator, IC 555 Timer-pin diagram, functional description, monostable multivibrator, astable multivibrator and its design.

UNIT - IV: Active Filters

RC active filters, transformation, design of first and second order low-pass and high-pass butterworth filters, design of band-pass filters.

UNIT - V: Voltage Regulators and Phase-Locked Loops

Series op-amp regulator, IC voltage regulators, 723 general purpose regulator, switching regulator, design of regulated power supply using 3-terminal and 723 ICs, Phase-Locked Loops (PLLs) – basic principles, phase detector/comparator, Voltage Controlled Oscillator (VCO), low-pass filter.

UNIT - VI: D/A & A/D Converters

Basic DAC techniques, A-D converters, direct type ADCs, specifications of ADC/ DAC.

Text Book

1. D. Roy Choudhury and Shail B.Jain, "Linear Integrated Circuits", New Age International (p) Ltd, Second Edition, 2003.

Reference Books

1. Sergio Franco, "Design with Operational Amplifier and Analog Integrated Circuits", TMH, Fourth Edition, 2011.
2. G.B.Clayton, "Operational Amplifiers", Elsevier Science, Fifth Edition, 2003.
3. K.Radha Krishna Rao, "Analog ICs", NPTEL Video Course.
4. Paul R.Gray, Paul J.Hurst, Stephen H.Lewis, and Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, Inc., Fourth Edition, 2001.
5. Ramakanth A. Gayakwad, "OP-amps and Linear Integrated Circuits", PHI, Fourth Edition, 2010.

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DIGITAL COMMUNICATIONS

III Year – I Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To introduce pulse modulation techniques.
- To acquaint with different pulse digital modulation techniques.

Learning Outcomes

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

- understand basic concepts of digital communication systems.
- distinguish PCM and DM systems.
- elucidate different digital modulation techniques.
- determine the probability error for different digital modulation techniques.
- identify error detection & correction capabilities of linear block codes.

UNIT - I: Pulse Code Modulation

Elements of digital communication systems, elements of PCM- sampling, quantizing, encoding, regeneration, decoding, reconstruction, multiplexing, synchronization,companding in PCM systems, differential PCM systems (DPCM).

Course Content

UNIT - II: Delta Modulation

Delta modulation, noise in PCM & DM systems, comparison of PCM & DM systems.

UNIT - III: PSK

Phase Shift Keying, Differential Phase Shift Keying, Quadrature Phase Shift Keying, M-ary PSK.

UNIT - IV: ASK and FSK

Amplitude shift keying, frequency shift keying, similarity of BFSK and BPSK, M-ary FSK.

UNIT - V: Data Transmission

Pass band transmission model, base band signal receiver, probability of error, the optimum filter, probability of error using matched filter, coherent reception, calculation of error probability of ASK, BPSK, BFSK, QPSK techniques using coherent detection.

UNIT - VI: Information Theory & Coding

Information and its properties, average information, entropy and its properties, Shannon's theorem, Shanon-Fano and Huffman coding, efficiency calculations,matrix description of linear block codes, error detection and error correction capabilities of linear block codes.

Text Books

1. Simon Haykin, "Digital Communications" John Wiley, 2005.
2. H. Taub and D. Schilling, "Principles of Communication Systems", TMH, 2003.

Reference Books

1. Sam Shanmugam, "Digital and Analog Communication Systems", John Wiley, 2005.
2. John Proakis, "Digital Communications",TMH, 1983.
3. B.P.Lathi, "Modern Analog and Digital Communication", Oxford reprint, 3rd Edition, 2004.

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ANTENNAS AND WAVE PROPAGATION

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with antenna parameters and radiation mechanisms, antenna arrays and its radiation patterns.
- To introduce antennas used at different frequencies UHF, VHF, microwave frequencies.
- To impart the concepts of wave propagations.

Learning Outcomes

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

- understand the fundamental concepts of Antennas.
- differentiate antennas based on their radiation mechanism.
- design basic antenna arrays using multiplication of patterns.
- analyze the performance of non resonant radiators, VHF and UHF antennas.
- compare the performance of several antennas working at high frequencies.
- distinguish wave propagations based on frequency of operation.

Course Content

UNIT - I: Antenna Fundamentals

Basic concepts and antenna parameters – radiation patterns (E & H planes), main lobe and side lobes, beam width, beam area, radiation intensity, beam efficiency, directivity and gain, resolution; aperture concepts and types – aperture area and efficiency, effective height; antenna theorems.

UNIT - II: Radiation Mechanism

Retarded potentials, radiation from small dipole, quarter wave monopole and half wave dipole, current distribution, electric and magnetic field components, radiated power, radiation resistance, directivity and aperture area.

UNIT - III: Antenna Arrays

Two element arrays – different cases; N element linear arrays – broadside and end fire arrays, characteristics and comparison; multiplication of patterns, binomial Arrays.

UNIT - IV: Non-Resonant Radiators

Introduction; travelling wave radiators – basic concepts, V antenna, rhombic antenna, construction details, design considerations.

VHF And UHF Antennas: Arrays with parasitic elements, Folded Dipoles, Yagi Uda antenna, Helical Antenna.

UNIT - V: Microwave Antennas

Plane sheet and corner reflectors; paraboloidal reflectors – characteristics, types of feeds, spill over, aperture blocking, offset feed, cassegrain feeds; horn antennas – types, characteristics, optimum horns; lens antennas – features, dielectric and metal plate lenses, applications.

UNIT - VI: Wave Propagation

Introduction, factors involved in wave propagation; ground wave propagation – characteristics, wave tilt, flat earth considerations; ionosphere – formation of layers and mechanism of propagation, reflection and refraction mechanisms; critical frequency, Maximum Usable Frequency (MUF), optimum frequency, skip distance, virtual height; space wave propagation - m curves and duct propagation, tropospheric scattering.

Text Books

1. John D.Kraus and Ronald J.Marhefka, "Antennas", TMH, 4th Edition, 2010.
2. E.C. Jordan & K.G. Balman," Electromagnetic Waves and Radiating Systems", Prentice Hall of India, 2nd Edition, 2000.

Reference Books

1. Constantine A.Balanis, "Antenna Theory", John Wiley & Sons, 2nd Edition, 2002.
2. A.R.Harish and M.Sachidananda, "Antennas and wave propagation" , Oxford University Press, 2008.
3. F.E.Terman, "Electronic and Radio Engineering", McGrawHill, 4th Edition, 1955.

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PRINCIPLES OF VLSI DESIGN

III Year – I Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To familiarize the students with the MOSFET characteristics, CMOS processing, and VLSI circuits characterization, design, and testing.

Learning Outcomes

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

- characterize the MOS devices
- draw layouts
- apply design techniques for VLSI circuits
- apply testing and verification principles for VLSI circuits

Course Content

UNIT - I: MOS Transistor Theory

Brief history, VLSI design flow, ideal I-V characteristics, C-V characteristics, non-ideal I-V effects, DC transfer characteristics, switch-level RC delay models.

UNIT - II: CMOS Processing Technology

CMOS technologies, layout design rules, CMOS process enhancements, technology related CAD issues.

UNIT - III: Circuit Characterization and Performance Estimation

Delay estimation, logical effort and transistor sizing, power dissipation, interconnect, reliability, scaling.

UNIT - IV: Design Methodology

Design methodology, design flows, CMOS physical design styles.

UNIT - V: Special-purpose Subsystems

Packaging, power distribution, I/O, Clock.

UNIT - VI: Testing and Verification

Tests categories, testers, test fixtures, test programs, logic verification principles, silicon debug principles, manufacturing test principles, design for testability, boundary scan.

Text Book

1. Neil H.E.Weste, David Harris, and Ayan Banerjee, “CMOS VLSI Design: A Circuits and Systems Perspective”, Pearson Education Inc., Third Edition, 2005 (Indian Reprint 2014).

Reference Books

1. Kamran Eshraghian, Douglas A Pucknell, and Sholeh Eshraghian, “Essentials of VLSI Circuits and Systems”, PHI Learning, 2009.
2. Sung-Mo Kang, Yusuf Leblebici “CMOS Digital Integrated Circuits: Analysis and Design”, TMH Education, Third Edition, 2003.
3. Carver Mead and Lynn Conway, “Introduction to VLSI Systems”, Addison Wesley, First Edition, 1979.
4. Eugene D. Fabricius,” Introduction to VLSI design”, McGraw-Hill International Edition, 1990.
5. IIT Bombay,” VLSI Design”, NPTEL Web Course.

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Professional Elective - I

CAD FOR VLSI

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To make the students familiarize with the VLSI design methodologies, optimization of combinational circuits, layout, floorplan, and simulation and synthesis techniques.

Learning Outcomes

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

- understand various methodologies for the design of VLSI systems.
- optimize combinational circuits.
- develop algorithms for the layout optimization.
- size floor plan and solve routing problems.
- analyze different simulation and synthesis techniques.

Course Content

UNIT - I: VLSI Design Methodologies

The VLSI design problem, design domains, actions, methods, and technologies; algorithmic and system design, structural and logic design, transistor-level design, layout design, verification methods, design management tools.

UNIT - II: Combinatorial Optimization

Unit-size placement problem, backtracking and branch-and-bound, dynamic programming, integer linear programming, local search, simulated annealing, tabu search, genetic algorithms.

UNIT - III: Layout Optimization

Design rules, symbolic layout, problem formulation, algorithms for constraint-graph compaction, placement and partitioning-circuit representation, wire length estimation, types of placement problem, placement algorithms, partitioning.

UNIT - IV: Floor planning and Routing

Floor planning-concepts, shape functions and floorplan sizing, routing-types of local routing problems, area routing, channel routing, introduction to global routing, algorithms for global routing.

UNIT - V: Simulation

VLSI simulation, Gate-level modelling and simulation, switch-level modelling and simulation.

UNIT - VI: Logic Synthesis

Introduction to combinational logic synthesis, binary-decision diagrams, two-level logic synthesis, High-level synthesis-hardware models, internal representation of input algorithm, allocation, assignment, and scheduling, scheduling algorithms.

Text Book

1. S.H.Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons,2002.

Reference Books

1. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.
2. Sadiq M. Sait, Habib Youssef, "VLSI Physical Design Automation: Theory and Practice", World Scientific 1999.
3. Steven M.Rubin, "Computer Aids for VLSI Design", Addison Wesley Publishing 1987.
4. Prof. V. Kamakoti and Prof.Shankar Balachandran, "CAD for VLSI Design I", NPTEL Web Course, IIT Madras.
5. Prof. V. Kamakoti and Prof.Shankar Balachandran, "CAD for VLSI Design II", NPTEL Web Course, IIT Madras.
6. Coursera, "VLSI CAD Part I : Logic", Online course.
   (https://www.coursera.org/learn/vlsi-cad-logic)
7. Coursera, "VLSI CAD Part II : Layout", Online course.
   (https://www.coursera.org/learn/vlsi-cad-layout)

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Professional Elective - I

COMPUTER ORGANIZATION

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarized with the concepts of computer components, instruction set, addressing modes and computer arithmetic.
- To impart the implementation of control unit, memory organization and various I/O data transfer schemes.

Course Outcomes

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

- learn the basic structure and operations performed by the components of a digital computer.
- know the concepts of micro-programming, micro code sequencing and pipelining techniques.
- differentiate the hierarchical memory system including cache, virtual memories and instruction level parallelism.

Course Content

UNIT - I: Computer System

Computer components, computer function, interconnection structures, bus interconnection, integer representation, floating point representation.

UNIT - II: Central Processing Unit

Process Structure and Functions - Processor organization, register organization, instruction cycle, instruction pipelining.

Instruction Sets: Characteristics and Addressing Modes – Machine instruction characteristics, types of operands and operations, addressing, instruction format.

UNIT - III: Control Unit and Micro Programmed Control

Micro-operations, control of the processor, hardwired implementation, micro programmed control – basic concepts, microinstruction sequencing, microinstruction execution.

UNIT - IV: Computer Arithmetic

Addition and subtraction, multiplication algorithms, division algorithms, floating point arithmetic operations.

UNIT - V: Memory Organization

Memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, virtual memory, memory management hardware.

UNIT - VI: Input Output Organization & Introduction to ARM

Peripheral devices, input-output interface, asynchronous data transfer, modes of transfer, priority interrupt, direct memory access.

Text Books

1. William Stallings, "Computer Organization and Architecture", Pearson Publications, 8^{th} edition. (Unit I-III & ARM)
2. M. Morris Mano, "Computer System Architecture", Pearson Publications, 3^{rd} edition. (Unit IV – VI)

Reference Books

1. Hamachar, Vranesic, "Computer Organization", 5^{th} edition, TMH.
2. V. Rajaraman, T. Radhakrishnan, "Computer Organization and Architecture", PHI Learning, 2007.
3. P.Pal Chaudhuri, "Computer Organization and Design", 3^{rd} Edition, PHI Learning.

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Professional Elective - I

COMPUTER AND COMMUNICATION NETWORKS

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce principles and functionality of layered network
- To familiarize with the ethical, legal, and social issues related to computer networking.

Learning Outcomes

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

- identify the topology and architecture of a computer network.
- differentiate the OSI and TCP reference models.
- apply protocols to different layers of a network hierarchy.
- understand different datalink protocols.
- identify the routing algorithm for given user application.
- understand the applications of computer networks.

Course Content

UNIT - I: Network Models

LAN, MAN and WAN, network topologies, protocols and standards, The OSI/ ISO reference model- layers in the OSI model, TCP/IP protocol suite, addressing.

Switching - circuit-switched networks, datagram networks, virtual-circuit networks.

UNIT - II: Data Link Control

Framing, flow and error control, error detection and correction, Stop and wait protocol, Go-back N, selective repeat, HDLC protocols.

UNIT - III: MAC Sub Layer

Random access protocols, IEEE 802.3-MAC sub layer, physical layer. IEEE 802.11 and Bluetooth.

UNIT - IV: Network Routing Algorithms

Routing algorithms- shortest path, flooding, distance vector, link state routing. IPv4 addresses-address space, notation; IPV4, IPV6, transition from IPv4 to IPv6, mapping logical to physical address, mapping physical to logical address.

UNIT - V: Congestion Control and QoS

Congestion control- open loop and closed loop congestion control; Quality of Service, techniques to improve QoS;

Transport Layer- UDP, TCP- services, features, segment, connection management, flow control, error control, and congestion control.

UNIT - VI: Application Layer

Domain name system- domain name space, distribution of name space, DNS in the internet, resolution; Electronic mail- architecture, user agent, message transfer agent, message access agent; WWW and HTTP.

Text Books

1. Behrouz. A. Forouzan, “Data Communication and Networking”, 4th Edition, Tata McGraw-hill, New Delhi, 2006.
2. Andrew .S. Tanenbaum, “Computer Networks”, 4th Edition PHI Learning Private Ltd, New Delhi, 2008.

Reference Books

1. William Stallings, “High Speed Networks and Internets”, 2nd Edition, Pearson Education Asia, New Delhi, 2002.
2. Houston. H. Carr and Charles. A. Snyder, “Data Communications and Network security”, Tata McGraw-hill, New Delhi, 2007
3. Peterson. L and Davie. B, “Computer Networks”, Morgan Kauffmann, 2008.

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Professional Elective - I

BIOMEDICAL ENGINEERING

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the basics of biological concepts and relate it to engineering.
- To familiarize with physiology of cardio-vascular system, respiratory system and the elements of Patient Care Monitoring.
- To impart the knowledge on the patient monitoring displays, diagnosis & techniques.

Learning Outcomes

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

- know the concept of bio-medical engineering, evolution, age, development, advancements and applications.
- get awareness on noval theory related to human body and various components.
- analyze the operation of measuring the cardio-vascular system by knowing its inner organization, sensor and transducer theory & plethysmographical concepts.
- learn the principles of respiration and respiratory therapy equipment.
- understand the fundamental principles & techniques of diagnosys and bio-telemetry, monitors, recorders.

Course Content

UNIT - I: Introduction to Bio-Medical Instrumentation

Man instrumentation system-introduction & components, physiological system of the body, sources of bio-electric potentials, resting & action potentials,Electro-Cardiogram(ECG),Electro-Encephalogram(EEG), Electro Myogram (EMG),envoked responses.

UNIT - II: Electrodes & Transducers

Bio-potential electrodes, basic transducers-transduction principles, biochemical transducers, active & passive transducers, transducers of bio-medical applications, pulse sensors, respiration sensors.

UNIT - III: Cardio-Vascular System & Respiratory System Measurements

The heart & cardiovascular system, Electro-Cardiography, blood pressure measurement, measurement of blood flow & cardiac output, the physiology of the respiratory system, tests & instrumentation for the mechanics of breathing, respiratory therapy equipment.

UNIT - IV: Patient Care & Monitoring

Elements of intensive care monitoring, patient monitoring displays, diagnosis, calibration & repair ability of patient monitoring equipment, organization of the hospital for patient care monitoring, pace-makers, defibrillators.

UNIT - V: Diagnostic Techniques & Bio-Telemetry

Principles of ultrasonic measurement, Ultrasonic Imaging, Ultrasonic Diagnosis X-Ray & Radio-Isotope Instrumentations CAT Scan, Emission Computerized Tomography, MRI, Introduction & components of bio-telemetry system.

UNIT - VI: Monitors, Recorders & Shocking Hazards

Monitors, recorders, shock hazards & prevention, physiological effects & electrical equipment, methods of accident prevention, isolated power distribution system.

Text Books

1. Onkar N. Pandey, Rakesh kumar, "Bio-Medical Electronics and Instrumentation", S. K. Kataria & Sons, 2007.
2. Cromewell, Wiebell, P.feiffer, "Biomedical instrumentation and measurements", Prentice-Hall, 1973.

Reference Books

1. Joseph J.Carr, John M.Brown, "Introduction to Bio-Medical Equipment Technology", Pearson Publications, 4th Edition.
2. Khandapur, "Handbook of Bio-Medical Instrumentation", TMH, 2nd Edition.

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Open Elective - II

GEOINFORMATICS

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course objectives

- To introduce the basic concepts and principles of remote sensing.
- To familiarize with structure and function of Geographic Information Systems.
- To illustrate the multidisciplinary nature of Geospatial applications.

Learning Outcomes

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

- relate the scientific theories to the behaviour of electromagnetic spectrum.
- distinguish between different types of satellites and identify appropriate remote sensing data products for mapping, monitoring and management applications.
- interpret Satellite images and processed outputs for extracting relevant information.
- structure the concept of a spatial decision support system in its analog and digital forms.
- perform tasks related to building a GIS database with location, attribute and meta-data.
- list and elaborate applications of Geoinformatics in various fields.

Course Content

UNIT - I: Electro-Magnetic Radiation (EMR), its interaction with Atmosphere & Earth

Definition of remote sensing and its components – Electromagnetic spectrum, wavelength regions important to remote sensing, wave theory, particle theory, Stefan-Boltzmann and Wien's Displacement Law – Atmospheric scattering, absorption, atmospheric windows, spectral signature concepts, typical spectral reflective characteristics of water, vegetation and soil.

UNIT - II: Platforms and Sensors

Types of platforms, orbit types, Sun-synchronous and Geosynchronous – Passive and Active sensors, resolution concept, payload description of important Earth Resources and Meteorological satellites – Airborne and Space-borne TIR (Thermal Infrared Radiation) and microwave sensors.

UNIT - III: Image Interpretation and Analysis

Types of Data Products – types of image interpretation, basic elements of image interpretation, visual interpretation keys – Digital Image Processing, pre-processing, image enhancement techniques – multispectral image classification, supervised and unsupervised

UNIT - IV: Geographic Information System

Introduction to Maps, definitions, map projections, types of map projections, map analysis – GIS definition, basic components of GIS, standard GIS software's – Data types, spatial and non-spatial (attribute) data – measurement scales – Data Base Management Systems(DBMS).

UNIT - V: Data Entry, Storage and Analysis

Data models, vector and raster data – data compression – data input by digitisation and scanning – attribute data analysis – integrated data analysis – modelling in GIS for scenario analysis and planning.

UNIT - VI: RS and GIS Applications

Land cover and land use, agriculture, forestry, urban applications, hydrology, flood zone delineation & mapping, groundwater prospects & recharge, reservoir storage estimation.

Text Books

1. Remote Sensing and Geographical Information Systems, M.Anji Reddy, 4th Edition, B.S.Publications.
2. Remote Sensing and GIS, Basudeb Bhatta, 2nd Edition, Oxford University Press.

Reference Books

1. Remote Sensing and Image Interpretation, Lillesand, T.M, R.W. Kiefer and J.W. Chipman , 7th Edition (2015), Wiley India Pvt. Ltd., New Delhi
2. Remote Sensing Digital Image Analysis, Richard, John A, 5th Edition (2014), Springer.

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Open Elective - II

ENVIRONMENTAL SANITATION

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To communicate the importance of institutional sanitation in maintaining public health.
- To introduce the strategies for maintaining healthy living and working environment.
- To delineate the role of environmental engineer in industrial environments.

Learning Outcomes

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

- identify the common communicable diseases and the solutions for controlling them.
- suggest appropriate sanitation measures for water supply and sanitation in un-sewered areas.
- describe the process of refuse disposal in rural areas.
- draw out the procedures adopted for maintaining hygiene in institutional buildings.
- list out the occupational comfort parameters to be considered for designing built environment.
- introduce the notion of occupational health, safety and the related management approaches.

Course Content

UNIT - I: Epidemics, Epizootics

Origin and spread of Communicable diseases like Cholera, Smallpox, Tuberculosis, Malaria, Filaria, and Plague, common methods (nose, throat, intestinal discharges) – Role of Public Health Engineering in the preventive aspects of the above diseases – Role of vectors in transmitting diseases and Rodent control methods.

UNIT - II: Rural water supply and Sanitation

Sanitary protection of wells, springs, economic methods of treatment – Excreta disposal systems – Types of sanitary privies.

UNIT - III:Refuse Sanitation

Quality and quantity of garbage, rubbish, ashes, street sweepings, night soil; methods of conveyance and sanitary disposal methods, latest technologies adopted to dispose off the solid wastes.

UNIT - IV: Food Hygiene and Sanitation

Milk and milk products, sanitary maintenance of catering, establishment, measures – Sanitary requirements and maintenance of the public utility services like schools, hospitals, offices and in other public buildings.

UNIT - V:Ventilation, Air Conditioning And Light

Composition of ambient air, air pollutants, bacteria, odours – Effective Temperature – Comfort standards of ventilation, air interchange, natural ventilation, artificial ventilation, air conditioning – Measurement of light, illumination standards, natural lighting, artificial lighting.

UNIT - VI: Occupational Health and Safety

Occupational hazards in public buildings, schools, hospitals, eating establishments, swimming pools – Cleanliness and maintenance of comfort – Industrial plant sanitation – OHSAS 18001 and the WELL Building Standard and rating for built environment.

Text Books

1. Municipal and Rural Sanitation, Victor M.Ehlers, Ernest W. Steel, 6th Edition, McGraw Hill
2. Environmental Sanitation, Joseph A. Salvato, Nelson L. Nemerow, Franklin J. Agardy , 5th Edition, John Wiley and Sons
3. OHSAS 18001 Manual
4. WELL Rating System Manual

Reference Books

1. Integrated Solid Waste Management, George Tchobanoglous, Hilary Theisen, Samuel A Vigil,McGraw Hill.
2. Not in my backyard – Solid Waste Management in Indian Cities, Sunita Narain, Jain Book Agency.
3. National Building Code of India, Bureau of Indian Standards.

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Open Elective - II

MODELING AND SIMULATION OF ENGINEERING SYSTEMS

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with programming skills using basic MATLAB and its associated tool boxes.
- To impart knowledge on building SIMULINK and Graphical user interface.

Learning Outcomes

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

- develop MATLAB programme for the solution of engineering system.
- build a SIMULINK model and GUI to simulate engineering system and asses its performance.
- solve and visualize the dynamic performance of engineering systems through MATLAB tool boxes.
- compute and analyse the data of a physical system using advanced programming methods in MATLAB.

Course Content

UNIT - I: Variables, scripts, and operations

Getting Started, Scripts, Making Variables, Manipulating Variables, Basic Plotting

UNIT - II: Visualization and programming

Functions, Flow Control, Line Plots, Image/Surface Plots, Vectorization

UNIT - III: Solving equations and curve fitting

Linear Algebra, Polynomials, Optimization, Differentiation/Integration, Differential Equations

UNIT - IV: Advanced methods

Probability and Statistics, Data Structures, Images and Animation, Debugging, Online Resources

UNIT - V: Symbolics, Simulink®, file I/O, building GUIs

Symbolic Math, Simulink, File I/O, Graphical User Interfaces

UNIT - VI:

Examples on statistics, optimization, plots.

Text Books

1. “Getting started with MATLAB” by Rudra pratap, Oxford University, 2002.
2. MATLAB and SIMULINK for Engineers by Agam Kumar Tyagi, OUP 2011

Reference Books

1. Spencer, R.L. and Ware, M (2008), Introduction to MATLAB, Brigham Young Unviersity, available online, accessed, 7, 2008.
2. David F.Griffiths, October (2012) “An introduction to MATLAB” the Unviersity of Dundee, available online, Acessed, October 2012.

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Open Elective - II

POWER SYSTEMS ENGINEERING

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the working of power plants in power generation and layout of substations.
- To familiarize with the concepts of corona, insulators and sag in overhead lines.

Learning Outcomes

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

- describe the operation of thermal power station.
- describe the operation of nuclear and hydel power plants.
- distinguish various bus bar arrangements in substation
- analyze the phenomenon of corona.
- determine the sag in over head lines

Course Content

UNIT - I: Thermal Power Stations

Single line diagram of Thermal Power Station showing paths of coal, steam, water, air, ash and flue gasses-Brief description of TPS components: Economizers, Boilers, super heaters, Turbines ,condensers, chimney and cooling towers.

UNIT - II: Nuclear Power Stations

Working principle, Nuclear fuels. Nuclear reactor Components: Moderators, Control roads, Reflectors and Coolants. Types of Nuclear reactors and brief description of PWR, BWR and FBR.

UNIT - III: Hydal power stations

Selection of site, block diagram approach of hydro electric power plant and classification of pumped storage power plants.

UNIT - IV: Air insulated substations

Equipments used in substations, Classification of substations: - Indoor & Outdoor substations: Single line diagram of substation. Bus bar arrangements and their classification.

UNIT - V : Overhead Line Insulators and Corona

Types of Insulators, String efficiency and methods for improving string efficiency, Corona - Description of the phenomenon, factors affecting corona, critical voltages and power loss.

UNIT - VI: Sag and Tension Calculations

Sag and Tension calculations with equal and unequal heights of towers, effect of Wind and Ice on weight of Conductor, Stringing chart and sag template and its applications.

Text Books

1. A Text Book on Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar and A.Chakrabarti, Dhanpat Rai & Co. Pvt. Ltd., 1999.

Reference Books

1. Principles of Power Systems by V.K Mehta and Rohit Mehta S.Chand& Company Ltd.New Delhi 2004.
2. Electrical Power Systems by C.L.Wadhawa New age International (P) Limited, Publishers 1997.
3. Electrical Power Generation, Transmission and Distribution by S.N.Singh., PHI, 2003.

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Open Elective - II

ELEMENTS OF MECHANICAL TRANSMISSION

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To familiarize with the principles of mechanical power transmission elements

Learning Outcomes

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

- Identify suitable shaft couplings for a given application.
- describe various transmission elements like belts, ropes and chain drives.
- Explain different thread profiles and applications of power screws
- explain the working of various gears, gear trains and gear box.

Course Content

UNIT - I: Shaft Couplings

Shaft couplings: Rigid couplings – Muff, split muff and flange couplings, Flexible coupling-Modified Flange coupling

UNIT - II: Belt Drives

Flat Belts: Introduction, Selection of a Belt Drive, Types of Belt Drives, Length of Belts, Materials, Belt Joints, Types of Flat Belt Drives, Power transmitted.

UNIT - III: V-Belt, Rope Drives & Chain Drives

V-belts: Introduction, Types of V-belts, Ratio of Driving Tensions for V-belt, Power transmitted.

Rope Drives: Introduction, Classification of rope drives, Power transmitted

Chain drives: Introduction, Chain drives, Polygonal effect, Selection of roller chains, length of chain.

UNIT - IV: Power Screws

Forms of Threads, Multi-start Threads, Right Hand and Left Hand Threads, nut, compound screw, differential screw

UNIT - V: Gears and Gear trains

Types, terminology, materials, law of gearing, velocity of sliding, forms of teeth, path of contact, arc of contact, interference, Gear Trains - Types, differential of an automobile.

UNIT - VI: Gearbox

Introduction, types, constant mesh gearbox, sliding type gear box, single and multi stage gear box

Text Books

1. Design of machine elements by Bhandari, Tata McGraw Hill book Co.3rd Edition,2010.
2. Machine Design by P.C. Sharma & D.K. Agarwal. 4th Edition-1996.S.K.Kataria & Sons

Reference Book

1. Design of Machine Elements by Sharma & Purohit ,PHI, 10th Edition,2011.
2. Design of Machine Elements by Kannaiah.5th Edition,1999.Scitech Publication.

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Open Elective - II

MATERIAL HANDLING EQUIPMENT

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To provide knowledge on materials handling equipment.

Learning Outcomes

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

- understand the basic concepts of material handling equipments.
- illustrate the working principle of conveyors, industrial trucks, hoppers, hoists and cranes.

UNIT - I: Introduction

Types of industrial transport – classification and characteristics of materials – classification and selection of materials handling.

UNIT - II: Conveyor Equipment

Classification of conveyors – description and uses of belt – conveyors – apron conveyors -Roller conveyors – water – screw conveyors – pneumatic and hydraulic conveyors, Computer controlled conveyor system.

UNIT - III: Industrial Trucks

Industrial trucks – main types – purpose of hand trucks – tractors and trailers – self propelled trucks – fork trucks , Automated guided vehicles.

UNIT - IV: Auxiliary Equipment

Hoppers and gates – uses, auxiliary equipment – feeders – chutes – uses.

UNIT - V: Hoisting Appliances

types, description and uses of chain – ropes – types and description and purpose of crane hooks – Grab buckets, lifts – excavators.

UNIT - VI: Cranes

Hand-propelled and electrically driven E.O.T overhead Traveling, cranes; Traveling mechanisms of cantilever and monorail cranes.

Text Books

1. Conveyor Equipment Manufacturer's Association, "*Belt conveyors for bulk materials*" 6th edition, The New CEMA Book.
2. Rudenko N., "*Materials handling equipment*", Elnvee Publishers, 1970
3. Ishwar G Mulani and Mrs. Madhu I Mulani, "*Engineering Science and application design for belt conveyor*", Madhu I. Mulani, 2002.

Reference Books

1. Spivakovsy A.O. and Dyachkov V.K., "*Conveying Machines, Volumes I and II*", MIR Publishers, 1985.
2. Alexandrov, M., "*Materials Handling Equipments*", MIR Publishers, 1981.
3. Boltzharol, A.,"*Materials Handling Handbook*", The Ronald press company 1958.

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Open Elective - II

AUTOMOTIVE ELECTRONICS

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the electronic systems inside an automotive vehicle.
- To introduce the concepts of advanced safety systems.

Learning Outcomes

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

- learn the fundamentals of automotive technology.
- describe the operation of microcomputer systems.
- acquire knowledge in automotive sensors and control systems.
- develop communications & navigation/routing in automotive vehicles.

Course Content

UNIT - I: Automotive Fundamentals

Use of electronics in the automobile, evolution of automotive electronics, the automobile physical configuration, evolution of electronics in the automobile, survey of major automotive systems, engine control or electronic control unit, ignition system.

UNIT - II: Automotive Micro-Computer System

Binary number system, binary counters, Microcomputer fundamentals-digital versus analog computers, basic computer block diagram, microcomputer operations, CPU registers, accumulator registers, condition code register-branching; microprocessor architecture, memory-ROM, RAM; I/O parallel interface, digital to analog converter and analog to digital converters with block diagram.

UNIT - III: Basics of Electronics Engine Control

Motivation for electronic engine control, exhaust emissions, fuel economy, concept of an electronic engine control system, engine functions and control, electronic fuel control configuration, electronic ignition with sensors.

UNIT - IV: Sensors and Actuators

Introduction; basic sensor arrangement; types of sensors such as oxygen sensors, crank angle position sensors, fuel metering/vehicle speed sensors and detonation sensors, altitude sensors, flow sensors, throttle position sensors, solenoids, stepper motors, actuators – fuel metering actuator, fuel injector, and ignition actuator.

UNIT - V: Electronic Vehicle Management System

Cruise control system, antilock braking system, electronic suspension system, electronic steering control, and transmission control, safety: air bags, collision avoidance radar warning system with block diagram, low tire pressure warning system, advanced cruise control system.

UNIT - VI: Automotive Instrumentation System

Speech synthesis, sensor multiplexing, control signal multiplexing with block diagram, fibre optics inside the car, automotive internal navigation system, GPS navigation system, voice recognition cell phone dialling.

Text Books

1. William B. Ribbens, "Understanding Automotive Electronics", SAMS/Elsevier Publishing, 6th Edition. (UNIT I to VI).
2. Robert Bosch Gambh, "Automotive Electrics Automotive Electronics Systems and Components", John Wiley& Sons Ltd., 5th edition, 2007.

Reference Books

1. Ronald K Jurgen, "Automotive Electronics Handbook", 2nd Edition, McGraw-Hill, 1999.
2. G. Meyer, J. Valldorf and W. Gessner, "Advanced Microsystems for Automotive Applications", Springer, 2009.
3. Robert Bosch, "Automotive Hand Book", SAE, 5th Edition, 2000.

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Open Elective - II

INTRODUCTION TO MEMS

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce lithography principles, mechanical sensors and actuators.
- To make it known the thermal sensors and actuators, magnetic sensors and actuators.
- To present formally micro fluidic systems and chemical and bio medical micro systems.

Learning Outcomes

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

- define MEMS, lithography methods, sensors and actuators.
- describe the principles of MOEMS technology and its applications.
- elucidate different magnetic sensing and detection for MEMS.
- apply sensing principles and mechanisms the chemical and bio medical micro systems.

Course Content

UNIT - I: Introduction

Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA.

Mechanical Sensors and Actuators: Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.

UNIT - II: Thermal Sensors and Actuators

Thermal energy basics and heat transfer processes, thermistors, thermo devices, thermo couple, micro machined thermo couple probe, Peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

UNIT - III: Micro-Opto-Electro Mechanical Systems

Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

UNIT - IV: Magnetic Sensors and Actuators

Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, by directional micro actuator, feedback circuit integrated magnetic actuator, large force reluctance actuator, magnetic probe based storage device.

UNIT - V: Micro Fluidic Systems

Applications, considerations on micro scale fluid, fluid actuation methods, dielectrophoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, optoelectro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, microfluid dispenser, micro needle, molecular gate, micro pumps. RADIO FREQUENCY (RF) MEMS: RF based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter.

UNIT - VI: Chemical and Bio Medical Micro Systems

Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemoresistors, chemocapacitors, chemotransistors, electronic nose (E-nose), mass sensitive chemosensors, fluroscence detection, calorimetric spectroscopy.

Text Book

1. Nitaigour Premchand Mahalik “MEMS”, TMH Publishing co.

Reference Books

1. Chang Liu “Foundation of MEMS”, Prentice Hall Ltd.
2. Sergey Edwrd Lyshevski “MEMS and NEMS”, CRC Press, Indian Edition.
3. Tai-Ran Hsu “MEMS and Micro Systems: Design and Manufacture”, TMH Publishers.
4. Richard A Layton, Thomas M Adams “Introductory MEMS”, Springer International Publishers.

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Open Elective - II

DATA SCIENCE

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with statistical methods to analyze data using classification, graphical and computational methods
- To introduce Data Wrangling approaches and descriptive analytics on large data sets.

Learning Outcomes

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

- apply statistical methods to data for inferences.
- analyze data using Classification, Graphical and computational methods.
- describe Data Wrangling approaches.
- perform descriptive analytics over massive data.

Course Content

UNIT - I: Introduction and Linear Regression

Overview of random variables and distributions, statistical learning, assessing model accuracy, descriptive statistics, dependent and independent events

Linear Regression: Simple and multiple linear regressions, comparison of linear regression with k-nearest neighbors.

UNIT - II: Hypothesis Testing

Simple Hypothesis testing, student's t-test, paired t and u test, correlation and covariance, tests for association.

UNIT - III: Graphical Analysis

Histograms and frequency polygons, box-plots, quartiles, scatter plots, heat maps.

UNIT - IV: Computational Methods

Programming for basic computational methods such as Eigen values and Eigen vectors, sparse matrices, QR and SVD.

UNIT - V: Data Wrangling

Data acquisition, data formats, imputation, the split-apply-combine paradigm.

UNIT - VI: Descriptive Analytics

Data warehousing and OLAP, data summarization, data de-duplication, data visualization using CUBEs.

Text Book

1. Gareth James, Trevor Hastie, Robert Tibshirani, Daniela Witten, "An Introduction to Statistical Learning with Applications in R".

Reference Book

1. Mark Gardener, "Beginning R The statistical Programming Language", Wiley.

Web link

www.statlearning.com

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Open Elective - II

VIRTUAL AND AUGMENTED REALITY

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce key elements of virtual Reality with the components in VR systems.
- To gain knowledge of various input and output devices required for interacting in virtual world and augmented reality.

Learning Outcomes

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

- identify basic elements of virtual reality
- describe various input and output devices required for VR experience
- classify human factors that affect VR experience
- distinguish augmented reality from virtual reality
- express the object position and orientation in virtual space.

Course Content

UNIT - I: Introduction

The three I's of virtual reality, commercial VR technology and the five classic components of a VR system.

UNIT - II: Input Devices

Trackers, Navigation, and Gesture Interfaces: Three-dimensional position trackers, navigation and manipulation, interfaces and gesture interfaces.

UNIT - III: Output Devices

Graphics displays, sound displays and haptic feedback.

UNIT - IV: Human Factors

Methodology and terminology, user performance studies, VR health and safety issues. Applications: Medical applications, military applications, robotics applications.

UNIT - V: Augmented Reality

Introduction - head-up displays, helmet-mounted sights and displays, smart glasses and augmenting displays

UNIT - VI: Understanding Virtual Space

Visual and object space, defining position and orientation in three dimensions.

Text Books

1. John Vince, “Virtual Reality Systems”, Pearson Education.
2. Steve Aukstakalnis, “Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR”, Addison-Wesley.

Reference Books

1. Brett S. Martin, “Virtual Reality”, Norwood House Press, 2017.
2. Alan B. Craig, “Understanding Augmented Reality: Concepts and Applications”, Newnes.

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Open Elective - II

OPEN SOURCE SOFTWARE

III Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To impart the opportunities for open source software in the global market.
- To familiarize with different steps in implementing the open source.

Learning Outcomes

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

- state the need and applications of open source software.
- compare and Contrast between Open source and commercial software
- demonstrate LINUX operating systems concepts.
- create database in MYSQL and perform operations on it.
- design and develop a web application using PHP.

Course Content

UNIT - I: Introduction

Introduction to Open sources, Need of Open Sources, Advantages of Open Sources and Application of Open Sources.

UNIT - II: LINUX

LINUX Introduction, General Overview, Kernel Mode and user mode , Process, Advanced Concepts - Personalities, Cloning, Signals.

UNIT - III: Open Source Programming Languages

PHP- Introduction, Programming in web environment, variables, constants, data types, operators Statements, Arrays.

UNIT - IV: Introduction to MySQL

MySQL: Introduction, Setting up account, Starting, terminating and writing your own SQL programs, Record selection Technology, Working with strings, Date and Time.

UNIT - V: Working with MySQL

Sorting Query Results, Generating Summary, Working with metadata, Using sequences.

UNIT - VI: Advanced PHP

OOP – String Manipulation, PHP and SQL database, PHP Connectivity, Debugging and error handling.

Text Books

1. Remy Card, Eric Dumas and Frank Mevel, “The Linux Kernel Book”, WileyPublications,2003.
2. Steve Suchring, “MySQL Bible”, John Wiley, 2002

Reference Books

1. RasmusLerdorf and Levin Tatroe, “Programming PHP”, O’Reilly, 2002.
2. Steven Holzner, “PHP: The Complete Reference”, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, Indian Reprint 2009.
3. VikramVaswani, “MYSQL: The Complete Reference”, 2nd Edition, TataMcGraw –Hill Publishing Company Limited, Indian Reprint 2009.

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Open Elective - II

CYBER LAWS

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To expose the need of cyber laws to prosecute cybercrimes in the society.
- To familiarize with Licensing Issues Authorities for Digital Signatures.

Learning Outcomes

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

- outline the pros and cons of Internet.
- operate on confidential data in a precautious manner.
- discuss Criminal Justice in India and its Implications.
- interpret the Cyber Consumers under the consumer Protection Act.
- devise the legal framework for Confidential Information.
- determine the e-commerce issues for copyright protection and defend personal data from being hacked.

Course Content

UNIT - I: The IT Act, 2000- A Critique

Crimes in this Millennium, Section 80 of the IT Act, 2000 – A Weapon or a Farce?,Forgetting the Line between Cognizable and Non - Cognizable Officers, Arrest for"About to Commit" an Offence Under the IT Act, A Tribute to Darco, Arrest But NoPunishment.

UNIT - II: Cyber Crime and Criminal Justice

Penalties, Adjudication and Appeals Under the IT Act, 2000: Concept of CyberCrime and the IT Act, 2000, Hacking, Teenage Web Vandals, Cyber fraud andCyber Cheating, Virus on Internet Deformation, Harassment and E- mail Abuse

UNIT - III: Cyber Criminality Strategies and Trends

Network Service Providers, Jurisdiction and CyberCrimes, Nature of Cyber Criminality Strategies to Tackle Cyber Crime and Trends,Criminal Justice in India and Implications.

UNIT - IV: Digital Signatures, Certifying Authorities and e-Governance

Introduction to Digital Signatures, Certifying Authorities and Liability in the Eventof Digital Signature compromise, E - Governance in the India. A Warming toBabudom, Are Cyber Consumers Covered under the Consumer Protection, Goodsand Services, Consumer Complaint Defect in Goods and Deficiency in ServicesRestrictive and Unfair Trade Practices

UNIT - V: Traditional Computer Crime

Early Hacker and Theft of Components Traditional problems, Recognizing andDefining Computer Crime, Phreakers: Yesterday's Hackers, Hacking, Computersas Commodities, Theft of intellectual Property.

UNIT - VI: Web Based Criminal Activity

Interference with Lawful Use of Computers, Malware, DoS (Denial of Service) andDDoS (Distributed Denial of Service) Attacks, Spam ,Ransomware and Kidnappingof Information, Theft of Information, Data Manipulation, and Web EncroachmentOnline Gambling Online Fraud, Securities Fraud and stock Manipulation, Ancillarycrimes

Text Books

1. Vivek Sood, " Cyber Law Simplefied", Tata McGraw Hill.
2. Marjie T. Britz, "Computer Forensics and Cyber Crime", Pearson

Reference Book

1. Cyber Laws Texts and Cases, Ferrera, CENGAGE.

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Open Elective - II

QUALITY, RELIABILITY AND OPERATIONS RESEARCH

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To equip students with basic practical skills with sufficient theory.
- To understand the principles involved in the application area.
- To develop the power of systematic thinking and reasoning, practical approach and exposition in the students.

Learning Outcomes

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

- Construct the control charts to understand whether the process is under control.
- Solve various problems regarding quality and life testing of a given product(s).
- Form the real life situations/practical problems into LPP.
- Apply various algorithms like graphical method, simplex method, Charne's method, Hungarian method etc.
- Find the optimal Transportation cost and optimal assignment policy.
- Appreciate Travelling Salesman Problem.
- Identify the job sequence to the given situation and to find the total elapsed time.

Course Content

UNIT - I: Statistical Process Control

Importance of Statistical Quality Control (SQC) in industry, Statistical basis of Shewart Control Charts, Construction of control charts for variables and attributes (with fixed and varying sample sizes), Interdependence of control charts, Natural tolerance limits and specification limits, process capability index, concept of Six sigma and its importance.

UNIT - II: Accepting Sampling Plans

Producer's Risk and Consumer's Risk, Concept of AQL and LTPD. Single and Double Sampling plans for attributes and derivation of their OC and ASN functions, design of single and double sampling plans for attributes using Binomial distribution.

UNIT - III: Reliability

Introduction, Hazard function, Exponential distribution as life model, its memory less property, Reliability function and its estimation, concepts of censoring and truncation, system reliability - series, parallel and k out of N systems and their reliabilities.

UNIT - IV: Linear Programming

Meaning and scope of OR, Convex sets and their properties. Definition – general LPP, formulation of LPP, solution of LPP by Graphical method, Simplex algorithm, concept of degeneracy and resolving it, concept of duality , duality as LPP, Dual-Primal relationships.

UNIT - V: Transportation Problem

Definition of Transportation problem(TP) – TP as a special case of LPP, Feasible solutions by North-west corner rule, Matrix minima method, Vogel's Approximation method. Optimal solution through MODI tableau method for balanced and unbalanced TPs. Degenercy in TP and resolving it.

UNIT - VI: Assignment and Sequencing Promlems

Description of Assignment problem(AP) and its variations, AP as a special case of TP and LPP (both balanced and unbalanced cases), Optimum solution by Hungarian method. Travelling salesman problem.

Introduction to Sequencing problem, optimum sequence of N jobs on two an three machines (without passing).

Text Books

1. Kanti Swaroop, P. K. Gupta and Man Mohan: Operations Research, Sultan Chand Company.
2. L. S. Srinath: Reliability Engineering, Affiliated East-West Press.
3. Parimal Mukhopadhyay: Applied Statistics, New Central Book Agency.
4. Gass: Linear Programming, Mc Graw Hill.
5. R. C. Gupta: Statistical Quality Control.

Reference Books

1. V. K. Kapoor and S. C. Gupta: Fundamentals of Applied Statistics, Sultan Chand.
2. S. K. Sinha: Reliabilty and Life Testing
3. S. M. Ross: Probability Models, Harcourt India Pvt. Ltd.
4. D. C. Montgomory: Introduction to Statistical Quality Control, Wiley.
5. Hadly: Linear Programming, Addison – Wiley.
6. Taha: Operation Research: An Introduction, Mac Millan.
7. Wayne L. Wiston: Operations Research, Thomson, India edition, 4th Edition.

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LINEAR INTEGRATED CIRCUITS APPLICATIONS LAB

III Year – I Semester

Practical	: 4	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

To make the students familiarize with the

- design, conduct of experiments, and interpreting results of various op-amp based circuits.
- design, conduct of experiments, and interpreting results of 555 timer multivibrators.

Learning Outcomes

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

- perform experiment, take observations, present the results in proper form, analyze and interpret results, draw conclusions by correlating with theory.
- measure the parameters of IC 741 op-amp.
- design, hardware implement, and test op-amp adder, integrator, Schmitt trigger, square and triangular wave generators, low-pass, high-pass, and band-pass active filters.
- design, hardware implement, and test monostable and astable mutivibrator circuits using 555 timer.
- design, hardware implement, and test regulated power supply using 3-terminal / 723 IC regulators.
- verify the lock range and capture range of PLL IC 565, operation of weighted resistor / R-2R digital to analog converters, and analog to digital convertors.
- make oral presentations and prepare written reports.

List of Experiments

1. Measurement of IC 741 op-amp characteristics.
2. Design, implement, and test adder and integrator using IC 741 op-amp.
3. Design, implement, and test comparator and schmitt trigger using IC 741 op-amp.
4. Design, implement, and test square and triangular wave generators using IC 741 op-amp.

5. Design, implement, and test monostable and astable multivibrators using IC 555 timer.
6. Design, implement, and test low-pass and high-pass active filters.
7. Design, implement, and test band-pass active filter.
8. Design, implement, and test regulated power supply using 3-terminal / 723 IC regulators.
9. Verify the lock range and capture range of PLL IC 565.
10. Verify the operation of weighted resistor / R-2R digital to analog converters.
11. Verify the operation of analog to digital converters.
12. Open-ended experiment.

Reference Books

1. D. Roy Choudhury and Shail B.Jain, "Linear Integrated Circuits", New Age International (p) Ltd, Second Edition, 2003.
2. Sergio Franco, "Design with Operational Amplifier and Analog Integrated Circuits", TMH, Fourth Edition, 2011.
3. G.B.Clayton, "Operational Amplifiers", Elsevier Science, Fifth Edition, 2003.
4. K.Radha Krishna Rao, "Analog ICs", NPTEL Video Course.
5. Paul R.Gray, Paul J.Hurst, Stephen H.Lewis, and Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", John Wiley & Sons, Inc., Fourth Edition, 2001.
6. Ramakanth A. Gayakwad, "OP-amps and Linear Integrated Circuits", PHI, Fourth Edition, 2010.
7. Datasheets of linear ICs.

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ANALOG AND DIGITAL COMMUNICATIONS LAB

III Year – I Semester

Practical	: 4	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To familiarize with the various analog and digital modulation schemes.
- To introduce the error detection and correction capabilities of linear block, codes.

Learning Outcomes

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

- verify the sampling process with different sampling rates.
- compare the operation of various analog and digital modulation schemes.
- distinguish Frequency Shift Keying and Differential Phase Shift Keying techniques.
- test linear block encoders and decoders.

List of Experiments:(Minimum 10 experiments)

1. Analyze and test AM- Modulation and Demodulation
2. Power Analysis of AM and FM signals using Spectrum Analyzer
3. Sampling Theorem verification.
4. Analyze and test DSB-SC Modulation and Demodulation
5. Analyze and test Frequency modulation and Demodulation
6. Pulse code modulation and demodulation
7. Delta modulation and demodulation
8. Frequency shift keying
9. Differential phase shift keying
10. Amplitude shift keying
11. Linear block encoder and decoder.
12. Pre-emphasis and De-emphasis
13. Time Division multiplexing
14. Open ended experiment.

Reference Books

1. Simon Haykin, "Digital Communications" John Wiley, 2005.
2. H. Taub and D. Schilling, "Principles of Communication Systems", TMH, 2003.
3. Sam Shanmugam, "Digital and Analog Communication Systems", John Wiley, 2005.
4. John Proakis, "Digital Communications",TMH, 1983.
5. B.P.Lathi, "Modern Analog and Digital Communication", Oxford reprint, 3rd Edition, 2004.

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Optional Elective - II

DATA WAREHOUSING AND DATA MINING

III Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce concepts of Data mining, data pre-processing and Data warehousing.
- To familiarize with concepts of association rule mining, classification, clustering techniques and algorithms.

Learning Outcomes

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

- outline different types of databases used in data mining.
- apply pre-processing methods on raw data to make it ready for mining.
- illustrate the major concepts and operations of multi dimensional data models.
- analyze the performance of association rules mining algorithms for finding frequent item sets from the large databases.
- simplify the data classification procedure by selecting appropriate classification methods / algorithms.
- classify various clustering methods and algorithms on data sets to create appropriate clusters.

Course Content

UNIT - I: Introduction

Motivation and importance of data mining, types of data to be mined: relational databases, data warehouses, transactional databases, advanced database systems, data mining functionalities.

UNIT - II: Data Pre-processing

Major tasks in data pre-processing, data cleaning: missing values, noisy data; data reduction : overview of data reduction strategies, principal components analysis, attribute subset selection, histograms, sampling; data transformation: data transformation strategies overview, data transformation by normalization.

UNIT - III: Data Warehousing and Online Analytical Processing

Data warehouse: Basic concepts, OLAP vs. OLTP; Data warehousing: A multi-tiered architecture; Data warehouse modelling: Data cube and OLAP; Data cube:

A multidimensional data model, star, snowflake and fact constellation schemas for multidimensional data models, the role of concept hierarchies, typical OLAP operations.

UNIT - IV: Mining Frequent Patterns, Associations, and Correlations

Basic concepts, frequent item sets, closed item sets and association rules, frequent item set mining methods: apriori algorithm, generations association rules form frequent item sets, a pattern- growth approach for mining frequent item sets.

UNIT - V: Classification

Basic concepts, what is classification, general approach to classification, decision tree induction, attribute selection measures: information gain, Bayes classification methods: Bayes theorem, Naive Bayesian classification.

UNIT - VI: Cluster Analysis

Introduction, overview of basic clustering methods, partitioning methods: k-means, k-medoids; hierarchical methods: agglomerative versus divisive hierarchical clustering, density based method : DBSCAN.

Text Book

1. Jiawei Han, Micheline Kamber & Jian pei, “Data Mining Concepts and Techniques”, 3rd edition, Morgan Kaufmann Publisher an imprint of Elsevier,.

Reference books

1. Pang-Ning Tan, Michael Steinbach, Vipin Kumar “Introduction to Data Mining”, 1st edition, Pearson,.
2. Margaret H Dunham, “Data Mining Introductory and Advanced Topics”, 1st edition, Pearson Education.

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Optional Elective - II

MECHATRONICS

III Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To impart knowledge on design of complex engineering systems using sensors, actuators, controllers.
- To familiarize with the intelligent systems used in Mechatronics.

Learning Outcomes

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

- identify the elements of Mechatronic Systems
- select suitable sensors, actuators and controllers to meet specific requirements
- draw a parallelism between crisp set operations and fuzzy set operations through the use of characteristic and membership functions respectively.

Course Content

UNIT - I:

Introduction: Definition of Mechatronics, Mechatronics in manufacturing, Products, and design. Comparison between Traditional and Mechatronics approach, advantages and disadvantages of Mechatronics systems.

UNIT - II:

Sensors and Transducers: Types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature, light sensors and micro sensors.

UNIT - III:

Review of fundamentals of electronics. Data conversion devices, signal processing devices, relays, contactors and timers. Microprocessors, microcontrollers and PLCs.

UNIT - IV:

Actuators: Drives: stepper motors, servo drives. Ball screws, linear motion bearings, cams, systems controlled by camshafts, electronic cams, indexing mechanisms, tool magazines, and transfer systems**.** Description of PID Controllers.

UNIT - V:

Hydraulic systems: flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, and pumps. Design of hydraulic circuits.

Pneumatics: Production, distribution and conditioning of compressed air, system components and graphic representations.

Electro hydraulic, Electro pneumatic and hydro pneumatic servo systems**.**

UNIT - VI:

Fuzzy Set Theory: Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations, Properties of membership function, Fuzzy extension principle, Fuzzy Systems: fuzzification and defuzzification and fuzzy controllers.

Text Books

1. Bolton. W, "Mechatronics", Addison Wesley, 4th Edition, New Delhi.
2. Dan Nesulescu, "Mechatronics", 3rd Edition, Pearson Education
3. Michael B. Histand and David G. Aliatore, " Introduction to Mechatronics and Measurement Systems", McGraw-Hill

Reference Books

1. Devadas Shetty, Richard A Kolk, "Mechatronics System Design",
2. B.P. Singh (2002), "Advanced Microprocessor and Microcontrollers" New Age International Publisher.
3. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 2nd Ed, Prentice Hall, 2003.
4. H.J.Zimmermann, Fuzzy Set Theory and Its Applications, 2nd Ed., Kluwer Academic Publishers, 1996.
5. S.N. Sivanandam and S.N.Deepa, "Principles of Soft Computing" Second Edition, Wiley India Pvt.Ltd.

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Optional Elective - II

INTRODUCTION TO MEMS

III Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce lithography principles, mechanical sensors and actuators.
- To make it known the thermal sensors and actuators, magnetic sensors and actuators.
- To present formally micro fluidic systems and chemical and bio medical micro systems.

Learning Outcomes

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

- define MEMS, lithography methods, sensors and actuators.
- describe the principles of MOEMS technology and its applications.
- elucidate different magnetic sensing and detection for MEMS.
- apply sensing principles and mechanisms the chemical and bio medical micro systems.

Course Content

UNIT - I: Introduction

Definition of MEMS, MEMS history and development, micro machining, lithography principles & methods, structural and sacrificial materials, thin film deposition, impurity doping, etching, surface micro machining, wafer bonding, LIGA.

Mechanical Sensors and Actuators: Principles of sensing and actuation: beam and cantilever, capacitive, piezo electric, strain, pressure, flow, pressure measurement by micro phone, MEMS gyroscopes, shear mode piezo actuator, gripping piezo actuator, Inchworm technology.

UNIT - II: Thermal Sensors and Actuators

Thermal energy basics and heat transfer processes, thermistors, thermo devices, thermo couple, micro machined thermo couple probe, Peltier effect heat pumps, thermal flow sensors, micro hot plate gas sensors, MEMS thermo vessels, pyro electricity, shape memory alloys (SMA), U-shaped horizontal and vertical electro thermal actuator, thermally activated MEMS relay, micro spring thermal actuator, data storage cantilever.

UNIT - III: Micro-Opto-Electro Mechanical Systems

Principle of MOEMS technology, properties of light, light modulators, beam splitter, micro lens, micro mirrors, digital micro mirror device (DMD), light detectors, grating light valve (GLV), optical switch, wave guide and tuning, shear stress measurement.

UNIT - IV: Magnetic Sensors and Actuators

Magnetic materials for MEMS and properties, magnetic sensing and detection, magneto resistive sensor, more on hall effect, magneto diodes, magneto transistor, MEMS magnetic sensor, pressure sensor utilizing MOKE, mag MEMS actuators, by directional micro actuator, feedback circuit integrated magnetic actuator, large force reluctance actuator, magnetic probe based storage device.

UNIT - V: Micro Fluidic Systems

Applications, considerations on micro scale fluid, fluid actuation methods, dielectrophoresis (DEP), electro wetting, electro thermal flow, thermo capillary effect, electro osmosis flow, optoelectro wetting (OEW), tuning using micro fluidics, typical micro fluidic channel, microfluid dispenser, micro needle, molecular gate, micro pumps. RADIO FREQUENCY (RF) MEMS: RF based communication systems, RF MEMS, MEMS inductors, varactors, tuner/filter, resonator, clarification of tuner, filter, resonator, MEMS switches, phase shifter.

UNIT - VI: Chemical and Bio Medical Micro Systems

Sensing mechanism & principle, membrane-transducer materials, chem.-lab-on-a-chip (CLOC) chemoresistors, chemocapacitors, chemotransistors, electronic nose (E-nose), mass sensitive chemosensors, fluroscence detection, calorimetric spectroscopy.

Text Book

1. Nitaigour Premchand Mahalik "MEMS", TMH Publishing co.

Reference Books

1. Chang Liu "Foundation of MEMS", Prentice Hall Ltd.
2. Sergey Edwrd Lyshevski "MEMS and NEMS", CRC Press, Indian Edition.
3. Tai-Ran Hsu "MEMS and Micro Systems: Design and Manufacture", TMH Publishers.
4. Richard A Layton, Thomas M Adams "Introductory MEMS", Springer International Publishers.

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DIGITAL SIGNAL PROCESSING

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the basic concepts of discrete time signals and systems
- To introduce the concepts of Z-transform and frequency domain representation of discrete time signals.
- To familiarize with the designing of digital filters and their realization.

Learning Outcomes

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

- analyze and process signals in the discrete domain.
- determine the Fourier series coefficients and z-transform of discrete time signals.
- apply the various transform techniques on discrete time signals.
- design digital filters (IIR and FIR) for a given specifications.
- apply various windowing techniques in the design of FIR filter.
- realize digital filters (IIR and FIR).

Course Content

UNIT - I: Discrete Time Signals and Systems

Discrete time signals- classification, elementary discrete time signals, basic operations on sequences; discrete time systems-classification, discrete time linear Time Invariant systems and their properties, convolution sum.

UNIT - II: **Z-Transform and Discrete Fourier Series**

Z Transform of sequence, properties of ROC, properties of Z transform, inverse Z transform- partial fraction method.

Discrete Fourier series: Fourier series for discrete time periodic signals, Fourier Transform for discrete time non-periodic signals, energy density spectrum, relationship of Fourier transform to Z transform, frequency response.

UNIT - III: Discrete Fourier Transform

Frequency sampling- Discrete Fourier Transform (DFT), properties of DFT, linear convolution of sequences using DFT, relationship between DFT and Z transform.

UNIT - IV: **Fast Fourier Transforms (FFT)**

Fast Fourier Transform-Radix-2 decimation in time and in frequency FFT algorithms, IDFT using FFT algorithms.

UNIT - V: Design of IIR Filters

Analog filter approximation-Butterworth and Chebyshev (Type-I) filters, design of IIR filters from analog filters- Impulse Invariant technique, Bilinear transformation

UNIT - VI: **Design of FIR Filters**

Linear Phase FIR filters-frequency response, Fourier Series method of designing FIR filter, design of FIR filters using windows (Rectangular, Bartlett, Hamming, Hanning)

Realization of Digital Filters: Realization of IIR Filters**-** Direct form I, II; realization of FIR filters**-** transversal structure, cascade realization

Text Books

1. John G. Proakis,Dimitris G.Manolakis, "Digital Signal Processing, Principles, Algorithms, and Applications", Pearson Education / PHI, 2013.

Reference Books

1. A.V.Oppenheim and R.W. Schaffer, "Discrete Time Signal Processing", PHI
2. Andreas Antoniou, "Digital Signal Processing", TATA McGraw Hill , 2006.
3. MH Hayes, "Digital Signal Processing", Schaum's Outline series,TATA Mc Graw Hill, 2007.

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CONTROL SYSTEMS

III Year – II Semester

Lecture : 3	Tutorial : 1	Internal Marks	: 40
Credits : 3		External Marks	: 60

Course Objectives

- To introduce the basic concepts of control systems by developing mathematical models for physical systems.
- To familiarize with the time domain behavior of linear control systems.
- To impart knowledge on analytical and graphical methods to quantify stability of linear control systems.
- To introduce concepts on the state variable theory as a pre-requisite to advance control systems.

Learning Outcomes

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

- develop mathematical models for physical systems.
- employ the time domain analysis to quantify the performance of linear control systems and specify suitable controllers.
- quantify time and frequency domain specifications to determine stability margins.
- apply state variable theory to determine the dynamic behavior of linear control systems.

Course Content

UNIT - I: Introduction

Concepts of control systems- open loop and closed loop control systems and their differences- different examples of control systems- classification of control systems, feed-back characteristics, effects of feedback. mathematical models – differential equations, impulse response and transfer function.

UNIT - II: Control Systems Components

Transfer function of DC servo motor - AC servo motor- synchro transmitter and receiver, block diagram representation of systems considering -block diagram algebra – representation by signal flow graph - reduction is using Mason's gain formula.

UNIT - III: Time Response Analysis

Standard test signals - time response of first order systems – characteristic equation of feedback control systems, transient response of second order systems

- time domain specifications – steady state response - steady state errors and error constants, introduction to P, PI, PD and PID controllers.

UNIT - IV: Stability Analysis in S-Domain

The concept of stability – Routh's stability criterion – qualitative stability and conditional stability – limitations of Routh's stability.

Root Locus Technique: The root locus concept - construction of root loci – effects of adding poles and zeros to G(s) H(s) on the root loci.

UNIT - V: Frequency Response Analysis

Introduction, frequency domain specifications-Bode diagrams-determination of frequency domain specifications and transfer function from the Bode diagram-phase margin and gain margin-stability analysis from Bode plots. polar plots-Nyquist plots- stability analysis.

UNIT - VI: State Space Analysis of Continuous Systems

Concept of state, state variables and state model, derivation of state models from physical systems (Electrical), solving the time invariant state equations- state transition matrix and its properties – concepts of controllability and observability.

Text Books

1. I. J. Nagrath and M. Gopal , "Control Systems Engineering", New Age International Limited Publishers, 2nd edition.
2. B.C.Kuo , "Automatic control systems", john wiley and son's 8th edition, 2003.

Reference Books

1. K.Ogata , "Modern control engineering ", prentice Hall of India Pvt. Ltd., 5th Edition.
2. N.K.Sinha, "Control system ", New Age International (p) Limited Publishers, 3rd Edition, 1998.
3. Norman S-Nice, "Control system engineering", Willey Studio Edition, 4th Edition.

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MICROPROCESSORS, MICROCONTROLLERS AND APPLICATIONS

III Year – II Semester

Lecture	: 3	Practical	: 1	Internal Marks	: 40
Credits	: 3			External Marks	: 60

Course Objectives

- To familiarize with the architecture of 8086 processor & 8051 microcontroller and assembly language programming.
- To emphasize with the concepts of I/O Interfacing with 8086 and 8051.
- To introduce the fundamentals of ARM.

Learning Outcomes

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

- recall and apply a basic concept of digital fundamentals to Microprocessor based personal computer system.
- identify a detailed s/w & h/w structure of the microprocessor and microcontroller
- illustrate how the different peripherals (8255) are interfaced with Microprocessor
- interface various I/O devices to the 8051 microcontroller.
- know the ARM philosophy

Course Content

UNIT - I: Basics of Microprocessor & Microcontroller

A basic microprocessor system, the CPU, memory I/O organization of microprocessor system, microprocessor architecture and its operations: microprocessor initiated operations, internal data operations, peripheral or external initiated operations, fetch and execute cycles, difference between microprocessor and microcontroller.

UNIT - II: Architecture of 8086 Microprocessor

8086 Architecture, register organization, memory organization, 8086 pin diagram: common function signals, minimum and maximum mode signals. interrupts, interrupt structure, processing, timing diagrams.

UNIT - III:Assembly language of 8086& Interfacing

Addressing modes, classification of instructions, assembly directives, programs using data transfer arithmetic, logical, branch, string instructions, evaluation of arithmetic expressions,strings etc.interfacing with memory & I/O, interfacing with 8255- stepper motor control.

UNIT - IV: Architecture of 8051

8051 Architecture, memory organization, ports, timers & serial communication, addressing modes, instructions set of 8051.

UNIT - V: Applications of 8051

Interfacing with display devices: LED's, 7 segment display unit, LCD unit, temperature measurement system, relay control, A/D, D/A.

UNIT - VI: ARM Processor fundamentals

The RISC design philosophy, ARM design philosophy, Embedded system hardware, registers, CPSR, pipeline, exceptions, interrupts and the vector table, core extensions, architecture revisions.

Text Books

1. D.V Hall, "Microprocessors & Interfacing", TMH, 2nd Edition, 2005. (Unit I-Unit III)
2. Muhammad Ali Mazidi, Janice GillispieMazidi and Rolin D. McKinlay, "The 8051 Microcontrollers and Embedded Systems", Pearson, 2nd Edition (Unit IV-Unit V).

Reference Books

1. Andrew N.Sloss, Dominic Symes, Chris Wright, "ARM Systems Developer's Guides- Designing & Optimizing System Software", Elsevier, 2008. (Unit VI)
2. Ramesh S. Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Penram Publication, 2000.
3. A. K. Ray and K.M. Bhurchandani, "Advanced Microprocessors and Peripherals", TMH, 2nd edition, 2006.
4. Barry B.Brey, "The Intel Microprocessors: Architecture, Programming, and Interfacing", PHI, 6th Edition.

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MICROWAVE AND OPTICAL COMMUNICATIONS

III Year – II Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To introduce the microwave passive components, solid state devices and procedures to measure different parameters in microwave frequency range.
- To familiarize with different types of optical fibers, light sources and detectors.

Learning Outcomes

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

- design the microwave bench setup with different wave guide components
- distinguish microwave sources based on constructional, operational and performance aspects
- demonstrate the use of microwave bench for calculating power, attenuation, frequency and VSWR.
- understand the basic concepts of fiber optics.
- design a fiber optic communication network with suitable light sources for a given application.
- design a fiber optic communication network with suitable optical detectors for a given application.

Course Content

UNIT - I: Introduction To Microwave Components

Microwave frequencies and applications, waveguide attenuators – resistive card and rotary vane types; calculation of scattering matrix for E plane, H plane, Magic Tee and directional coupler; ferrite components – Gyrator, Isolator, Circulator.

UNIT - II: Microwave Tubes

Classification of microwave tubes, two cavity Klystron – structure, velocity modulation, output power; reflex Klystron – structure, power output and efficiency; Travelling Wave Tube – structure, amplification process; 8-cavity cylindrical travelling wave magnetron operation.

UNIT - III: Microwave Solid State Devices And Measurements

Gunn diode – Principle, RWH theory; IMPATT diode, description of microwave bench, measurement of attenuation, frequency, VSWR and power using microwave bench.

UNIT - IV: Overview of Optical Fibres

The evolution of fibre optic systems, elements of an optical fibre transmission link, optical fibre **s**tructures, nature of light, basic optical laws and definitions, optical fibre modes and configurations.

UNIT - V: Optical Sources

LEDs- structures, quantum efficiency, modulation capability; Laser diodes - principle, threshold conditions, external quantum efficiency, resonant frequencies.

UNIT - VI: Photo Detectors

Photodiodes – Principle, PIN and avalanche photo diodes; comparison of photo detectors, noise in photo detectors.

Text Books

1. Samuel Y. Liao, "Microwave Devices and Circuits", Pearson Education, 3rd Edition, 2003.
2. Gerd Keiser, "Optical Fiber Communications",3rd edition, McGrawHill

Reference Books

1. M.Kulkarni "Microwave and Radar engineering", Umesh publications, New Delhi. 3rd Edition, 2008.
2. R.E. Collin, "Foundations for Microwave Engineering", IEEE Press, John Wiley, 2nd Edition, 2002.
3. Herbert J. Reich, J.G. Skalnik, P.F. Ordung and H.L. Krauss, "Microwave Principles", CBS Publishers and Distributors, New Delhi, 2004.
4. Djafar K. Mynbaev and Lowell L. Scheiner, "Fiber Optic Communication Technology", Pearson Education Asia.
5. R.S.Rao, " Microwave Engineering", PHI New Delhi, 2nd Edition, 2016.

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Professional Elective - II

ANALOG IC DESIGN

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the concepts and design of analog integrated circuits.
- To expose the students to various circuits like amplifiers, switched capacitor circuits, current mirrors, PLLs used in analog ICs.

Learning Outcomes

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

- Apply the knowledge of Mathematics and semiconductor theory in analyzing and designing of analog integrated circuits
- Demonstrate the knowledge and understanding of various current mirrors and switched capacitor circuits
- Describe and determine the effect of feedback on the stability of amplifier circuits.
- Select an appropriate A/D and D/A converter to meet specified performance requirements.

Course Content

UNIT - I:

Basic Mos Device Physics: Second order effects, MOS Device Models

Single Stage Amplifiers: Basic concepts, MOS amplifiers-Common Source stage, source follower, common gate stage, Cascode stage- folded cascode.

UNIT - II:

Differential Amplifiers: single ended and differential amplifiers, Basic differential pair, Common mode response, Differential pair with MOS loads.

Current Mirrors: Simple CMOS current mirror with common source amplifier, source degenerated current mirrors, High output impedance current, mirrors, Bipolar current mirrors. Cascade, Wilson, Wildar current mirrors.

UNIT - III:

Operational Amplifiers: one – stage op-amps, two stage op-amps-gains boosting stage comparison, I/P range limitations, slew rate.

Feed Back and Stability: Feedback topologies, multi pole systems, phase margin, frequency compensation.

UNIT - IV:

Switched Capacitors Circuits: Sampling switches, Switched-Capacitor Amplifiers, Switched –Capacitor Integrator.

UNIT - V:

Phased Locked Loop Design: Basic loop architecture, derivation for lock range and capture range. Charge pump PLL, small signal analysis of charge pump PLL.

UNIT - VI:

Nyquist Rate D/A Converters: Decoder based converter resistor storing converters folded resister string converter – Binary scale converters – Binary weighted resistor converters – Reduced resistance ratio ladders – R-2R based converters – Thermometer code current mode D/A converters.

Nyquist Rate A/D Converters: Integrating converters – successive approximation converters. DAC based successive approximation – flash converters time interleaved A/D converters.

Text Books

1. David A Johns, Ken Martin, "Analog Integrated circuit Design", John Wiley & Sons (Unit: VI).
2. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", TMH, 2001 (Units: I to V)

Reference Books

1. Gray, Hurst Lewis, Meyer, "Analysis and design of Analog Integrated Circuits", John Wiley & Sons, 2000.
2. Franco Maloberti, "Analog Design for CMOS VLSI Systems", Kluwer Academic Publishers, 2001.

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Professional Elective - II

NANO ELECTRONICS

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To understand the limitations of silicon electronics, progress of nanoelectronics and basic concepts of nano electronics.
- To know the fabrication techniques and scaling of nanodevices.
- To study the significance of tunneling effect in nanoelectronic devices and the concepts of Coulomb blockade.

Learning Outcomes

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

- explain various aspects of nano electronics.
- explore the fabrication techniques used for nanodevices.
- identify the importance of scaling.
- list of various applications of tunneling.
- demonstrate the concepts of coulomb blockade and electron transport mechanisms.

Course Content

UNIT - I: Toward the Nanoscale

Scientific opportunities, technological motivations, improving materials on the nanoscale, fabrication techniques on the nanoscale, improvement in characterization methods for the nanoscale, new principles of device operation at the nanoscale, nanotechnology for optoelectronics.

UNIT - II: Growth and Fabrication of Nanostructures

Bulk crystal and heterostructure growth, nanolithography, etching, and other means of nanostructures and nanodevices, spontaneous formation and ordering of nanostructures, clusters and nanocrystals, methods of nanotube growth- chemical and biological methods for nanoscale fabrication, fabrication of nano-electromechanical systems.

UNIT - III: Nanoscale MOSFETs

Introduction, MOSFET scaling, short- channel effects, multiple-gate MOSFETs, FinFETs.

UNIT - IV: Tunnel Junctions and Applictions of Tunneling

Tunneling through a potential barrier, potential energy profiles for material interfaces, Application of tunneling.

UNIT - V: Coulomb Blockade

Coulomb blockade in a nanocapacitor, tunnel junction excited by a current source, coulomb blockade in a Quantum Dot Circuit.

UNIT - VI: Nanostructure Devices

Resonant tunneling diode, single electron transistors, carbon nanotube transistor, transport of spin and spintronics.

Text Books

1. Vladimir V. Mitin, Viatcheslav A. Kochelap, and Michael A. Stroscio, "Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications", Cambridge University Press, 2008 (UNITS: I & II).
2. George W.Hanson, "Fundamentals of Nanoelectronics", Pearson Education, 2009 (UNITS: IV - VI).

Reference Books

1. Anantha Chandrakasan, "FinFETs and Other Multi-Gate Transistors", Springer, 2008 (UNIT: III).
2. Jerry G. Fossum and Vishal P. Trivedi, "Fundamentals of Ultra-Thin-Body MOSFETs and FinFETs", Cambridge University Press, 1st Edition, 2013 (UNIT: III) .

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Professional Elective - II

SMART ANTENNAS

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce beamforming concepts.
- To impart angle of arrival estimation techniques

Learning Outcomes

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

- apply different windowing techniques to obtain weights for desired antenna pattern.
- make use of random variables for pre-processing of the signals.
- differentiate the performance of general antenna and smart antenna for spatial processing of the signal.
- conceptualize adaptive beamforming.
- understand the concept of angle of arrival algorithms for beamforming.
- test the received signal performance with different algorithms and can choose the suitable algorithm for the given application.

Course Content

UNIT - I: Array Weighting Fundamentals

Array weighting-Blackman weights, Hamming weights, Gaussian weights, Kaiser Bessel weights, fixed beam arrays, fixed sidelobe cancelling,

UNIT - II: Principles of Random Variables and Process

Definition of random variables, probability density functions, expectation and moments, common probability density functions, autocorrelation and power spectral density, correlation matrix.

UNIT - III: Smart Antennas

Introduction, the historical development of smart antennas, early forms of spatial processing, fixed weight beamforming basics: maximum S/I ratio, minimum mean square error, maximum likelihood, and minimum variance. diversity, sectorization.

UNIT - IV: Adaptive Beam Forming

Least mean squares (LMS), sample matrix inversion (SMI), recursive least squares (RLS), constant modulus (CM)

UNIT - V: Angle of Arrival Estimation

Fundamentals of matrix algebra, array correlation matrix, non-blind beamforming, blind beam forming, angle of arrival estimation methods: Bartlett AOA estimate, Capon AOA estimate.

UNIT - VI: Smart Antenna Performance

Beamforming array performance, receive diversity performance, combined diversity and beamforming performance, choosing a spatial processing technique.

Text Books

1. Frank B. Gross “Smart Antennas for Wireless Communications with MATLAB”, McGraw –Hill, 2005.
2. Pieter van Rooyen, Michiel Lotter and Danie van Wyk “Space Time Processing for CDMA Mobile Communications” Kluwer Academic Publishers, 2000.

Reference Books

1. Tapan K. Sarkar, Michel C. Wicks, M.S. Palma and Robert J. Bonnea “Smart Antennas”, John Wiley & Sons – 2003.
2. S.Chandran “Adaptive Antenna Arrays: Trends and Applications” Springer,2004.
3. A Paulraj, Rohit nabar and Dhananjay Gore “Introduction to Space Time Wireless Communications”, Cambridge University Press, 2003.

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Professional Elective - II

CODING THEORY

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the concepts of information theory.
- To familiarize basic concepts of linear block codes and convolution codes.

Learning Outcomes

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

- develop mathematical models for practical communication channels and analyze information carrying capacity.
- understand source coding mechanism.
- analyze linear block codes and investigate the relationship between minimum distance and error correction/detection capabilities
- analyze encoder and efficient decoder algorithms for convolutional codes.
- design and implement channel encoder and decoder in hardware/ software to meet the required error performance in present day communication applications.

Course Content

UNIT - I: Information Theory

Discrete messages, concept of amount of information and its properties, average information, Entropy and its properties,information rate, mutual information and its properties.

UNIT - II: Source Coding

Shannon's theorem, Shanon-Fano coding, Huffman coding, efficiency calculations, channel capacity of a Gaussian channel, bandwidth –S/N trade off.

UNIT - III: Linear Block Codes

Introduction, matrix description of linear block codes, error detection and error correction capabilities of linear block codes, hamming codes.

UNIT - IV: Cyclic Codes

Binary cyclic codes, algebraic structure, encoding, syndrome calculation, and table look-up decoding using standard array.

UNIT-V: BCH and Reed Solomon Codes

BCH codes- decoding of BCH codes,the Berlekamp- Massey decoding algorithm. Reed Solomon codes- generalized Reed Solomon codes, MDS codes.

UNIT - VI: Convolution Codes

Introduction, encoding of convolution codes, time domain approach, transform domain approach, graphical approach: state, tree and trellis diagram,decoding using Viterbi algorithm and sequential decoding, advantages of convolution codes over block codes.

Text Books

1. W.C. Huffman and Vera Pless, "Fundamentals of Error correcting codes", Cambridge University Press, 2003.
2. Sam Shanmugam "Digital and Analog Communication Systems", John Wiley, 2005.

Reference Books

1. Simon Haykin "Communication Systems", John Wiley, 2005
2. Sklar, "Digital Communication", Pearson Education.
3. Shu Lin and Daniel. J. Costello Jr., "Error Control Coding: Fundamentals and applications", 2nd Edition Prentice Hall Inc, 2004.
4. R.E. Blahut, "Theory and Practice of Error Control Coding", McGraw Hill 1983.

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Open Elective - III

HYDROLOGY

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To impart the knowledge of essential components of the hydrologic cycle
- To provide an overview and understanding of Unit Hydrograph theory and its analysis.
- To familiarize with different methods of flood frequency analysis and flood routing.
- To impart knowledge on groundwater movement and well hydraulics
- To familiarize with the relationships between soil, water and plant and their significance in planning an irrigation system

Learning Outcomes

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

- measure and analyze the rainfall in any given area and develop intensity-duration-frequency curves.
- quantify the abstractions from precipitation and the factors affecting
- determine runoff in a catchment and prepare the unit hydrograph which in-turn determines the runoff for any given rainfall
- estimate flood magnitude and carry out flood routing
- determine hydraulic properties of an aquifer and specific capacity, efficiency and yield of a well
- choose appropriate method of irrigation for different crops and cropping patterns and determine the quality and quantity of water required for a crop

Course Content

UNIT - I: Hydrologic Cycle

Introduction: Engineering hydrology and its applications, Hydrologic cycle. Precipitation: Types and forms of precipitation, rainfall measurement, types of rain gauges, rain gauge network, average rainfall over a basin, consistency of rainfall data, frequency of rainfall, intensity-duration-frequency curves, probable maximum precipitation.

UNIT - II: Abstractions

Abstractions: Evaporation, factors affecting evaporation, measurement of evaporation, evaporation reduction, evapotranspiration, factors affecting evapotranspiration, measurement of evapotranspiration - Infiltration, factors affecting infiltration, measurement of infiltration, infiltration indices.

UNIT - III: Runoff

Runoff :Factors affecting runoff ,components of runoff, computation of runoff-rational and SCS methods, separation of base flow ,Unit Hydrograph, assumptions, derivation of Unit Hydrograph, unit hydrographs of different durations, principle of superposition and S-hydrograph methods, limitations and applications of UH

UNIT - IV: Floods

Floods-Causes and effects, flood frequency analysis-Gumbel's method, flood control methods, flood routing-hydrologic routing, hydraulic routing, channel and reservoir routing- Muskingum method of routing

UNIT - V Ground Water

Ground Water Occurrence: Ground water hydrologic cycle, origin of ground water, rock properties effecting ground water, vertical distribution of ground water, zone of aeration and zone of saturation, geologic formation as Aquifers, types of aquifers, porosity, Specific yield and Specific retention.

UNIT - VI: Irrigation

Necessity and Importance of Irrigation, advantages and ill effects of Irrigation, types of Irrigation, methods of application of Irrigation water, water logging and drainage, standards of quality for Irrigation water, principal crops and crop seasons, crop rotation.

Text Books

1. Engineering Hydrology, P. Jayaram Reddy, third edition, Laxmi publications
2. Irrigation and water power engineering, B.C. Punmia, Pande B.B Lal, Ashok Kumar Jain & Arun Kumar Jain sixteenth edition, Laxmi publications.

Reference Books

1. Engineering Hydrology, K. Subramanya, third edition, Tata McGraw-Hill.. Hydrology principles, analysis and design, HM Raghunath, revised second edition, New Age International Publishers.
2. Irrigation Water Resources and Water Power Engineering, P.N.Modi, seventh edition, Standard Book House.

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Open Elective - III

PLANNING FOR SUSTAINABLE DEVELOPMENT

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objective

- To familiarize the concept of sustainable development
- To introduce various components of sustainable development

Learning Outcomes

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

- explain the importance of sustainable development
- use various strategies for promoting sustainable development
- analyze important current issues and areas of debate in relation to sustainable development.
- implement policy responses in environmental degradation.

Course Content

UNIT - I: Introduction

Sustainable Development-explains and critically evaluates the concept of sustainable development, Environmental degradation and poverty Sustainable development: its main principles, the evolution of ideas about sustainability,

UNIT - II: Key Components in Sustainable Development

Strategies for promoting sustainable development, resistances to the concept, and some alternative approaches. Examine some important current issues and areas of debate in relation to sustainable development.

UNIT - III: Innovation for Sustainable Development

Innovation for sustainable development- Environmental management and innovation strategies.

UNIT - IV: Theories of Sustainable Development

Societal transformations.Institutional theory.

UNIT - V: Governance and Policy Response

Governance for sustainable development.Policy responses to environmental degradation.

UNIT - VI: Research in Sustainable Development

Capacity development for innovation.Research methods.

Text Books

1. Basic Principles for Sustainable Development,Harris, J.M, 2004.
2. Some thoughts on the idea of sustainable development Ecological Economics, Robinson, J. (2004), 48(4): 369-384.

Reference Books

1. Navigating towards Sustainable Development: A System Dynamics Approach, Hjorth, P. and A. Bagheri (2006), Futures 38: 74-92.
2. Struggling with Sustainability – A Comparative Framework for Evaluating Sustainable Development Programs ,Mog, J.M. (2004), World Development 32(12): 2139–2160. IISD Commentary on the OECD's Draft Principles for International Investor Participation in Infrastructure
3. Global Development and Environment Institute, working paper 00-04. Available at:http://ase.tufts.edu/gdae/publications/Working_Papers/Sustainable%20Development.PDF.

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Open Elective - III

ELECTRICAL AND HYBRID VEHICLES

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the concepts on working principles of electric drives used for different hybrid electric vehicles.
- To familiarize with the different energy storage systems and their management strategies.

Learning Outcomes

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

- describe hybrid vehicles and their performance
- analyze various power converter configurations of hybrid electric drives.
- analyze and suggest possible energy storage systems for different applications.
- apply the appropriate energy management strategies for various applications.

Course Content

UNIT - I: Introduction to Hybrid Electric Vehicles

History of hybrid and electric vehicles, electric vehicles, impact of modern drive-trains on energy supplies.

UNIT - II: Hybrid Electric Drive-trains

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies

UNIT - III: Electric Drive-trains

Basic concept of electric traction Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC and AC Motor drives

UNIT - IV: Energy Storage

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis.

UNIT - V: Hybridization of different energy storage devices

Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine, sizing the power electronics, selecting the energy storage technology.

UNIT - VI: Energy Management Strategies

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Text Books

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015

Reference Books

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
2. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

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Open Elective - III

POWER PLANT INSTRUMENTATION

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To provide an overview of different methods of power generation with a particular stress on thermal power generation.
- To impart knowledge on the different types of control loops.

Learning Outcomes

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

- describe the constructional details, working principles of various generating stations.
- analyze the working of different types of controls and control loops.
- choose various measurements involved in power generation plants.
- understand the knowledge about the different types of devices used for analysis.

Course Content

UNIT - I: Overview Of Power Generation

Brief survey of methods of power generation – hydro, thermal, nuclear, solar and wind power – importance of instrumentation in power generation – thermal power plants – building blocks – details of boiler processes UP&I diagram of boiler – cogeneration.

UNIT - II: Measurements In Power Plants

Electrical measurements – current, voltage, power, frequency, power – factor etc. – non electrical parameters – flow of feed water, fuel, air and steam with correction factor for temperature – steam pressure and steam temperature – drum level measurement – radiation detector – smoke density measurement – dust monitor.

UNIT - III: Analyzers In Power Plants

Flue gas oxygen analyser – analysis of impurities in feed water and steam – dissolved oxygen analyser – chromatography – PH meter – fuel analyser – pollution monitoring instruments.

UNIT - IV: Control Loops In Boiler

Combustion control – air/fuel ratio control – furnace draft control – drum level control – main stem and reheat steam temperature control – super heater control – attemperator –deaerator control – distributed control system in power plants – interlocks in boiler operation.

UNIT - V: Turbine – Monitoring And Control

Speed, vibration, shell temperature monitoring and control – steam pressure control – lubricant oil temperature control – cooling system

UNIT - VI: Analysis in Power Plant

Thermal conductive type, paramagnetic type-Oxygen analyzer, hydrogen purity meter-chromatography – PH meter,fuel analyzer, pollution monitoring and control

Text Books

1. Sam G. Dukelow, 'The control of Boilers', Instrument Society of America,1991.
2. Modern Power Station Practice, Vol.6, Instrumentation, Controls and Testing, Pergamon Press, Oxford, 1971.
3. E.L Wakil, M.M./Power Plant technology/Mc Graw Hill 1984.
4. J.Balasubramaniam & R.K Jain/Modern Power Plant Engineering/Khanna

Reference Books

1. Elonka,S.M.and Kohal A.L.Standard Boiler Operations, McGraw-Hill, New Delhi,1994.
2. R.K.Jain, Mechanical and industrial Measurements, Khanna Publishers, New Delhi, 1995.

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Open Elective - III

MATERIAL SCIENCE

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- to understand the properties of engineering materials, so as to manipulate them for the desired engineering applications.

Learning Outcomes

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

- compare the different types of conductors and semi conductors and their applications
- classify magnetic materials based on their parameters
- understand the applications of dielectric principles in engineering devices.
- propose a corrosion prevention technique for a particular application
- summarize the different optical properties of metallic materials
- apply different characterization techniques for validation of metals.

Course Content

UNIT - I: Conductors, Semi Conductors and Resisters

Resistivity, Range of Resistivity- free electron theory - classical theory & quantam theory. Semiconducting materials: Energy gap in solids - intrinsic semi conductors - extrinsic semi conductors - element & compund semi conductors - crystal structure - growth & purification of semi conductor crystals.

UNIT - II: Magnetic Materials

Magnetic Materials: Classification of magnetic materials based on spin - Hard and soft magnetic materials - Dia, Para & Ferro types, atomic magnetic moment - anti ferro magnetism.

UNIT - III: DIELECTRIC MATERIALS

Dielectric Materials: Dielectric susceptability - complex die electric constant - Polarization mechanisms in dielectrics - Frequency and temperature dependence of polarization mechanism - Dielectric loss - Dielectric waveguide and dielectric resonator antenna - Piezoelectric, pyroelectric and ferroelectric materials and their applications.

UNIT - IV: Optical Properties of Materials

Introduction - electromagnetic radiation - light interactions with solids - Refraction, Reflction, Absorption, Transmission, Opacity & Translucency in insulators - Luminescence - Photo conductivity.

UNIT - V: Corrosion & Oxidation

Corrosion: Principles of corrosion - electrode potential - galvanic series - galvanic cell - polarization - passivation - electro chemical considerations - corrosion rate - forms of corrosion - corrosion prevention.

Oxidation: Mechanisms of oxidation - oxidation resistant materials.

UNIT - VI: Materials Characterization

X-ray diffraction, Neutron diffraction and Electron diffraction - X-ray fluorescence spectroscopy - Thermogravimetric Analysis (TGA) - Differential Thermal Analysis (DTA) - Differential Scanning Calorimetry (DSC).

Text Books

1. V. Raghavan, “Materials Science and Engineering”, PHI Learning Publication, 5th edition.
2. Rajendran, V. “Materials Science”,Tata McGraw- Hill,New Delhi,2011.

Reference Books

1. William D. Callister, “Materials Science and Engineering” 9th ed., John Wiley and sons, Incorporated.
2. Sam Zhang, “Materials Characterization Techniques”, CRC Press.
3. J. M. D. Coey, “Magnetism and Magnetic Materials”, Cambridge University Press.

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Open Elective - III

RENEWABLE ENERGY SOURCES

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To study various types of non-conventional sources of energy and techniques used in exploiting solar, wind, tidal and geothermal sources of energy and bio-fuels.

Learning Outcomes

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

- analyze the significance of renewable energy.
- describe the principles of solar radiation and design the solar collectors.
- know the functioning of basic components of wind energy and understand the utilization of biomass in power generation.
- discuss the working principles of geothermal, ocean, tidal and wave energy techniques.
- know the functioning of direct energy conversion techniques.

Course Content

UNIT - I: Introduction

Energy Sources and their availability, Role and potential of renewable source.

Principles of Solar Radiation: Solar constant, Solar Radiation outside the Earth's atmosphere, Solar Radiation at the Earth's surface, instruments for measuring solar radiation, solar radiation geometry, solar radiation on titled surfaces with numerical problems.

UNIT - II: Solar Energy Storage and Applications

Different methods, sensible, latent heat and stratified storage, solar ponds. Solar Applications-solar heating/cooling technique, solar distillation, drying, photovoltaic energy conversion, solar central power tower concept and solar chimney. solar collectors- flat plate, concentric collectors.

UNIT - III: Wind Energy

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria

Bio-Mass: Biomass Energy Sources, methods for obtaining energy from biomass, Biomass gasification.

UNIT - IV:

Geothermal Energy: Resources, types of wells, methods of harnessing the energy.

Ocean Energy: OTEC, Principles, utilization, setting of OTEC plants, thermodynamic cycles.

Tidal and wave energy: Potential and conversion techniques, Mini-hydel power plants

UNIT - V:

Direct Energy Conversion (DEC): Need for DEC, limitations, principles of DEC. Thermoelectric Power – See-beck, Peltier, Joule -Thomson effects, Thermo-electric Power generators.

UNIT - VI: MHD Power Generation

Principles, dissociation and ionization, Hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion.

Fuel cells: Principles, Faraday's laws, thermodynamic aspects, selection of fuels and operating conditions, applications.

Text Books

1. Tiwari and Ghosal, "Renewable energy resources", Narosa.
2. B.H.Khan "Non – conventional Energy Resources" Tata McGraw Hill education Pvt Ltd.

Reference Books

1. G.D. Rai, "Non-Conventional Energy Sources", Dhanpat Rai and Sons
2. Twidell & Weir, "Renewable Energy Sources " Sukhatme, "Solar Energy", Tata McGraw-Hill Education.

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Open Elective - III

ASSISTIVE TECHNOLOGIES

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce different assistive technology devices
- To familiarize with the concepts of enhance speech communication and independent living.

Learning Outcomes

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

- identify the legislative policies connected with assistive Technologies
- know the universal design principles in the context of general education environments and curriculum materials.
- explore the process for finding the right technology and the right applications and determine how to pay for it.

Course Content

UNIT - I: Introduction to Assistive Technology (AT) Devices and Services

Assistive technology defined, historical overview of assistive technology, multidisciplinary nature of service provision.

UNIT - II: Adaptations Framework for Considering Assistive Technology

Introduction to the adaptations framework, setting-specific demands, person-specific characteristics, adaptations, evaluation of effectiveness of adaptations.

UNIT - III: Assistive Technology Assessments

Overview of assessment issues, overview of general assessments, assistive technology assessments, assessment components.

UNIT - IV: Enhance Speech Communication

Nature of spoken language, introduction to augmentative and alternative communication systems, selection techniques for aided communication systems, overview of non-electronic systems and electronic devices.

UNIT - V: Mobility and Access to Information

Introduction to mobility adaptations, basic design considerations, seating and positioning issues, introduction to information access, computer access, telecommunication, listening and print access.

UNIT - VI: Enhance Independent Living

Introduction to independent living, devices for daily life, switches and scanning, environmental control units, access to management devices.

Text Books:

1. Diane P edrotty Bryant, Brian R. Bryant, Allyn and Bacon "Assistive Technology for People with Disabilities", 2nd edition, Psycho Educational Services.
2. Amy G.Dell, Deborah A. Newton, Jerry G.Petroff, "Assistive Technology in the class room Enhancing the school experiences of students with disabilities", Pearson Publications, 2nd edition.

Reference Books

1. Marion A.Hersh, Michael A.Johnson, "Assistive Technology for the Hearing impaired, Deaf and Deafblind", Springer Publications, 2003.
2. Meeko Mitsuko K.Oishi, Ian M.Mitchell, H.F. Machiel vanderloss, "Design and use of Assistive Technology", Springer Publications, 2010.
3. Eckehard Fozzy Moritz, "Assistive Technologies for the Interaction of the Elderly", Springer Publications, 2014.

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Open Elective - III

BIOMEDICAL ENGINEERING

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the basics of biological concepts and relate it to engineering.
- To familiarize with physiology of cardio-vascular system, respiratory system & the elements of Patient Care Monitoring.
- To impart the knowledge on the patient monitoring displays, diagnosis & techniques.

Learning Outcomes

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

- know the concept of bio-medical engineering, evolution, age, development, advancements and applications.
- get awareness on noval theory related to human body and various components.
- analyze the operation of measuring the cardio-vascular system by knowing its inner organization, sensor and transducer theory & plethysmographical concepts.
- learn the principles of respiration and respiratory therapy equipment.
- understand the fundamental principles & techniques of diagnosys and bio-telemetry, monitors, recorders.

Course Content

UNIT - I: Introduction to Bio-Medical Instrumentation

Man instrumentation system-introduction & components, physiological system of the body, sources of bio-electric potentials, resting & action potentials,Electro-Cardiogram(ECG),Electro-Encephalogram(EEG), Electro Myogram (EMG),envoked responses.

UNIT - II: Electrodes & Transducers

Bio-potential electrodes, basic transducers-transduction principles, biochemical transducers, active & passive transducers, transducers of bio-medical applications, pulse sensors, respiration sensors.

UNIT - III: Cardio-Vascular System & Respiratory System Measurements

The heart & cardiovascular system, Electro-Cardiography, blood pressure measurement, measurement of blood flow & cardiac output, the physiology of the respiratory system, tests & instrumentation for the mechanics of breathing, respiratory therapy equipment.

UNIT - IV: Patient Care & Monitoring

Elements of intensive care monitoring, patient monitoring displays, diagnosis, calibration & repair ability of patient monitoring equipment, organization of the hospital for patient care monitoring, pace-makers, defibrillators.

UNIT - V: Diagnostic Techniques & Bio-Telemetry

Principles of ultrasonic measurement, Ultrasonic Imaging, Ultrasonic Diagnosis X-Ray & Radio-Isotope Instrumentations CAT Scan, Emission Computerized Tomography, MRI, Introduction & components of bio-telemetry system.

UNIT - VI: Monitors, Recorders & Shocking Hazards

Monitors, recorders, shock hazards & prevention, physiological effects & electrical equipment, methods of accident prevention, isolated power distribution system.

Text Books

1. Onkar N. Pandey, Rakesh kumar, “Bio-Medical Electronics and Instrumentation”, S. K. Kataria & Sons, 2007.
2. Cromewell, Wiebell, P.feiffer, “Biomedical instrumentation and measurements”, Prentice-Hall, 1973.

Reference Books

1. Joseph J.Carr, John M.Brown, “Introduction to Bio-Medical Equipment Technology”, Pearson Publications, 4th Edition.
2. Khandapur, “Handbook of Bio-Medical Instrumentation”, TMH, 2nd Edition.

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Open Elective - III

NODE AND ANGULAR JS

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with defining own custom AngularJS directives that extend the HTML language
- To introduce the concepts of client-side services that can interact with the Node.js web server
- To understand the best practices for server -side JavaScript

Learning Outcomes

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

- develop single page applications that reduces app's time to market without plugins.
- identify the services, modules and directives to subdivide application logic into modules and share code across apps
- explain the routing process in angular for managing URL's.
- interpret command line applications in Node.js that allows developers a more maintainable code
- develop code with use of Node.js and JSON services for web applications.
- examine how error events affect piped streams and handling events in Node.js

UNIT - I: Introduction to Node.js and JSON

Introduction, operators, decision and iterative statements, Node.js collections: create array object, insert, access, update and remove data. JSON:Create JSON object, display, access and edit data. JSON Array: Creation, display, access and edit data. Check JSON attribute.

UNIT - II: Node.js Files, Functions and Strings

File modules, reading text, creating file. Functions: creating function, types of functions, callback function. Strings: operations, string to numeric and vice-versa, string parser.

UNIT - III: Node.js Modules, Error Handling & Logging and Events

Create simple module, module class. Error handling and logging. Events: Events module, once event listener, remove events.

UNIT - IV: Introduction to Angular

Introduction to TypeScript (TS), node package manager, introduction to Angular 4, create angular application using TS and angular CLI, webpack, gulp introduction.

UNIT - V: Elements in Angular

Angular components, controllers, modules, dependency injection, angular service, providers and directives, pipes and filters, Angular forms-Reactive, lifecycle hooks.

UNIT - VI: Routing in Angular

Routing-module, component, lazy loading of components, apply route guards-security, Angular material design.

Text Books

1. Andrew Grant, “Beginning AngularJS”, Apress Publishers.
2. Agus Kurniawan, “Nodejs Programming By Example”, PE Press.

Reference Books

1. Ken Williamson,”Learning AngularJS: A Guide to AngularJS Development”, O’Relly Media.
2. Matt Frisbie, “AngularJS Web Application Development Cookbook”, Packt Publishing Ltd.
3. David Herron, “Node.js Web Development”, 4th edition, Packt Publishing Ltd.
4. Marc Wandschneider, “Learning Node.js: A Hands-On Guide to Building Web Applications in JavaScript”, Addison Wesley.

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Open Elective - III

CYBER SECURITY

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To understand security concepts, Ethics in Network Security.
- To familiarize with new algorithms (mathematical formulas) and statistical measures that assesses relationships among members of large data sets.
- To identify the vulnerability of the Internet systems and recognize the mechanisms of the attacks, and apply those to design and evaluate counter measure tools.
- To gain knowledge on security threats, and the security services and mechanisms to counter them.

Learning Outcomes

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

- outline management framework.
- describe various tools that can be used in cyber security management.
- write a secure access client for access to a server.
- determine firewall requirements, and configure a firewall.
- employ policies and standards to solve security problems.
- use security techniques in an organisational context.

UNIT - I: Systems Vulnerability Scanning

Overview of vulnerability scanning, Open Port / Service Identification, Banner / Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Networks vulnerability scanning - Netcat, understanding port and Services tools-Datapipe, Fpipe, Network reconnaissance –Nmap, THC-Amap. Network sniffers and injection tools–Tcpdump and Windump.

UNIT - II: Network Defence Tools

Firewalls and packet filters: Firewall basics, packet filter vs firewall, how a firewall protects a network, packet characteristic to filter, stateless vs stateful firewalls, network address translation (NAT) and port forwarding, the basic of virtual private networks, Snort: Intrusion detection system.

UNIT - III: Web Application Tools

Scanning for web vulnerabilities tools: Nikto, HTTP utilities-Curl, OpenSSL and stunnel, password cracking and Brute-Force tools–John the Ripper,L0phtCrack, pwdump, HTC-Hydra.

UNIT - IV: Introduction to Cyber Crime and Law

Cyber crimes, types of cyber crime, hacking, attack vectors, cyberspace and criminal behavior, clarification of terms, traditional problems associated with computer crime.

UNIT - V: Introduction to Incident Response

Digital forensics, computer language, network language, realms of the cyber world, a brief history of the Internet, recognizing and defining computer crime, contemporary crimes, computers as targets, contaminants and destruction of data, Indian IT ACT 2000.

UNIT - VI: Introduction to Cyber Crime Investigation

Firewalls and packet filters, password cracking, keyloggers and spyware, virus and worms, Trojan and backdoors, steganography, attack on wireless networks.

Text Books

1. Mike Shema, “Anti-Hacker Tool Kit (Indian Edition)”, Publication Mc Graw Hill.
2. Computer forensics and cyber crime : an introduction by Marjie T. Britz.

Reference Books

1. James Graham, Ryan Olson, Rick Howard, “Cyber Security essentials”, 1st edition.
2. Chwan-Hwa (John) Wu, J. David Irwin, “Introduction to Computer Networks and Cybersecurity”.
3. Nina Godbole and Sunit Belpure, “Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Publication Wiley.

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Open Elective - III

SCRIPTING LANGUAGES

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with JQuery, JSON, PERL, Ruby, AJAX to develop client-side and server-side web applications.

Learning Outcomes

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

- use jQuery with DOM to manipulate HTML elements, attributes and CSS.
- store and exchange data between server and browser using JSON.
- develop PERL scripts using arrays, hashes, control structures and subroutines.
- write Ruby scripts usingdata types, arrays, hashes, control structures and classes.
- retrieve data from a database using PHP and AJAX.

Course Content

UNIT - I : jQuery

Introduction, Selectors, Events, Effects, Manipulating HTML and CSS using jQuery

UNIT - II: JSON

Introduction, Syntax rules, JSON Vs XML, Data types, Objects, Arrays, Parsing JSON and using stringify() function

UNIT - II: Introduction to PERL

Basic syntax, Perl language elements: variables, operators, control flow statements, Arrays, Hashes and File handling; Regular expressions, Subroutines

UNIT - IV: Working with PERL

Packages and modules, Working with files, Retrieving documents from the web with Perl.

UNIT - V: Ruby

Introduction to Ruby, Variables, types, simple I/O, Control, Arrays, Hashes, Methods, classes, Iterators, Pattern Matching. Overview of Rails.

UNIT - VI: AJAX A New Approach

Introduction, Creating XMLHttpRequest object, Integrating AJAX with PHP, Retrieving data from a database using PHP and AJAX, Handling XML data using PHP and AJAX.

Textbooks

- Kogent , HTML 5 Black Book, 2nd Edition, Dreamtech Press
- Dave Thomas, Programming Ruby 1.9 & 2.0: The Pragmatic Programmers' Guide, 4th Edition, Pragmatic Bookshelf
- Randal L. Schwartz,ý Brian D. Foy ,ý Tom Phoenix, Learning Perl, 6th edition,O'REILLY Publications.

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Open Elective - III

SOFTWARE PROJECT MANAGEMENT

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce plan and manage projects at each stage of the software development life cycle (SDLC).
- To impart effective software projects that support organization's strategic goals.

Learning Outcomes

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

- analyze the different software projects.
- prepare project plans that address real time management challenges.
- relate important risks facing a new project.
- design effective software development model to meet organizational needs.
- recognize appropriate methodology to develop a project schedule.
- apply appropriate techniques to assess ongoing project performance.

Course Content

UNIT - I: Conventional Software Management

The waterfall model, conventional software Management performance.

Evolution of Software Economics: Software Economics, pragmatic software cost estimation.

Improving Software Economics: Reducing Software product size, improving software processes, improving team effectiveness.

UNIT - II: Principles of Modern Software Management

The old way and the new: The principles of conventional software Engineering, principles of modern software management, transitioning to an iterative process.

Life cycle phases: Engineering and production stages, inception, Elaboration, construction, transition phases.

UNIT - III: Checkpoints and Process Planning

Checkpoints of the process: Major mile stones, Minor Milestones, Periodic status assessments.

Iterative Process Planning: Work breakdown structures, planning guidelines, cost and schedule estimating.

UNIT - IV: Project Organizations

Project Organizations And Responsibilities: Line-of-Business Organizations, Project Organizations, evolution of Organizations.

Process Automation: Automation Building blocks.

UNIT - V: Project Control and Process Instrumentation

The seven core Metrics, Management indicators, quality indicators, life cycle expectations, pragmatic Software Metrics, Metrics automation, T**ailoring the Process**- Process discriminants.

UNIT - VI: Future Software Project Management

Modern Project Profiles, Next generation Software economics, modern process transitions.

Text Books

1. Walker Royce,Software Project Management, Pearson Education, 2005.

Reference Books

1. Bob Hughes and Mike Cotterell, Software Project Management, Tata McGraw-Hill Edition.
2. Joel Henry, Software Project Management, Pearson Education.
3. PankajJalote, Software Project Management in practice, Pearson Education, 2005.

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Open Elective - III

ELEMENTS OF STOCHASTIC PROCESSES

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Outcomes

- To study and understand the systems which evolve randomly over time, especially in long run.
- To survey the important tools of stochastic processes.
- To model and solve engineering problems arising in real life situations.

Learning Outcomes

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

- formulate and solve probabilistic problems using random variables.
- distinguish between Poisson process and the exponential random variable and apply this knowledge to solve problems involving memory less processes.
- use renewal theory to solve problems where Poisson is not a realistic processes.
- ise Markov chain is discrete and continuous time to solve queuing problems.

Course Content

UNIT - I: Generating Functions

Introduction, Definitions and elementary results, Convolutions, Compound distributions, Partial fraction expansions, Moment and cumulant generating functions.

UNIT - II: Recurrent Events

Definitions, Basic theorems, Delayed recurrent events.

Random Walk Models: Introduction, Gambler's Ruin, Probability distribution of ruin at nth trial and extensions.

UNIT - III: Markov Chains

Introduction, Notation and definition, classification of states, classification of chains, Evaluation of P^n (transition probability matrix)

UNIT - IV: Markov Process

Discrete and continuous – The Poisson process, Use of generating functions, Random variable technique, Solution of linear partial deferential equations.

UNIT - V: Homogeneous and Non-Homogeneous Birth and Death Processes

Introduction, simple birth process, general birth process, divergent birth processes. Simple death process, simple birth and death processes, the effect of immigration, the general birth and death process, multiplication processes. Polya process, a simple non-homogeneous birth and death process. The effect of immigration.

UNIT – VI: Queuing process

Introduction, Equilibrium theory, Queues with many servers, Monte carlo methods in appointment systems, Non-equilibrium treatment of a sample queue, First passage times, Diffusion process.

Text Book

1. The Elements of Stochastic Processes, Norman T.J. Bailey.

Reference Book

1. Stochastic Processes, J. Mehdi

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Open Elective - III

ACADEMIC COMMUNICATION

III Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To acquaint the students with the process and elements of academic writing.
- To help them gain accuracy in the academic writing tasks they will be called upon to perform as part of their graduate and postgraduate studies.
- To empower them to carry out academic writing tasks such as project report writing with success.

Learning Outcomes

Upon successful completion of the course, the student will be able to produce successful academic writing tasks (such as designing and reporting a survey/project, writing discussion essays, and composing formal letters) with attention to:

- the writing process involving a good understanding of the purpose and the register as well as organizational strategies such as introduction, main body, conclusion, paragraphing;
- the elements of academic writing such as argument, cause and effect, cohesion and coherence, generalizations, references, style, and visual information; and
- the kind of accuracy, technical as well as grammatical, that writing in academic contexts demands

Course Content

I. The Writing Process

a. Background to writing

i. The purpose of academic writing

ii. Common types of academic writing

iii. The features of academic writing

iv. Writing in paragraphs

b. From understanding to planning

i. The planning process

ii. Analyzing essay titles

iii. Brainstorming

c. Organizing paragraphs

i. Paragraph structure | ii. Development of ideas

iii. Linking paragraphs together

d. Introductions and conclusions

i. Introduction contents | ii. Introduction structure

iii. Opening sentences | iv. Conclusions

e. Re-writing and proof-reading

i. Re-writing | ii. Proof-reading

II. Elements of Writing

a. Cohesion

i. Reference words | ii. Preventing confusion

b. Comparisons

i. Comparison structures | ii. Forms of comparison

iii. Using superlatives

c. Style

i. Components of academic style | ii. Guidelines

d. Visual information

i. The language of change | ii. Types of visuals

iii. Describing visuals | iv. Labelling

III. Accuracy in Writing

a. Academic vocabulary | b. Remedial grammar

c. Punctuation

IV. Writing Models

a. Formal/Professional emails | b. CVs

c. Reports | d. Scholarly essays

Suggesting Reading

1. Bailey, Stephen. (2011). *Academic Writing A Handbook for International Students*. Routledge: London.

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MICROPROCESSOR AND MICROCONTROLLER INTERFACING LAB

III Year – II Semester

Practical	: 4	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To introduce the assembly language programming concepts and interfacing with 8086 processor.
- To familiarize with the Embedded-C language programming concepts and interfacing with 8051 microcontroller.

Learning Outcomes

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

- acquire the knowledge of assembly language programming using 8086 microprocessor.
- perform various arithmetic and shift operations with 8086 based system.
- interface various I/O modules with 8086 based system.
- implement various real time applications using 8051.

List of Experiments

Part A: Assembly Language Programming Exercises / Experiments using 8086 Trainer kit

1. Implementation of simple decimal arithmetic and bit manipulation operations.
2. Implementation of code conversion between BCD, Binary, Hexadecimal and ASCII.
3. Implementation of searching and sorting of 16-bit numbers.
4. Implementation of String manipulations.

Part B: Interfacing Exercises/Experiments with 8086 trainer kit through Assembly Language Programming

1. Develop a stepper motor interface for rotating through any given sequence.
2. Develop a Digital-to-Analog Converter interface for waveform generation.
3. Develop an Analog-to-Digital Converter interface for analog signal to digital conversion.
4. Implementation of 2's complement and decoder functionalities using DIDO interface.

Part C: Assembly Language Programming Exercises/Experiments in 8051 using Keil

1. Develop a Embedded C Program to interface seven segment display to port1 and port2 and display the count from 00 to FFH
2. Implement the functionality of traffic signal controller using 8051 microcontroller.
3. Develop an Embedded C Program to display the given string on LCD.
4. Open ended Experiment

Reference Books

1. D. V. Hall, "Microprocessors and Interfacing", TMGH,2nd edition 2006
2. Barry B.Brey , "The Intel Microprocessors", PHI, 7th edition 2006.
3. M.A. Mazidi, J.G. Mazidi, R.D. Mckinlay, "The 8051 microcontroller and embedded systems", Pearson, 2nd Edition.

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DIGITAL SIGNAL PROCESSING LAB

III Year – II Semester

Practical	: 4	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To analyze and manipulate digital signals for the representation of systems using MATALB.
- To introduce the architecture of TMS320C6711 DSP and the programming of DSP.

Learning Outcomes

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

- analyze and implement digital signal processing systems in time domain.
- compute linear and circular convolution and the discrete Fourier transform (DFT) of discrete-time signals.
- perform the frequency response of frequency-selective digital filters using Butterworth, chebyshev approximations and windows.
- implement DSP operations on TMS320C6711 DSP processor.

List of Experiments

1. Represent signal, its basic transformations, sum of sinusoidal signals and multiplication of sinusoidal signals.
2. Obtain output of LTI system (without using default functions).
3. Perform linear convolution using the circular convolution (without using default functions)
4. Obtain spectrum of the discrete time sequence (without using default functions)
5. Obtain DFT using FFT(without using default functions)
6. Verify DFT properties (without using default functions)
7. Design IIR filter using Butterworth/Chebyshev Approximations.
8. Design FIR filter using windowing techniques.
9. Obtain power density spectrum of a sequence.
10. Linear convolution implementation on DSP chips.
11. Open-ended experiment-application of filters.

Text Books

1. John G. Proakis,Dimitris G.Manolakis, “Digital Signal Processing, Principles, Algorithms, and Applications”: Pearson Education / PHI, 2013.
2. A.V.Oppenheim and R.W. Schaffer , “Discrete Time Signal Processing “, PHI

URL’S

1. *www.ti.com/cn/lit/pdf/spru509*c.pdf
2. *www.ti.com/lit/ug/spru301c/spru301c.pdf*

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VLSI LAB

III Year – II Semester

Practical	: 4	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

To make the students familiarize with the

- design of analog and digital circuits.
- usage of EDA tool to simulate, draw schematic and layout, analyze, and test of analog and digital circuits.

Learning Outcomes

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

- design analog and digital circuits.
- use EDA tools to perform simulation, draw schematic and layout, analysis, testing, and interpret results.
- write VHDL/Verilog code.
- make oral presentations and prepare written reports.

List of Experiments

A) Analog Design:

To design the circuits with given specifications and verify the following:

(a) Schematic: (i) DC analysis and (ii) Transient analysis

(b) Layout: (i) DRC (ii) LVS and (iii) RCX DRC – Design Rule Check; LVS – Layout Versus Schematic; RCX –RC Extraction

1. Single-stage common-source amplifier
2. Single-stage differential amplifier
3. Single-stage operational amplifier
4. 4-bit R-2R DAC using opamp

B) Digital Design:

To write VHDL/Verilog code and test bench for verification, and observe the waveform for the following:

1. Inverter (design with given specifications and verify (a) Schematic: (i) DC analysis, (ii) Transient analysis (b) Layout: (i) DRC (ii) LVS and (iii) RCX; and (c) as given above).

2. Buffer
3. Logic gates (AND, OR, NAND, NOR, XOR, XNOR, transmission gate)
4. Flip-flops (D, JK, T, RS)
5. Parallel and serial adders
6. 4-bit counters (Asynchronous and synchronous)
7. Successive approximation register (SAR) and SAR based ADC

C) Open-ended experiment (shall comprise all the VLSI design flow steps)

Reference Books

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", McGraw-Hill Edition, 2003.
2. R. Jacob Baker, "CMOS Circuit Design, Layout and Simulation", Revised Second Edition, IEEE press, 2008.
3. Neil H.E.Weste, David Harris, and Ayan Banerjee, "CMOS VLSI Design: A Circuits and Systems Perspective", Pearson Education Inc., Third Edition, 2005 (Indian Reprint 2014).
4. Sung-Mo Kang, Yusuf Leblebici "CMOS Digital Integrated Circuits: Analysis and Design", TMH Education, Third Edition, 2003.
5. Eugene D. Fabricius," Introduction to VLSI design", McGraw-Hill International Edition, 1990.
6. IIT Bombay," VLSI Design", NPTEL Web Course.
7. User Manuals for EDA Tools.

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Optional Elective - V

BIG DATA ANALYTICS

III Year – II Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the architectural concepts of Hadoop and introducing map reduce paradigm.
- To disseminate knowledge on how to summarize, query, and analyze data with Hive.
- To familiarize with business decisions and create competitive advantage with Big Data analytics.

Learning Outcomes

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

- summarize the importance of Big Data and its problems (storage and analysis).
- outline the building blocks of hadoop and anatomy of file read and write.
- analyze data with hadoop MapReduce.
- generalize how MapReduce works when running a job.
- choose best programming tools for solving real world and industrial problems.

Course Content

UNIT - I: Introduction to Big Data

What is Big Data, characteristics of Big Data - The four Vs Why Big Data is important, data, data storage and analysis, comparison with other systems, brief history of Hadoop, apache Hadoop and the Hadoop eco system.

UNIT - II: The Hadoop Distributed File System

The design of Hadoop Distributed File System (HDFS), architecture, building blocks of Hadoop (Namenode, Datanode, Secondary Namenode, JobTracker, TaskTracker), basic file system operations, anatomy of a file read, anatomy of a file write.

UNIT - III: Introduction to Map Reduce

A weather dataset, analyzing weather data with UNIX tools, analyzing data with Hadoop, Map and reduce, java map reduce, the old and new Java map reduce APIs, data flow, combiner functions, running a distributed map reduce job.

UNIT - IV: How Map Reduce works

Anatomy of a map reduce job run : job submission, job initialization, task assignment, task execution, progress and status updates, job completion; shuffle and sort : the map side, the reduce side.

UNIT - V: Pig

Admiring the Pig architecture, going with the Pig Latin Application Flow, working through the ABCs of Pig Latin, evaluating local and distributed modes of running Pig Scripts, checking out the Pig script interfaces, scripting with Pig Latin.

UNIT - VI: Hive

Getting started with apache hive, examining the hive clients, working with hive data types, creating and managing databases and tables with hive, seeing how the hive data manipulation language works, querying and analyzing data.

Text Books

1. Tom White, “Hadoop: The Definitive Guide”, 3rd Edition, O’Reilly.
2. Chuck Lam, “Hadoop in Action”, 1st edition ,Manning Publications.
3. Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk,Bruce Brown, Rafael Coss, “Hadoop for Dummies”, 1st edition, John Wiley ans Sons.

Reference Books

1. Dirk deRoos, Chris eaton, George Lapis, Paul Zikopoulos, Tom Deutsch “Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data”, 1st Edition, TMH, 2012.
2. Srinath Perera, Thilina Gunarathne, “Hadoop Map Reduce Cookbook”, Packt Publishing.

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Optional Elective - V

COGNITIVE RADIO NETWORKS

III Year – II Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce software defined radio evolution and cognitive radio.
- To make it known the characteristics of spectrum, regulation history and issues.
- To present formally communication techniques and cognitive radio network theory.

Learning Outcomes

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

- understand concepts of software defined radio.
- define physical characteristics of spectrum and regulatory challenges.
- describe the spectrum sensing and its implications.
- differentiate different spectrum sharing schemes.
- elucidate different relay communication techniques exist.
- apply the entropy concepts to find the limits on the cognitive radio networks.

Course Content

UNIT - I : Introduction

Software defined radio, evolution of software-defined radio, cognitive radio, evolution of cognitive radio, key applications, interoperability, dynamic spectrum access

UNIT - II : Radio Frequency Spectrum and Regulation

Spectrum: physical characteristics of spectrum and implications, regulatory history and successes, emerging regulatory challenges and actions, regulatory issues of cognitive access, spectrum measurements and usage, applications for spectrum occupancy data,

UNIT - III: Spectrum Sensing and Identification

Primary signal detection: energy detector, cyclo-stationary feature detector, matched filter, cooperative sensing, definition and implications of spectrum opportunity, spectrum opportunity detection, fundamental trade-offs: performance versus constraint, mac layer performance measures, global interference model, local interference model, fundamental trade-offs: sensing accuracy versus sensing overhead.

UNIT - IV: Spectrum Access and Sharing

Unlicensed spectrum sharing, licensed spectrum sharing, secondary spectrum access, non-real-time SSA, real-time SSA, negotiated access, possibility of quality of service provisioning in a shared band, opportunistic access, overlay approach, underlay approach

UNIT - V: User Cooperative Communications

User cooperation and cognitive systems, relay channels: general three-node relay channel, wireless relay channel, user cooperation in wireless networks: two-user cooperative network, cooperative wireless network, multihop relay channel

UNIT - VI: Information Theoretical Limits on CR Networks

Types of cognitive behavior, interference-avoiding behavior: spectrum interweave, interference-controlled behavior: spectrum underlay, underlay in small networks: achievable rates, underlay in large networks: scaling laws, interference-mitigating behavior: spectrum overlay, opportunistic interference cancellation, asymmetrically cooperating cognitive radio channels.

Text Books

1. Alexander M. Wyglinski, Maziar Nekoyee, and Y. Thomas Hou, ‘’ Cognitive Radio Communications and Networks – Principles and Practice’’, Elsevier Inc., 2010.

References Books

1. Kwang-Cheng Chen and Ramjee Prasad, ‘’Cognitive Radio Networks’’, John Wiley & Sons, Ltd., 2009.
2. Bruce A. Fette, ‘’Cognitive Radio Technology’’, Elsevier, 2009.
3. Joseph Mitola III,’’Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering’’, John Wiley & Sons Ltd. 2000.

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Optional Elective - V

CRYPTOGRAPHY AND NETWORK SECURITY

III Year – II Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce different types of security attacks and Services.
- To expose different cryptographic techniques and Algorithms.

Learning Outcomes

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

- describe security attacks and services over networks.
- differentiate symmetric and asymmetric encryption techniques.
- apply integrity checking and authentication techniques.
- compare E-mail security and IP level security.
- use firewalls and intrusion detection techniques for system security.
- outline web security threats and counter measures.

Course Content

UNIT - I: Security Fundamentals

Security attacks, security services, security mechanisms, a model for network security. non- cryptographic protocol vulnerabilities - session hijacking and spoofing. software vulnerabilities - phishing, buffer overflow, format string attacks, SQL injection.

UNIT - II: Secret Key Cryptography

Symmetric cipher model, block and stream ciphers, Data Encryption Standard (DES), strength of DES, block cipher design principles and modes of operation, triple DES, AES structure.

UNIT - III: Public-Key Cryptography

Public key cryptography, principles of public key crypto systems, RSA algorithm, diffie-Hellman key exchange, introduction to elliptic curve cryptography.

UNIT - IV: Hash Functions and Digital Signatures

Cryptographic hash functions, applications of cryptographic hash functions, secure hash algorithm, digital signatures, digital Signature schemes.

UNIT - V: E-mail Security & IP Security

E-mail Security: PGP, S/MIME. IP Security: Overview, IP security architecture, authentication header, encapsulating security payload.

UNIT - VI: Web Security & System Security

Web Security -Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS).

System Security -Firewall design principles, intrusion detection systems

Text Books

1. William Stallings, "Cryptography and Network security principles and practice" 5thedition, Pearson education 2011.
2. Bernard Menezes, "Network security and cryptography", Cengage learning 2011.

Reference Books

1. William Stallings,"Network Security Essentials", 4th Edition, Pearson education.
2. Eric Maiwald, "Fundamentals of Network Security", 1st Edition,Dreamtech press.
3. Buchmann, "Introduction to Cryptography", Springer.

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CMOS DIGITAL IC DESIGN

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize the students with the design of CMOS digital circuits.
- To make the students understand the impact of interconnects on the delay offered by digital logic circuits.

Course Outcomes

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

- characterize the behaviour of CMOS inverter
- design various combinational andsequential circuits using CMOS logic
- identify different components contributing to delay offered by interconnects
- design complex digital circuits
- design memory based array structures.

Course Content

UNIT - I: The CMOS Inverter

The static CMOS inverter, static behaviour, dynamic behaviour, power, energy and energy delay, technology scaling and its impact on the inverter metrics.

UNIT - II: Combinational Logic Design in CMOS

Static CMOS design, dynamic CMOS design, choosing a logic style, designing logic for reduced supply voltages.

UNIT - III: Sequential Logic Design in CMOS

Timing metrics for sequential circuits, classification of memory elements, static latches and registers, dynamic latches and registers, pipelining, non-bistable sequential circuits.

UNIT - IV: Interconnects

Capacitive parasitics, resistive parasitics, inductive parasitics

UNIT - V: Designing Complex Digital Integrated Circuits

Standard-cell design approach, array-based design, configurable and reconfigurable design.

UNIT - VI: Designing Memory Array Structures

Semiconductor memories, memory core, memory peripheral circuitry, design of PLA.

Text Book

1. Jan M. Rabaey, AnanthaChandrakasan, Borivoje Nikolic, “Digital Integrated Circuits: A Design Perspective”, Pearson Education Inc., Second Edition.

Reference Books

1. Sung-Mo Kang, Yusuf Leblebici “CMOS Digital Integrated Circuits: Analysis and Design”, TMH Education, Third Edition, 2003.
2. David A. Hodges, Horace G. Jackson, Resve A Saleh, “Analysis and Design of Digital Integrated Circuits” McGraw-Hill Higher Education; 3 edition (2003)
3. Amitava Dasgupta, “Digital Integrated Circuits”, NPTEL Video Course, Department of Electrical Engineering,IIT Madras.

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EMBEDDED SYSTEM DESIGN

IV Year – I Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objective

- To introduce the concepts of embedded system design and to show how such systems are developed using a concrete platform built around.

LearningOutcomes

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

- distinguish between the general computing system and the embedded system.
- differentiate general purpose processors and single purpose processors.
- model different state machines and concurrent process.
- specify different design technologies of software and hardware design.

Course Content

UNIT - I: Introduction

Embedded system-definition, classification, application areas and purpose of embedded systems, the typical embedded system-core of the embedded system, memory, sensors and actuators, communication interface, embedded firmware.

Design challenge-optimizing design metrics, processor technology, ic technology, design technology.

UNIT - II: Single Purpose Processors

RT-level combinational logic, sequential logic (RTlevel), custom single purpose processor design (RT-level), optimizing custom single purpose processors.

UNIT - III: General Purpose Processors

Basic architecture, operation, pipelining, programmer's view, development environment, Application Specific Instruction-Set Processors (ASIPs) – MicroControllers and Digital Signal Processors.

UNIT - IV: State Machine And Concurrent Process Models

Introduction, models Vs languages, finite state machines with data path model (FSMD), using state machines, program state machine model (PSM), concurrent process model.

UNIT - V: Interfacing

Communication basics, arbitration, multilevel bus architectures, advanced communication principles

UNIT - VI: Design Technology

Automation: Synthesis- parallel evolution of compilation and synthesis, synthesis levels, logic synthesis, RT synthesis, behavioral Synthesis, systems synthesis and Hardware/ Software Co-Design, verification: Hardware/Software co-simulation

Text Books

1. Frank Vahid, Tony D. Givargis, “Embedded System Design - A Unified Hardware/Software Introduction”, John Wiley, 2002. (Unit II to VI).
2. Shibu.K.V, “Introduction to Embedded Systems” Tata McGraw Hill Education Private Limited, 2009 (Unit I).

Reference Books

1. Raj kamal, “Embedded Systems”, TMH, 2nd Edition, 2008.
2. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier Publications, 2005.

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ELECTRONIC MEASUREMENTS AND INSTRUMENTATION

IV Year – I Semester

Lecture	: 3	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To imparte the basic characteristics and errors associated with the instruments.
- To familiarize with different types of electronic instruments.
- To introduce the essential components of industrial instruments and their usage.

Learning Outcomes

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

- classify the instruments based on static and dynamic characteristics.
- analyze the frequency component of a generated wave and its distortion
- learn the concepts of active and passive transducers.

Course Content

UNIT - I: Fundamentals of measurements

Performance characteristics of instruments, static characteristics- accuracy, resolution, precision, expected value, error, sensitivity, errors in measurement; dynamic characteristics- speed of response, fidelity, lag and dynamic error; DC Volt meters-multi-range, AC voltmeters- multi range, DC ammeter, Aryton shunt, Ohmmeters -series and shunt type.

UNIT - II: Digital Instruments

Ramp technique, dual slope integrating type DVM (Voltage to Time Conversion), integrating type DVM (Voltage to Frequency Conversion), successive approximations, digital ph meter, digital measurement of frequency, phase, speed and capacitance.

UNIT - III: Signal Generators and oscilloscopes

Fixed and variable, standard and AF sine and square wave; function generators-square, pulse, sweep; random noise, Dual beam, Dual trace and digital storage Oscilloscope.

UNIT - IV: Bridges and Analyzers

Wheat stone bridge, Maxwell's bridge, Schering bridge, Wien bridge, Q-meter, wave analyzers, harmonic distortion analyzers, spectrum analyzers, FFT analyzer.

UNIT - V: Transducers

Selecting a transducer, resistive, capacitive and inductive transducers priciples, frequency generating transducers, reluctance pulse pickups, photo electric transducer, flow measurement transducers.

UNIT - VI: Industrial Transducers

Strain gauges, LVDT, load cell, piezoelectric transducer, thermocouples, thermistors, resistance temperature detector, data acquisition systems.

Text Books

1. A.D. Helfrick and W.D.Cooper, “Modern Electronic Instrumentation and Measurement Techniques”, PHI, 5th Edition, 2002.
2. H.S.Kalsi, “Electronic Instrumentation”, TMH, 2nd Edition, 2004.

Reference Books

1. David A. Bell, “Electronic Instrumentation & Measurements”, PHI, 2nd Edition, 2003.
2. A K. Sawhney , “A Course in Electrical and Electronics Measurements & Instrumentation”, Dhanpat Rai & Co., 2015.
3. Golding & Waddis, “Electrical Measurement and Measuring Instruments” Tata McGraw Hill, 2003.

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Professional Elective - III

MIXED SIGNAL IC DESIGN

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

The student will be introduced to the

- basic principles of switched capacitor circuits and PLL applications.
- Understand the specifications and architectures of data converters, mixed signal layout issues.
- advanced CMOS logic design and different building blocks of digital integrated circuits.

Learning Outcomes

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

- analyze the switched capacitor circuits.
- explore the fundamentals and different architectures of ADCs and DACs, mixed signal layout issues.
- use PLLs for various applications.
- characterize various digital IC building blocks.

Course Content

UNIT - I: Introduction to Switched Capacitor Circuits

General considerations, sampling switches, MOSFET as a switch, speed considerations, precision considerations, charge injection cancellation, switched capacitor amplifiers-unity gain sampler/buffer, non inverting amplifier, precision multiply by two circuit, switched capacitor integrator, switched capacitor common mode feedback.

UNIT - II: Data Converter Fundamentals

Analog verses discrete time signals, converting analog signals to digital signals, sample and hold characteristics, digital to analog converter specifications, analog to digital converter specifications, VLSI layout, layout steps, mixed signal layout issues.

UNIT - III: DAC Architectures

Digital input code, resistor string, R-2R ladder networks, current steering, charge scaling DACs, Cyclic DAC, Pipeline DAC.

UNIT - IV: ADC Architectures

Flash, the two step flash ADC, the pipeline ADC, integrating ADCs, the successive approximation ADC, the oversampling ADC.

UNIT - V: Phase-Locked Loop

Simple PLL, phase detector, basic PLL topology, charge pump PLLs, problem of lock acquisition, phase/frequency detector and charge pump, basic charge pump PLL, jitter in PLLs, delay locked loops, applications-frequency multiplication, skew reduction, jitter reduction.

UNIT - VI: Advanced CMOS Logic Design

Domino–CMOS logic, No Race logic, differential CMOS, dynamic differential CMOS, digital integrated system building blocks-multiplexers and decoders, barrel shifters, counters, digital adders, digital multipliers.

Text Books

1. Behzad Razavi (2002), Design of Analog CMOS Integrated Circuits, TMH Edition.
2. R. Jacob Baker (2003), CMOS Circuit Design, layout and simulation, PHI
3. Ken Martin (2002), Digital integrated circuit design, Oxford university press.

Reference Books

1. David A. Johns, Ken Martin (2013), Analog Integrated Circuit Design, Wiley Student Edition.
2. R. Jacob Baker (2009), CMOS Mixed Signal Circuit Design, Wiley Wiley Student Edition.

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Professional Elective - III

CELLULAR AND MOBILE COMMUNICATIONS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce various issues of cellular radio system design.
- To expose students to different types of interferences occurred in cellular systems.
- To familiarize the students to various multiple access techniques and wireless systems.

Learning Outcomes

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

- understand the characteristics of radio environment.
- apply the concepts of frequency reuse and cell splitting to increase the capacity of cellular system.
- analyse different interferences in a cell to improve the performance of the system.
- create a cellular system model for a given region considering terrain configuration.
- design an efficient frequency management and channel assignment scheme by selecting proper handoff mechanism.
- conceptualize GSM and multiple access schemes.

Course Content

UNIT - I: Cellular Mobile Radio Systems

Introduction to cellular mobile system, performance criteria, uniqueness of mobile radio environment, operation of cellular systems, analog cellular systems.

UNIT - II: Elements of Cellular Radio System Design

Concept of frequency reuse, co-channel interference reduction factor, desired C/I from a normal case in an omni directional antenna system, cell splitting, consideration of the components of cellular system.

UNIT - III: Interference

Introduction to co-channel interference, real time co-channel interference, design of antenna system, antenna parameters and their effects, diversity receiver, non-cochannel interference.

UNIT - IV: Cell Coverage for Signal and Traffic

Signal reflections in flat and hilly terrain, effect of human made structures, phase difference between direct and reflected paths, constant standard deviation, straight line path loss slope, general formula for mobile propagation over water and flat open area, near and long distance propagation antenna height gain, form of a point to point model.

UNIT - V: Frequency Management and Channel Assignment

Numbering and grouping, setup, access and paging channels, channel assignments to cell sites and mobile units, channel sharing and borrowing, underlay-overlay arrangement, non fixed channel assignment.

Handoff Mechanism: Dropped call rates, types of handoff initiation, and types of handoff, and vehicle locating methods.

UNIT - VI: Digital Cellular Networks

GSM architecture, GSM channels, multiplex access schemes – FDMA, TDMA, CDMA

Text Books

1. W.C.Y. Lee, "Mobile Cellular Telecommunications", Tata McGraw Hill, 2nd Edition; 2006.(Units: I to V)
2. Theodore. S. Rapport, "Wireless Communications", Pearson Education, 2nd Edition;2002. (Unit: VI)

Reference Books

1. Jon W. Mark and Weihua Zhqung, "Wireless Communication and Networking", PHI, 2005.
2. R. Blake, "Wireless Communication Technology", R. Blake, Thompson Asia Pvt. Ltd., 2004.

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Professional Elective - III

DIGITAL TV ENGINEERING

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the television standards and TV signal transmission.
- To introduce the concepts of digital TV engineering.

Learning Outcomes

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

- understand color Television standards and their specifications.
- conceptualize the operation of color Television system.
- find the applications of Digital TV.

Course Content

UNIT - I: Introduction to TV Standards

Standard scanning sequence, line frequency and frame frequency, Video band width, composite video signal, blanking, synchronizing and equalizing pulses. CCIR-B Standard specifications.

UNIT - II: Colour Television

Block diagram of colour TV receiver, PAL – D decoder, Separation of U and Vsignals, Color burst separation and Burst phase discriminator, Indent and color killer circuits, U & V demodulators, Colour signal mixing.

UNIT - III: Sync Separation and AFC

AGC, Keyed AGC and noise cancellation, Synchronous separation, K noise in sync pulses and separation of frame and line sync pulses, Deflection Oscillators.

UNIT - IV: Digital Television Transmission Standards

ATSC terrestrial transmission standard, vestigial sideband modulation, DVB -T transmission standard, ISDB-T transmission standard, channel allocations, antenna height and power, MPEG-2.

UNIT - V: Performance Objectives for Digital Television

System noise, external noise sources, transmission errors, error vector magnitude, eye pattern, interference, co-channel interference, adjacent channel interference, analog to digital TV, transmitter requirements.

UNIT - VI: Television Applications

Remote control circuit, CCTV systems, video tape recording and playback circuit, HDTV, TV via satellite, Remote Control, DTH system.

Text Books

1. R.R.Gulati, "Monochrome Television Practice, Principles, Technology and servicing." Third Edition 2006, New Age International Publishers.(Units:I toIII,VI)
2. Gerald W. Collins, "Fundamentals of Digital Television Transmission", John Wiley, 2001.(Units: IV to VI)

Reference Books

1. A.M Dhake, "Television and Video Engineering", 2nd ed., TMH, 2003.
2. R.P.Bali, "Color Television, Theory and Practice", Tata McGraw-Hill, 1994.

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Professional Elective - III

DSP PROCESSORS AND ARCHITECTURES

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the Architecture and interfacing of TMS320C54XX processors.
- Conversant with applications of DSP processors.

Learning Outcomes

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

- apply the concepts of Sampling, DFT and Filters.
- calculate DSP computational Errors.
- identify the Architectural features of DSP processors.
- interface I/O and memory devices with DSP Processors.

Course Content

UNIT - I: Computational Accuracy in DSP Implementations

Number formats for signals and coefficients in DSP systems, dynamic range and precision, sources of error in DSP implementations, A/D Conversion errors, DSP computational errors, D/A conversion errors, compensating filter.

UNIT - II: 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.

UNIT - III: Programmable Digital Signal Processors – TMS320C54XX

Data addressing modes, memory space, program control, instructions and programming, on-chip peripherals, interrupts pipeline operation.

UNIT - IV: Analog Devices Family of DSP Devices

Analog devices family of DSP devices-ALU and MAC block diagram, shifter instruction, base architecture of ADSP 2100, ADSP-2181 high performance processor.

UNIT - V: Blackfin 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.

UNIT - VI: Applications of Programmable DSP Devices

Introduction, DSP- based biotelemetry receiver: Pulse Position Modulation, decoding scheme for the PPM Receiver, biotelemetry receiver implementation, ECG signal processing for heart rate determination, brain tumor detection using DSP processor.

Text Books

1. Avtar Singh and S. Srinivasan –,"Digital Signal Processing" , Thomson Publications, 2004.
2. K Padmanabahan, R.Vijayarajeswaran, Ananthi. S, "A practical Approach to Digital Signal Processing", New Age International, 2006/2009

Reference Books

1. Woon-SengGan, Sen M. Kuo, "Embedded Signal Processing with the Micro signal Architecture", Wiley - IEEE Press, 2007.
2. B. Venkataramani and M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications", 2004, TMH.
3. Jonatham Stein, "Digital Signal Processing", John Wiley, 2005.

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Professional Elective - IV

SYSTEM ON CHIP DESIGN

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To provide an overview on System-On-Chip design technology.
- To introduce components in a typical SoC system.
- To familiarize with the concept of different processor cores.

Learning Outcomes

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

- understand architecture designs and their design issues, Core Libraries and EDA Tools required for SoC Design.
- explore design methodology for Logic Cores, Soft and Hard Cores, Memory and Analog Cores.
- perform SoC Design validation, prototyping and verification.
- design SoCs for various applications.

Course Content

UNIT - I: Introduction to Architecture Designs

Architecture and Design Issues of SoC, Hardware Software Co-Design, Co-Design Flow, Core Libraries, EDA Tools and Web Pointers.

UNIT - II: Design Methodology for Logic Cores

SoC Design Flow, Guidelines for Design Reuse, Synchronous Design, Memory and Mixed-Signal Design, On-Chip Buses, Clock Distribution, Clear/Set/Reset Signals, Physical Design, Deliverable Models

UNIT - III: Design Process for Soft and Firm Cores

Design Flow, Design Process for Hard Cores, Sign-Off Checklist, Deliverables – Soft Core and Hard Core, System Integration – Designing with Hard Cores, Designing with Soft Cores, System Verification.

UNIT - IV: Design Methodology for Memory Cores and Analog Cores

Memory Cores: Embedded Memories and Design Methodology, Specifications of Analog Circuits, Circuit Techniques, Memory Compiler, Simulation Models.

Analog Cores: Analog-To-Digital Converter, Digital-To-Analog Converter, Phase-Locked Loops, High Speed Circuits

UNIT - V: Design Validation

Core-Level Validation, Core Validation Plan, Test Benches, Core-Level Timing Verification, Core Interface Verification, Protocol Verification, Gate-Level Simulation, SoC Design Validation, Co-Simulation, Emulation, Hardware Prototypes.

UNIT - VI: Core and SoC Design Examples

Micro Processor Cores, V830 R/AV Super Scalar RISC Core, Design Of Power PC 603e G2 Core, Memory Core Generators, Core Integration And On-Chip Bus, Examples Of Soc, Media Processors, And Testability Of Set-Top Box SoC.

Text Book

1. Rochit Raj Suman,"System-on-a-chip: Design and Test", Artech House, 2000

Reference Books

1. Jason Andrews – Newness"Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology) ", BK and CDROM.
2. Prakash Rashinkar, Peter Paterson and Leena Singh L "System on Chip Verification – Methodologies and Techniques", Kluwer Academic Publishers, 2001.
3. Ricardo Reis,"Design of System on a Chip: Devices and Components", 1st Ed., Springer 2004.

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Professional Elective - IV

WIRELESS SENSOR NETWORKS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To understand the design issues in ad hoc and sensor networks.
- To familiarize the architecture, protocols of wireless sensor networks.

Learning Outcomes

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

- explain the concepts, network architectures and applications of ad hoc and wireless sensor Networks
- analyse the protocol design issues of ad hoc and sensor networks.
- design routing protocols for ad hoc and wireless sensor networks with respect to some protocol design issues.
- evaluate the QoS related performance measurements of ad hoc and sensor networks.

Course Content

UNIT - I: Introduction

Fundamentals of wireless communication technology- the electromagnetic spectrum, radio propagation mechanisms, characteristics of the wireless channel, applications of Ad Hoc and Sensor networks, design challenges in Ad hoc and Sensor Networks.

UNIT - II: Physical Layer and Transceiver Design Considerations

Personal area networks, hidden node problem, exposed node problem, topologies of PAN'S, topologies of MANETS, topologies of WANETS.

UNIT - III: MAC Protocols For Ad Hoc Wireless Networks

Issues in designing a MAC Protocol- classification of MAC protocols- contention based protocols-contention based protocols with reservation mechanisms contention-based protocols with scheduling mechanisms – multi channel MACIEEE 802.11.

UNIT - IV: Routing Protocols and Transport Layer in Ad Hoc Wireless Networks

Issues in designing a routing and transport layer protocol for Ad hoc networks proactive routing, reactive routing (on-demand), hybrid routing- classification of transport layer solutions-TCP over Ad hoc wireless networks.

UNIT - V: Wireless Sensor Networks (WSNs) and MAC Protocols

Sensor network architecture, data relaying and aggregation strategies, MAC layer protocols: self-organizing, hybrid TDMA/FDMA and CSMA based MAC- IEEE 802.15.4.

UNIT - VI: Sensor Network Platforms and Tools

Sensor node hardware–Berkeley motes, programming challenges, node-level software platforms, node-level simulators, state-centric programming.

Application of WSN: Ultrawide band radio communication, wireless fidelity systems. future directions, home automation, smart metering applications.

Text Books

1. C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Prentice Hall Professional Technical Reference, 2008.
2. Holger Karl and Andreas Willig "Protocols and Architectures for Wireless Sensor Networks", Wiley, 2005.

Reference Books

1. Carlos De Morais Cordeiro, Dharma Prakash Agrawal, "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2006.
2. Feng Zhao and Leonides Guibas, "Wireless Sensor Networks", Elsevier Publication - 2002.
3. Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor NetworksTechnology, Protocols, and Applications", John Wiley, 2007.
4. Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.

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Professional Elective - IV

SATELLITE COMMUNICATION

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce fundamentals of satellite communications, satellite launching vehicles and subsystems of the satellite.
- To familiarize link design in satellite communications, multiple access techniques and GPS.

Learning Outcomes

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

- demonstrate the knowledge of orbital parameters and satellite launching techniques.
- compare the role of various satellite subsystems.
- design satellite link for required specifications.
- understand the coordination of earth stations for efficient utilization of the satellite by means of multiple accessing techniques.
- develop a virtual satellite earth station.
- navigate the receiving station by global positioning system.

Course Content

UNIT - I: Introduction

A brief history of satellite communications, orbital mechanics and launchers: orbital mechanics, look angle determination, orbital perturbations, orbit determination, launches and launch vehicles, orbital effects in communication systems performance.

UNIT - II: Satellite Subsystems

Attitude and orbit control system, telemetry, tracking, command and monitoring, power systems, communication subsystems.

UNIT - III: 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 example.

UNIT - IV: Multiple Access

Frequency division multiple access (FDMA), intermodulation, calculation of C/N. Time division Multiple Access (TDMA), frame structure, examples, satellite switched TDMA. onboard processing, DAMA, code division multiple access (CDMA), spread spectrum transmission and reception.

UNIT - V: VSAT Systems

Introduction, overview of VSAT systems, network architectures, access control protocols, basic techniques, VSAT earth station engineering.

UNIT - VI: Satellite Navigation & The 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, GPS C/A code accuracy, differential GPS.

Text Books

1. Timothy Pratt, Charles Bostian and Jeremy Allnutt "Satellite Communications", 2nd Edition John Wiley India, 2006.
2. Wilbur L. Pritchard, Robert A Nelson and Henri G. Suyderhoud "Satellite Communications Engineering", 2nd Edition, Pearson Publications, 2003.

Reference Books

1. M. Richharia "Satellite Communications: Design Principles", BS Publications, 2nd Edition, 2003.
2. D.C Agarwal "Satellite Communication", Khanna Publications, 5th Edition.
3. K.N. Raja Rao "Fundamentals of Satellite Communications", PHI, 2004
4. Dennis Roddy "Satellite Communications", McGraw Hill, 2nd Edition, 1996.
5. G.S.Rao "Global navigation satellite systems-with essentials of satellite systems", McGrawHill.

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Professional Elective - IV

DIGITAL IMAGE PROCESSING

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce fundamental concepts of image processing and different operations on image elements.
- To expose to the practical problems associated with processing of an image.
- To familiarize with advanced image processing operations.

Learning Outcomes

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

- analyze the need for image transforms, types and their properties.
- process the images for the enhancement of certain properties or for optimized use of the resources.
- explore causes for image degradation and to develop various restoration techniques.
- evaluate the image compression techniques

Course Content

UNIT - I: Fundamentals of Image Processing and Image Transforms

Introduction, fundamental steps in image processing, components of image processing system, image sensing and acquisition, image formation model, image sampling and quantization, pixel relationships, image distance measures.

Image Transforms - Need for image transforms, properties of DFT, Discrete Cosine Transform, Hadamard transform, Walsh transform, Haar transform, Slant transform.

UNIT - II: Image Enhancement

Spatial Domain: Gray level transformations, histogram processing, spatial filtering smoothing and sharpening. **Frequency Domain:** Filtering in frequency domain – smoothing and sharpening filters, homomorphic Filtering.

UNIT - III: Image Restoration

Image degradation model, noise modeling, image restoration in the presence of only noise-mean filters, order statistic filters, band reject filters, band pass filters, notch filter inverse filter, wiener filter.

UNIT - IV: Image Segmentation and Morphology

Detection of discontinuities, edge detection, threshold based segmentation, region based segmentation – region growing, region splitting and merging.

Morphology: dilation, erosion, opening and closing, hit or miss transformation, basic morphological algorithms.

UNIT - V: Image Compression

Image Compression: Fundamentals, image compression model, types of redundancy, variable length coding, arithmetic coding, LZW coding, bit-plane coding, runlength coding.

UNIT - VI: Color Image Processing

Color Image Processing: Color fundamentals, color models-RGB,CMYK and HSI, color transformations.

Applications of Image Processing: Content based image retrieval systems, digital watermarking, image mosaicing and image compositing.

Text Books

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", 2nd edition, Pearson Eduction, 2003.(Units: I-V except image transforms)
2. S.Sridhar, "Digital Image Processing",Oxford University Press,2011. (Unit-I image transforms and Unit-VI).

Reference Books

1. Anil K. Jain, "Fundamentals of Digital Image Processing", Prentice Hall of India,2nd edition 2004.
2. S.Jayaraman, "Digital Image Processing", Tata McGraw-Hill Education, 2011.

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Open Elective - IV

DISASTER MANAGEMENT

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with disaster occurrence, strategies and remedial measures.

Learning Outcomes

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

- explain the aspects of disaster management and various types of disasters.
- assess and evaluate the impact of hazards on structures.
- identify the vulnerability conditions against disasters.
- adopt the rehabilitation procedures.

Course Content

UNIT - I: Introduction

Concept of Disaster Management.Types of Disasters.Disaster mitigating agenciesand their organizational structure at different levels.

UNIT - II: Overview of Disaster Situations in India

Vulnerability of profile of India and Vulnerability mapping including disaster – prone areas, communities, places. Disaster preparedness – ways and means; skillsand strategies; rescue, relief reconstruction. Case Studies: Lessons andExperiences from Various Important Disasters in India

UNIT - III: Flood and Drought Disaster

Raising flood damage, assessing flood risk, flood hazard assessment, flood impactassessment, flood risk reduction options. Drought and development, reliefmanagement and prevention, drought mitigation and management-integratingtechnology and people.

UNIT - IV: Landslide and Earthquake Disaster

Land slide hazards zonation mapping and geo environmental problems associatedwith the occurrence of landslides. The use of electrical resistivity method in thestudy of landslide.Causes and effects of earth quakes. Secondary effects. Criteria for earthquake resistant design.

UNIT - V: Cyclone and Fire Disaster

Cyclone occurrence and hazards.Cyclone resistant house for coastal areas.Disaster resistant construction role of insurance sector.Types of fire. Fire safetyand fire fighting method, fire detectors , fire extinguishers.

UNIT - VI: Rehabilitation

Rehabilitation programmes, Management of Relief Camp, information systems &decision making tools

Text Books

1. Disaster Management – Future Challenges and Opportunities, Jagbir Singh, 2007, I K International Publishing House Pvt. Ltd.
2. Disaster Management – Global Challenges and Local Solutions, Rajib shah & R R Krishnamurthy, 2009, Universities press.

Reference Books

1. Disaster Science & Management, Tushar Bhattacharya, 2012, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
2. Disaster Management, H K Gupta, 2003, Universities press.
3. Natural Disaster management, Jon Ingleton, Leigh Trowbridge,1999, Tudor Rose Holdings Ltd.

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Open Elective - IV

REPAIR AND RETROFITTING TECHNIQUES

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with durability aspects, quality of concrete causes of deterioration.
- To impart the knowledge on inspection and assessment of distressed structures, strengthen measures and demolition procedures.
- To familiarize with various concrete materials for repairs, and various precautions during retrofitting.

Learning Outcomes

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

- identify and evaluate the degree of damage in structures.
- explain the cause of deterioration of concrete structures.
- point out the causes of distress in concrete
- explain the concept of Serviceability and Durability.
- assess damage to structures and select suitable retrofitting and repair techniques
- apply different materials for repairing

Course Content

UNIT - I: Assessment, Maintenance and Repair Strategies

Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.

UNIT - II: Serviceability and Durability of Concrete

Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion - Effects of cover thickness and cracking.

UNIT - III: Materials for Repair

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement, Fibre reinforced concrete.

UNIT - IV: Techniques for Repair and Protection Methods

Rust eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete, Expoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings and catholic protection. Engineered demolition techniques for dilapidated structures.

UNIT - V: Repair, Rehabilitation and Retrofitting of Structures

Repairs to overcome low member strength.Deflection, Cracking, Chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure.

UNIT - VI: Work Site Safety

General safety-vehicles, eye and ear protection, clothing; Tool safety-drills and bits, power saws, power mixers, ladders, screwdrivers and chisels; co-worker safety.

Text Books

1. Concrete Structures, Materials, Maintenance and Repair, Denison Campbell, Allen and Harold Roper, edition-1991, Longman Scientific and Technical UK.
2. Repair of Concrete Structures, Allen R.T. & Edwards S.C, edition-1991 Blakie and Sons, UK.

Reference Books

1. Concrete Technology-Theory and Practice, M.S.Shetty, Edition-2006 S.Chand and Company.
2. Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures, Ravishankar.K, Krishnamoorthy.T.S, Edition-2004, Allied Publishers.
3. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers Edition-2004.
4. Hand book on Repair and Rehabilitation of RCC buildings, Published by CPWD, Delhi, Edition-2002.
5. Repair and protection of concrete structures, Noel P.Mailvaganam, Edition-1991 CRC Press London.

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Open Elective - IV

MODERN OPTIMIZATION TECHNIQUES

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the concepts of evolutionary optimization
- To introduce the principles of soft computing optimization algorithes such as Genetic Algorithm, Particle Swarm Optimization, Differential Evolution and Ant Colony Optimization.

Learning Outcomes

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

- distinguish the various optimization techniques.
- describe the concepts of various optimization techniques.
- develop suitable algorithms for the implementation of optimization techniques.
- apply suitable optimization technique to solve various engineering optimization problems

Course Content

UNIT - I: Definition-Classification Of Optimization Problems

Unconstrained and Constrained optimization-Optimality conditions, Evolution in nature-Fundamentals of Evolutionary algorithms- Evolutionary Strategy and Evolutionary Programming.

UNIT - II: Genetic Algorithm

Basic concepts- search space- working principle -encoding-fitness function - Genetic Operators-Selection: Roulette-wheel, Boltzmann, Tournament, Rank and Steadystate-Elitism- Crossover: single-pint, two-point, multi-point, uniform, matrix and cross over rate, mutation, mutation rate.

UNIT - III: Variations of GA & PSO

Variations of GA: Adaptive GA and Real coded GA - Issues in GA implementation-Particle Swarm Optimization: Introduction- Fundamental principles of Particle Swarm Optimization-Velocity Updating-Advanced operators-Parameter selection.

UNIT - IV: Variations of PSO

Implementation issues-Convergence issues, Multi-objective PSO (Dynamic neighbourhood PSO-Vector evaluated PSO)-Variations of PSO: weighted, repulsive, stretched, comprehensive learning, combined effect PSO and clonal PSO.

UNIT - V: Differential Evolution

Introduction-Fundamental principles of Differential Evolution- different strategies of differential evolution-function optimization formulation-mutation and crossover operators-estimation and selection-Discrete Differential Evolution.

UNIT - VI: Ant Colony Optimization

Introduction-Fundamental principles of Ant colony optimization-Ant foraging behaviour-initialization-transition strategy-pheromone update rule- applications.

Text Books

1. Kalyanmoy Deb, "Multi objective optimization using Evolutionary Algorithms",John Wiley and Sons, 2008.
2. E. Goldberg, Genetic Algorithms in search, Optimization and machine learning,1989
3. Particle Swarm Optimization, An overview by Riccardo Poli, James Kennedy,Tim Blackwell, pringer
4. Differential Evolution, A Practical Approach to Global Optimization, Authors:Price, Kenneth, Storn, Rainer M., Lampinen, Jouni A. , Springer
5. Ant Colony Optimization by Marco Dorigo, Thomas Stutzle, MIT Press.

Reference Books

1. "Modern optimization techniques with applications in Electric Power Systems", Soliman Abdel Hady, Abdel Aal Hassan Mantawy, Springer,2012.
2. 'Introduction to Genetic Algorithms", M. Mitchell, Indian reprint, MIT press Cambridge, 2nd edition, 2002.
3. R.C. Eberhart, Y.Sai and J. Kennedy, Swarm Intelligence , The Morgan Kaufmann Series in Artificial Intelligence, 2001.
4. "Biomimicry for optimization, Control and Automation, K.M. Passino, Springer-Verlag, London, UK, 2005.
5. "New Optimization Techniques in Engineering, G. C. Onwubolu, & B. V. Babu,Springer- Verlag Publication, Germany, 2003.

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Open Elective - IV

ELECTRICAL POWER UTILIZATION

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the mechanics of train movement.
- To impart knowledge on various heating methods and laws of illumination.
- To familiarize with the concepts of refrigeration and air-conditioning.

Learning Outcomes

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

- analyze the appropriate type of traction system.
- select a suitable method of heating for a given application.
- design an illumination system.
- calculate the required tonnage capacity for a given air-conditioning system.
- select a suitable charging method.
- evaluate domestic wiring connection and debug any faults occured.

Course Content

UNIT - I: Electrical Traction

Features of an Ideal Traction System, Systems of Electrical Traction, Traction Supply System, Mechanism of Train Movement, Speed- Time Curve, Traction Motors, Tractive Effort and Horse Power, Speed Control Schemes, Electric Braking,Recent Trends in Traction.

UNIT - II: Electric Heating

Classification, Heating Element, Losses in Oven and Efficiency, Resistance Furnace, Radiant Heating, Induction Heating, High Frequency Eddy Current Heating, Dielectric Heating, Arc Furnace, Heating of Furnace, Electric Welding, Methods and Equipments.

UNIT - III: Illumination

Radiant Energy, Terms and Definitions, Laws of Illumination, Polar Curves, Photometry, MSCP, Integrating Sphere, Luminous Efficacy, Electrical Lamps, Design of Interior and Exterior Lighting Systems, Illumination Levels for Various Purposes, Light Fittings, Factory Lighting, Flood Lighting, Street Lighting, Energy Conservation in Lighting.

UNIT - IV: Air Conditioning and Refrigeration

Control of Temperature, Protection of Motors, Simple Heat-Load and Motor Calculations, Various Types of Air Conditioning, Functioning of Complete Air Conditioning System, Type of Compressor Motor, Cool Storage, Estimation of Tonnage Capacity and Motor Power.

UNIT - V: Electro-Chemical Processes

Electrolysis – Electroplating – Electro deposition – Extraction of metals current, Efficiency - Batteries – types – Charging Methods.

UNIT - VI: Basics of Domestic Electrical Wiring

Types of Cables, Flexible Wires Sizes and Current Capacity, Use of Fuse, MCB and MCCB (Working and Construction), Idea about Megger, Earthling – Domestic and Industrial.

Text Books

1. "Utilisation of Electric Energy" Garg and Girdhar, 1982, Khanna Publisher.
2. "Art and Science of Utilization of Electrical Energy", Pratab H., Second Edition, Dhanpat Rai and Sons, New Delhi.

Reference Books

1. "Generation, Distribution and Utilization of Electrical Energy",Wadhwa C.L., 1993, Wiley Eastern Limited,
2. "Electric Energy Utilization and Conservation", S.C.Tripathy, 1993, Tata McGraw Hill.
3. "Utilization of Electric Power", R.K. Rajaput,Laxmi Publications, 1st Edition, 2007.
4. "Utilization of Electric Power", N.V.Suryanarayana, New Age International, 2005.
5. "Generation, Distribution and Utilization of Electrical Energy, C.L.Wadhwa, New Age International, 4th Edition, 2011.
6. Refrigiration and Air-conditioning, M. Prasad, Wiley Eastern Ltd., 1995 .
7. "Utilization of Electrical Energy", Taylor E. Openshaw, 1968, Orient Longman.
8. "Utilization of Electric Power and Electric Traction", Gupta J. B., 2002, S. K. Kataria and Sons.

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Open Elective - IV

GREEN ENGINEERING

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To impart the knowledge needed to minimize impacts of products, processes on environment for sustainable development.

Learning Outcomes

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

- evaluate the impact of technology on environment
- compare biological ecology to industrial ecology
- design eco friendly product.
- create sustainable products, facilities, processes and infrastructure
- asses the life cycle of a product to evaluate its impact on energy and materials use
- determine the effects of air and water quality

Course Content

UNIT - I: Introduction

Humanity and technology, the concept of sustainability, quantifying sustainability, industrial ecology

UNIT - II: Frame work for green engineering

The relevance of biological ecology to industrial ecology, metabolic analysis, technology and risk, the social dimensions of industrial ecology.

UNIT - III: Implementation

Technological product development,design for environment and sustainability- customer products- buildings and infrastructure.

UNIT - IV: Life Cycle Assessment

An introduction to life cycle assessment, the LCA impact and interpretation stages, streamlining the LCA process.

UNIT - V: Analysis of Technological Systems-material flow and energy

Systems Analysis, industrial ecosystems, material flow analysis, energy and industrial ecology,

UNIT - VI: Analysis of Technological Systems-air-water

Air quality impacts, carbon cycles and energy balance, water quality impacts, urban industrial ecology, modelling in industrial ecology.

Text Books

1. T E Graedel, Braden R Allenby "Industrial ecology and sustainable engineering" Prentice Hall.
2. David T. Allen, David R Shonnard "Sustainable Engineering Concepts, Design and Case Studies" Prentice Hall.

References Books

1. Bradley A. Striebig, Adebayo A. Ogundipe, Maria Papadakis "Engineering applications in sustainable design and development" Cengage Learning.
2. Anastas, Paul T, Zimmerman, Julie B, "Innovations in Green Chemistry and Green Engineering", Springer, First Edition.
3. Daniel A. Vallero, Chris Brasier, "Sustainable Design: The Science of Sustainability and Green Engineering", Wiley, First Edition.

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Open Elective - IV

NON DESTRUCTIVE EVALUATION

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the concepts of various NDE techniques to identify the defect in a mechanical elements.

Course Outcomes

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

- choose a suitable non destructive method to find the defect in the given mechanical components using radiography, ultrasonic test, magnetic particle test etc.,

UNIT - I: Introduction to Non-Destructive Testing

Radiographic test, Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography

UNIT - II: Ultrasonics Test

Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Sound Field, Piezo-electric Effect, Ultrasonic Transducers and their Characteristics, Ultrasonic Equipment and Variables Affecting Ultrasonic Test, Ultrasonic Testing, Interpretations and Guidelines for Acceptance, Rejection - Effectiveness and Limitations of Ultrasonic Testing.

UNIT - III: Liquid Penetrant Test

Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness and Limitations of Liquid Penetrant Testing

UNIT - IV: Magnetic Particle Test

Magnetic Materials, Magnetization of Materials, Demagnetization of Materials,Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test.

UNIT - V: Eddy Current Test

Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current Testing Effectiveness of Eddy Current Testing

UNIT - VI: Industrial Applications of NDE

Span of NDE Activities Railways, Chemical Industries, Automotive Industries, NDE of pressure vessels, castings, welded constructions.

Text Books

1. Non-Destructive Test and Evaluation of Materials, J Prasad, GCK Nair, TMH Publishers.
2. Ultrasonic Testing by Krautkramer and Krautkramer.
3. Non-Destructive Testing, Warress, JMc Gonmade.

References Books

1. Ultrasonic inspection training for NDT: E. A. Gingel, Prometheus Press.
2. ASTM Standards, Vol 3.01, Metals and alloys.
3. Non-Destructive, Hand Book – R. Hamchand.

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Open Elective - IV

CYBER PHYSICAL SYSTEMS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To prototype the Smart objects and provides a holistic understanding of development Platforms, connected products of Internet of things (IoTs).
- To familiarize with real World IoT Design Constraints, Industrial Automation and Commercial Building Automation in IoT.

Course Outcomes

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

- develop prototypes using appropriate Platforms of internet-connected products.
- assess and improve the reliability & security of a simple Cyber-Physical System.
- differentiate various methodologies and tools of automatic synthesis of controls and software

Course Content

UNIT - I: Introduction to Cyber physical System

Cyber-Physical Systems (CPS); history; key features; CPs design challenges; model-based design and design methodologies; simulation, validation, verification, and synthesis; platform-based design and contract-based design.

UNIT - II: Modeling

Introduction to models of computation; languages and tools for system design; mathematical background; notions of complexity and computability, finite state machines; synchronous/reactive model.

UNIT - III: Analysis

Cyber-Physical System requirements (functional, extra-functional, safety, liveness, reliability, real-time); specification languages; temporal logic; overview of requirement analysis and validation techniques, core engines for algorithmic system verification;

UNIT - IV: Introduction to Internet of Things

Definition and evolution of IoT, architecture of IoT, resource management, data management and analytics, security issues, identity management and authentication, privacy, standardization and regulatory limitations, opportunities for IoT.

UNIT - V: IoT Enabling Technologies

Wireless Sensor Networks: Overview, history, the node, connecting nodes, networking nodes. securing communication- standards. cloud computing, Big data analysis, communication protocols, wireless communication protocols, wireless communication protocols and application protocols.

UNIT - VI: Use cases and IoT applications

Home automation, smart building, smart health, location tracking, environment, energy, agriculture, smart cities and other IoT electronic industries.

Text Books

1. E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems, A Cyber-Physical Systems Approach," 2nd Edition, http://LeeSeshia.org, 2015.
2. R. Alur, "Principles of Cyber-Physical Systems," MIT Press, 2015.

Reference Books

1. Arshdeep Bahga, Vijay Madisetti "Internet of Things - A Hands-on Approach", Published by Arshdeep Bahga & Vijay Madisetti, 1st Edition.
2. Dieter Uckelmann, Mark Harrison Florian, Michahelles "Architecting the Internet of things", Springer-Verlag Berlin Heidelberg, 1st Edition.

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Open Elective - IV

SIGNALS AND SYSTEMS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the basic concepts of signals and systems.
- To introduce various transform techniques on signals.
- To develop an understanding of sampling and correlation techniques on signals.

Course Outcomes

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

- classify the signals and various operations on signals.
- perform Fourier analysis on the signals.
- analyze the various systems.
- perform correlation operational on signals.
- apply the various sampling techniques on continuous time signals.
- analyze the various continuous time signals through transformation (Fourier and Laplace) techniques.

Course Content

UNIT - I: Signal Analysis

Classification of signals, basic operations on signals-amplitude and time scaling, time shifting, addition and multiplication, introduction to elementary signals-unit step, impulse, ramp, parabolic, rectangular, triangular, sinusoidal, exponential, signum, sinc and gaussian functions.

UNIT - II: Fourier Series Representation of Continuous Time Signals

Trigonometric and exponential Fourier series, relationship between trigonometric and exponential Fourier series, representation of a periodic function by the Fourier series over the entire interval, convergence of Fourier series, alternate form of trigonometric series, symmetry conditions-even and odd, complex Fourier spectrum.

UNIT - III: Fourier Transform

Representation of an arbitrary function over the entire interval: Fourier transform, Fourier transform of some useful functions and periodic function, properties of Fourier transform, energy density spectrum, Parseval's theorem.

Sampling: Sampling theorem for band limited signals- explanation, reconstruction of signal from samples, aliasing, sampling techniques- impulse, natural and flat top sampling.

UNIT - IV:LTI Systems

Properties of systems, Linear Time Invariant (LTI) system, response of LTI system-convolution integral, properties of LTI system, transfer function and frequency response of LTI system.

Signal Transmission Through LTI Systems: Filter characteristics of LTI systems, distortion less transmission through LTI system, signal bandwidth, System bandwidth, ideal LPF, HPF and BPF characteristics, causality and physical realizability- Paley-Wiener criterion, relationship between bandwidth and rise-time.

UNIT - V: Correlation of Continuous Time Signals

Cross correlation and auto correlation of continuous time signals (finite and nonfinite energy signals), relation between convolution and correlation, properties of cross correlation and autocorrelation, power density spectrum, relation between auto correlation function and energy/power spectral density function.

UNIT - VI: Laplace Transform

Laplace transform of signals, properties of Region of Convergence (ROC), unilateral Laplace transform, properties of unilateral Laplace transform, inversion of unilateral and bilateral Laplace transform, relationship between Laplace and Fourier Transforms.

Text Books

1. B.P.Lathi, "Signals, Systems &Communications", BS Publications, 2003 (Units I-VI).
2. A.V. Oppenheim, A.S. Willsky and S.H.Nawab, "Signals and Systems",PHI, 2nd Edition (Units I, III, VI)

Reference Books

1. Simon Haykin and Van Veen, "Signals &Systems", Wiley, 2nd edition
2. Michel J. Robert , "Fundamentals of Signals and Systems", TMGH Int. Edition, 2008
3. C.L.Philips, J.M. Parr and Eve A. Riskin, "Signals, Systems and Transforms", Pearson Education, 3rd Edition, 2004.

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Open Elective - IV

DIGITAL FORENSICS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To provide a comprehensive overview of digital forensic process.
- To familiarize with the different roles a computer in crime investigation.

Learning Outcomes

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

- formulate a Digital Forensic Process
- employ fundamental computer theory in the context of computer forensics practices
- apply the principles of effective digital forensics investigation techniques
- explain the role of digital forensics in the field of information assurance and information security
- evaluate the effectiveness of available digital forensic tools
- outline the file storage mechanisms of DOS systems
- examine computer incidents in crime scene

Course Content

UNIT - I: Introduction to Digital Forensics

What is Computer Forensics?, Differences between Computer Forensics and Digital Forensics, History of Digital Forensics, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings, Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps taken by Computer Forensics Specialists, Types of Computer Forensics Technology.

UNIT - II: Computer Forensics Evidence and Capture

Data Recovery, Data Back-up and Recovery, The Role of Back-up in Data Recovery, The Data-Recovery Solution, Evidence Collection and Data Seizure: Why Collect Evidence? Collection Options, Obstacles, Types of Evidence, the Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collection, Artifacts, Collection Steps, Controlling Contamination: The Chain of Custody.

UNIT - III: Duplication and Preservation of Digital Evidence, Computer Image Verification and Authentication, Processing Crime and Incident Scenes: Identifying Digital Evidence, Collecting Evidence in Private-Sector Incident Scenes, Securing a Computer Incident or Crime Scene, Seizing Digital Evidence at the Scene, Storing Digital Evidence, Obtaining a Digital Hash, Reviewing a Case.

UNIT - IV: Digital Forensics Analysis and Validation

Determining what data to collect and analyze, Validating Forensic data, Data-Hiding Techniques, Examining Encrypted Files, Recovering Passwords, Performing Remote Acquisitions, Virtual Machines, Network Forensics and performing Live Acquisitions, Email Investigations, Mobile Device Forensics.

UNIT - V: Current Digital Forensics Tools

Types of Forensics Tools, Tasks performed by Forensic Tools, Tool Comparisons, Software Tools – Command-line Forensics Tools, UNIX/Linux Forensics Tools, other GUID Forensics Tools, Hardware Tools – Forensic Workstations, Using a Write-Blocker, Validating and Testing Forensic Software - Using National Institute of Standards and Technology (NIST) Tools, Using Validation Protocols.

UNIT - VI: Working with Windows and DOS Systems

File Systems, exploring Microsoft File Structures, examining NTFS disks, whole Disk Encryption, Windows Registry, Microsoft Start-up Tasks, MS-DOS Start-up Tasks, and Virtual Machines.

Text Books

1. John R.Vacca, “Computer Forensics: Computer Crime Scene Investigation”, 2nd edition, Charles River Media.
2. Bill Nelson, Amelia Phillips, Christopher Steuart, “Guide to Computer Forensics and Investigations”, 3rd edition, CENGAGE Learning.

Reference Books

1. Tony Sammes and Brian Jenkinson, “Forensic Computing, A Practitioners Guide”, 1st edition. Springer
2. Christopher L. T. Brown, “Computer Evidence: Collection and Preservation”, 2nd edition, Firewall Media.
3. Jesus Mena, “Homeland Security, Techniques and Technologies”, 1st edition Firewall Media.

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Open Elective - IV

BUSINESS INTELLIGENCE AND DECISION SUPPORT SYSTEMS

IV Year – I Semester

Lecture : 4	Internal Marks : 40
Credits : 3	External Marks : 60

Course Objectives

- To identify the process of decision making and use of model for decision making.
- To use various visualization tools for delivery of knowledge.

Learning Outcomes

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

- identify the need of Business Intelligence
- explain the process of decision making
- use mathematical model for decision making
- compare simple linear regression model with multiple linear regression model for prediction.
- choose a marketing model to design sales territory
- construct charts, graphs and widgets to deliver the knowledge for decision makers

Course Content

UNIT - I: Introduction to Business Intelligence

Effective and timely decisions, Data, information and knowledge, Role of mathematical models, Business intelligence architectures, Ethics and business intelligence.

UNIT - II: Decision support systems

Definition of system, Representation of the decision-making process, Evolution of information systems, Definition of decision support system, Development of a decision support system.

UNIT - III: Mathematical models for decision making

Structure of mathematical models, Development of a model, Classes of models.

Regression: Structure of regression models, Simple linear regression, Multiple linear regression.

UNIT - IV: BI Applications

Marketing Models: Relational Marketing, Sales force Management, Business case studies.

UNIT - V: Data envelopment analysis

Efficiency measures, Efficient frontier, The CCR model, Identification of good operating practices.

UNIT - VI: Knowledge Delivery

Visualization, Scorecards and Dashboards, Geographic Visualization, Integrated analytics, Considerations: Optimizing the presentation for the Right message.

Text Books

1. Carlo Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", Wiley Publications.
2. David Loshin, "Business Intelligence: The Savvy Manager's Guide", 2^{nd} edition, Morgan Kaufman Publications.

Reference Books

1. Efraim Turban, Jay E Aronson, Teng-Peng Liang, Ramesh Sharda, "Decision Support and Business Intelligence Systems", 8^{th} Edition, Pearson.
2. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", 2^{nd} edition, Morgan Kaufmann Publishers.
3. Larissa T. Moss and Shaku Atre, "Business Intelligence Roadmap: The complete Project Life Cycle of Decision Making", 1^{st} edition, Addison Wesley.
4. Cindi Howson, "Successful Business Intelligence: Secrets to Making BI a Killer App", McGraw- Hill.

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Open Elective - IV

ADHOC AND SENSOR NETWORKS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To acquire fundamental concepts of ad hoc networks.
- To learn design considerations of wireless sensor networks.

Learning Outcomes

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

- evaluate architecture and protocols in adhoc and wireless sensor networks.
- identify applications of adhoc and WSN's.
- illustrate wireless sensor networks design aspects.
- synthesize routing protocols for adhoc wireless networks.
- outline Transport layer and security protocols for Ad hoc wireless networks.
- summarize layer wise functionalities of wireless sensor networks.
- describe MAC protocols in adhoc and WSN's.

Course Content

UNIT - I: Introduction

Fundamentals of wireless communication technology, the electromagnetic spectrum, radio propagation mechanisms, characteristics of the wireless channel.Ad hoc wireless networks: introduction, cellular and Ad hoc wireless networks, applications of ad-hoc networks, issues in ad hoc wireless networks.

UNIT - II: MAC Protocols for Adhoc Wireless Networks

Issues in designing a MAC protocol for ad hoc wireless networks, classifications of MAC protocols, Contention based protocols.

UNIT - III: Routing protocols for Adhoc Wireless Networks

Issues in designing a routing protocol for ad hoc wireless networks, classifications of routing protocols, table-driven routing protocols, on-demand routing protocols.

UNIT - IV: Transport layer and Security Protocols for Adhoc Wireless Networks

Introduction, Issues, design goals, classification of transport layer solutions, TCP over ad hoc wireless networks: TCP-F, TCP-ELFN, TCP-BUS, ATCP, split-TCP. Network security attacks.

UNIT - V: Sensor Networks Design Considerations-I

Introduction, energy consumption, sensing and communication range, design issues, localization scheme, clustering of SN's, MAC layer, Applications of wireless sensor networks.

UNIT - VI: Sensor Networks Design Considerations-II

Routing layer, flat versus hierarchical, operation-based protocols, location-based protocols, high level application layer support.

Text Books

1. Carlos de Morais Cordeiro, Dharma Prakash Agrawal, "Ad Hoc and Sensor Networks: Theory and Applications", 2nd Edition, World Scientific Publications, 2011.
2. C. Siva Ram Murthy, B.S. Manoj "Ad Hoc wireless networks: Architectures and protocols ", Pearson, 2017.

Reference Books

1. Prasant Mohapatra and Srihanamurthy, "Ad Hoc Networks Technologies and Protocols", Springer, Springer International Edition, 2009.
2. Subir kumar sarkar, C. Puttamadappa, T.G.Basavaraju, "Ad hoc mobile wireless networks:principles, protocols and applications", Taylor & Francis India Pvt Ltd - New Delhi, 2007.
3. Jagannathan, sarangapani, "wireless ad hoc and sensor networks protocols, performance, and control", CRC press, 2007.

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Open Elective - IV

INFORMATION RETRIEVAL SYSTEMS

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To provide the foundation knowledge in information retrieval.
- To familiarize about different applications of information retrieval techniques in the Internet or Web environment.

Learning Outcomes

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

- identify basic theories in information retrieval systems.
- identify the analysis tools as they apply to information retrieval systems.
- understand the problems solved in current IR systems.
- describes the advantages of current IR systems.
- understand the difficulty of representing and retrieving documents.
- understand the latest technologies for linking, describing and searching the web.

Course Content

UNIT - I: Introduction to Information Storage and Retrieval System

Introduction, Domain Analysis of IR systems and other types of Information Systems, IR System Evaluation. Introduction to Data Structures and Algorithms related to Information Retrieval: Basic Concepts, Data structures, Algorithms.

UNIT - II: Inverted files

Introduction, Structures used in Inverted Files, Building Inverted file using a sorted array, Modifications to Basic Techniques.

UNIT - III: Signature Files

Introduction, Concepts of Signature Files, Compression, Vertical Partitioning, Horizontal Partitioning.

UNIT - IV: New Indices for Text

PAT Trees and PAT Arrays: Introduction, PAT Tree structure, Algorithms on the PAT Trees, Building PAT trees as PATRICA Trees, PAT representation as arrays.

UNIT - V: Stemming Algorithms

Introduction, Types of Stemming Algorithms, Experimental Evaluations of Stemming to Compress Inverted Files.

UNIT - VI: Thesaurus Construction

Introduction, Features of Thesauri, Thesaurus Construction,Thesaurus construction from Texts, Merging existing Thesauri.

Text Books

1. William B. Frakes, Ricardo Baeza-Yates, "Information Retrieval: Data Structures and Algorithms", Prentice Hall.
2. Ricardo Baeza-Yates, Bertheir Ribeiro-Neto, "Modern Information Retrieval", Pearson Education.
3. Robert R. Korfhage, "Information Storage and Retrieval", John Wiley & Sons.

Reference Books

1. Gerald Kowalski, Mark T Maybury, "Information Storage and Retrieval Systems-Theory and Implementation", 2nd edition, Kluwer Academic Press, 1997.
2. David A. Grossman, Ophir Frieder, "Information Retrieval:Algorithms and Heuristics", 2nd edition, Springer.

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Open Elective - IV

FUZZY LOGIC

IV Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To impart the knowledge of fuzzy set theory and its applications in Engineering.

Learning Outcomes

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

- distinguish between crisp set and fuzzy set.
- compose the operations on fuzzy sets to characterize the belongingness of elements in the sets
- construct fuzzy relations to draw inferences
- illustrate the methods of defuzzification to drive the control mechanism.
- apply fuzzy logic to control automatic engineering systems.

Course Content

UNIT - I: Crisp Sets Vs Fuzzy Sets

Crisp sets an overview, Concept of fuzziness, the notion of Fuzzy sets, basic concepts of fuzzy sets.

UNIT - II: Operations of Fuzzy Sets

Fuzzy set operations-fuzzy complement, fuzzy union, fuzzy intersection, combinations of operations.

UNIT - III: Fuzzy Relations

Fuzzy Cartesian product ,Fuzzy relations, operations on fuzzy relations, properties of fuzzy relations, lamda cut for fuzzy relations and composition, Fuzzy tolerance and equivalence relations.

UNIT - IV: Fuzzification and Defuzzification

Features of membership function, fuzzification, defuzzification to crisp set, Defuzzification to scalars (centroid method, centre of sums method, mean of maxima method).

UNIT - V: Fuzzy Logic

Introduction to fuzzy logic, Crisp connectives vs Fuzzy logical connectives, Approximate reasoning.

UNIT - VI: Applications of Fuzzy Systems

Fuzzy Control System, Control System Design Problem, Simple Fuzzy Logic Controller, general applications of fuzzy logic (washing machine, air conditioner controller).

Text Books

1. Timothy J.Ross., Fuzzy Logic with Engineering Applications - Second Edition, Wiley Publications, 2007, New Delhi.
2. S.Rajasekaran, G.A.Vijayalakshmi Pai, Neural networks, Fuzzy logic, and genetic algorithms synthesis and applications- – Prentice-Hall of India private limited, 2008, New Delhi.

Reference Books

1. H.J. ZIMMERMAN, Fuzzy set theory and its applications, 4^{th} edition — SPRINGER, 2006. New Delhi.
2. Recommended Text S.Nanda and N.R.Das “Fuzzy Mathematical concepts, Narosa Publishing House, New Delhi.

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MICROWAVE AND OPTICAL COMMUNICATIONS LAB

IV Year – I Semester

Practical	: 4	Internal Marks	: 40
Credits	: 2	External Marks	: 60

Course Objectives

- To familiarize with the behavioural aspects of various microwave sources and optical sources
- To introduce the measurement procedures of important parameters in microwave engineering and optical engineering

Learning Outcomes

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

- experiment with microwave sources like reflex klystron, Gunn diode and optical sources like LED's & Lasers.
- conduct measurements using a standard microwave test bench, analog and digital optical links for microwave and optical signal characteristics.
- develop test bench for characterizing a given microwave component.

List of Experiments

Part – A: (Minimum 7)

1. Reflex Klystron characteristics.
2. Gunn diode characteristics.
3. Attenuation measurement.
4. Directional coupler characteristics.
5. VSWR Measurement.
6. Impedance measurement.
7. Waveguide parameters measurement.
8. S matrix of Circulator.
9. S matrix of Magic Tee.

Part – B: (Minimum 5)

1. Characterization of LED.
2. Characterization of Laser diode.
3. Intensity modulation of laser output through an optical fiber.

4. Measurement of data rate for digital optical link.
5. Measurement of numerical aperture.
6. Measurement of losses in plastic fiber.

Reference Books

1. Samuel Y. Liao , “Microwave Devices and Circuits” , PHI, 3rd Edition,1994.
2. R.E. Collin, “Foundations for Microwave Engineering”, IEEE Press, John Wiley, 2nd Edition, 2002.
3. Peter A. Rizzi, “Microwave Engineering Passive Circuits” –PHI, 1999.
4. M.L. Sisodia and G.S.Raghuvanshi, “Microwave Circuits and Passive Devices” Wiley Eastern Ltd., New Age International Publishers Ltd., 1995.
5. R. Chatterjee, “Elements of Microwave Engineering”, Affiliated East-West Press Pvt. Ltd., New Delhi, 1988.
6. Gerd Keiser, “Optical fiber communications” –3rd Edition, McGrawHill.
7. Djafar K. Mynbaev and Lowell L. Scheiner, “Fiber Optic Communication Technology” (Pearson Education Asia)
8. User manuals for Microwave Lab equipment.
9. Data sheets for optical sources.

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Optional Elective - VII

DIGITAL CONTROL SYSTEMS

IV Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the concepts on digital control systems and their associated components.
- To impart knowledge on z–transformations for the analysis of digital control systems.
- To familiarize with the concepts on state model representation of discrete–time systems and its stability testing methods.
- To impart knowledge on design of state feedback controller using pole placement method.

Learniang Outcomes

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

- specify the components of digital control systems.
- employ z–transformations to analyze digital control systems.
- assess the stability of digital systems and suggest methods to improve stability margins.
- employ the state–space representation for the analysis and design of digital systems.

Course Content

UNIT - I: Introduction And Signal Processing

Introduction to analog and digital control systems – advantages of digital systems – typical examples – signals and processing – sample and hold devices – sampling theorem and data reconstruction – frequency domain characteristics of zero order hold.

UNIT - II: Z–Transformations

Z–Transforms–theorems – finding inverse z–transforms – formulation of difference equations and solving – block diagram representation – pulse transfer functions and finding open loop and closed loop responses.

UNIT - III: State Space Analysis and The Concepts of Controllability and Observability

State space representation of discrete time systems – state transition matrix and methods of evaluation – discretization of continuous – time state equations – concepts of controllability and observability – tests.

UNIT - IV:Stability Analysis

Mapping between the S–Plane and the Z–Plane – primary strips and complementary strips – stability criterion – modified Routh's stability criterion and jury's stability test.

UNIT - V: Design of Discrete–Time Control Systems By Conventional Methods

Transient and steady state specifications – design using frequency response in the w–plane for lag and led compensators – root locus technique in the z– plane.

UNIT - VI: State Feedback Controllers

Design of state feedback controller through pole placement – necessary and sufficient conditions – Ackerman's formula.

Text Books

1. K. Ogata, "Discrete Time Control systems", Pearson Education/PHI, 2nd Edition
2. M. Gopal, "Digital Control and State Variable Methods", Tata Mc Graw-Hill Companies, 1997.

Reference Books

1. Kuo, "Digital Control Systems", Oxford University Press, 2nd Edition, 2003.
2. M.Gopal, "Digital Control and State Variable Methods", TMH.

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Optional Elective - VII

ARTIFICIAL INTELLIGENCE

IV Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objective

- To familiarize the concepts of AI for representation of knowledge and problem solving.

Learning Outcomes

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

- identify the problems that are amenable and can be solved by using AI techniques.
- analyse the problem solving and game playing techniques.
- specify the classical Artificial Intelligence algorithms, which are used to solve the heuristic search and game playing problems.
- apply the basic principles and algorithms of Artificial Intelligence to recognise, model and solve the state space search, knowledge representation and reasoning problems.
- formulate the Reasoning model and state the conclusion for the uncertainty problems using actions and their effects over the time.
- describe expert systems and their applications.

Course Content

UNIT - I: Introduction to Artificial Intelligence

Introduction, history, intelligent systems, foundations of AI, applications, tic-tac-toe game playing, current trends in AI.

UNIT - II: Problem solving and game playing

State-space search and control strategies: Introduction, general problem solving, characteristics of problem, exhaustive searches, heuristic search techniques-Hill climbing, iterative-deepening A*, problem reduction, constraint satisfaction.

Game playing: Introduction, game playing, min-max algorithm, alpha-beta pruning.

UNIT - III: Logic Concepts

Introduction, propositional calculus, proportional logic, natural deduction system, axiomatic system, semantic table system in proportional logic, resolution in proportional logic, resolution in predicate logic and unification algorithm.

UNIT - IV: Knowledge Representation

Introduction, approaches to knowledge representation, knowledge representation using semantic network, knowledge representation using frames.

Advanced knowledge representation techniques: Introduction, conceptual dependency theory, script structure.

UNIT - V: Reasoning in Uncertain Situations

Introduction to non-monotonic reasoning, truth maintenance systems, logics for non-monotonic reasoning, classical planning problem: Goal stack, hierarchical planning.

UNIT - VI: Expert Systems and Applications

Introduction phases in building expert systems, expert system versus traditional systems, rule-based expert systems, blackboard systems, model-based expert system, case-based expert system and hybrid expert system and application of expert systems.

Text Books

1. Elaine Rich, Kevin Knight, “Artificial Intelligence”, Tata McGraw Hill edition, 2nd edition.
2. Stuart J. Russell, “Artificial Intelligence: A Modern Approach”, 2nd edition.

Reference Books

1. Patrick Henry Winston, “Artificial Intelligence”, 3rd edition, Pearson Education.
2. Russel and Norvig, “Artificial Intelligence”, 3rd edition, Pearson Education, PHI.
3. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, 2nd edition, PHI publication.

Web Links

1. https://onlinecourses.nptel.ac.in/noc18_cs19
2. https://www.tutorialspoint.com/artificial_intelligence/index.htm
3. https://www.ibm.com/developerworks/library/cc-beginner-guide-machine-learning-ai-cognitive/index.html

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Optional Elective - VII

TRANSFORM TECHNIQUES

IV Year – I Semester

Lecture	: -	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with wavelet transforms and multi rate analysis.
- To impart the knowledge of wavelet packets and wavelet generation.

Learning Outcomes

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

- analyze various signals using Fourier and wavelet transforms.
- apply different transform techniques for the analysis of one and two dimensional signals.
- describe various filter banks and signal reconstruction techniques.
- perform different processing operations using thresholding techniques.

Course Content

UNIT - I: STFT and Introduction of Wavelet Transform Time – frequency analysis: window function, short time Fourier transform, discrete short time Fourier transform, continuous wavelet transform, discrete wavelet transform, wavelet series, interpretation of the time-frequency plot.

UNIT - II: Transforms -Walsh, Hadamard, Haar and Slant transforms, DCT, DST, KLT, singular value decomposition; definition, properties.

UNIT - III: Continuous Wavelet Transform (CWT) - Short comings of STFT, need for wavelets, wavelet basis- concept of scale and its relation with frequency, continuous time wavelet transform equation- series expansion using wavelets, CWT, tiling of time scale plane for CWT. Haar, Mexican hat, Shannon, and Daubechies wavelets.

UNIT - IV: Multi resolution analysis-Image pyramids,subband coding,multi resolution expansions, two-channel filter banks, perfect reconstruction condition, relationship between filter banks and wavelet basis.

UNIT - V: Discrete Wavelet Transform (DWT)- DWT, structure of DWT filter banks,scaling function and its properties,wavelet function and its properties, Daubechies wavelet function, applications of DWT.

UNIT - VI: Wavelet Packets and Lifting- Wavelet packet transform and algorithms, hard and soft thresholding, multidimensional wavelets, bi-orthogonal basis - B-splines, lifting scheme of wavelet generation, multi wavelets.

Text Books

1. K.P.Soman and K.I Ramachandran, "Insight into Wavelets – from theory to practice" PHI, Second Edition,2008.(All Units)
2. Jaideva C Goswami, Andrew K Chan,"Fundamentals of Wavelets- Theory", Algorithms and Applications", John Wiley & Sons, Inc, 1999. (Units: I, III, IV, V)

Reference Books

1. Raghuveer M.Rao and Ajit S. Bopardikar, "A Wavelet Tour of Signal Processing Theory and Applications", Pearson Edu, 2003.
2. S.Jayaraman, S.Esakkirajan, T.Veera Kumar , "Digital Image Processing", Tata McGraw Hill, 2009.

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Professional Elective - V

LOW POWER VLSI CIRCUITS

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To make the students familiarize with the sources of power dissipation and power minimization techniques.

Learning Outcomes

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

- identify the requirements for low power
- distinguish static and dynamic power dissipations
- apply voltage scaling approaches to reduce dynamic power
- apply various methods to minimize switched capacitance
- identify suitable leakage power minimization technique
- describe low power design methodologies such as adiabatic circuits.

Course Content

UNIT - I: Low Power Requirements

Historical background, requirements for low power, sources of power dissipation, low power design methodologies.

UNIT - II: Sources of Power Dissipation

Short circuit power dissipation, switching power dissipation, glitching power dissipation, leakage power dissipation.

UNIT - III: Supply Voltage Scaling Approaches

Device feature size scaling, architectural level approaches, voltage scaling using high-level transformations, multilevel voltage scaling.

UNIT - IV: Switched Capacitance Minimization Approaches

Hardware software trade-off, bus encoding, clock gating, glitching power minimization, logic styles for low power.

UNIT - V: Leakage Power Minimization Approaches

Variable-Threshold voltage CMOS (VTCMOS) approach, transistor stacking, Multi-Threshold-voltage CMOS (MTCMOS) approach, power gating.

UNIT - VI: Adiabatic Logic Circuits

Adiabatic charging, adiabatic amplification, adiabatic logic gates, pulsed power supply, partially adiabatic circuits.

Text Books

1. Jan M. Rabaey and Massoud Pedram, "Low Power Design Methodologies", Kluwer Academic Publishers, 1996 (Unit-I).
2. Ajit Pal, Low Power VLSI Circuits and Systems, Springer India, 2015 Edition (Units - II to VI)

Reference Books

1. Sung Mo Kang and Yusuf Leblebici, "CMOS Digital Integrated Circuits", Tata Mcgraw Hill, Third Edition.
2. Neil H. E. Weste and K. Eshraghian, "Principles of CMOS VLSI Design", Addison Wesley (Indian reprint), Second Edition.
3. A. Bellamour and M. I. Elmasri, "Low Power VLSI CMOS Circuit Design", Kluwer Academic Press, 1995.
4. Anantha P. Chandrakasan and Robert W. Brodersen, "Low Power Digital CMOS Design", Kluwer Academic Publishers, 1995.
5. Kaushik Roy and Sharat C. Prasad, "Low-Power CMOS VLSI Design", Wiley-Interscience, 2000.
6. Prof. Ajit Pal, Department of Computer Science and Engineering, IIT Kharagpur, Low Power VLSI Circuits & Systems, NPTEL video course.

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Professional Elective - V

REAL TIME OPERATING SYSTEMS

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with the basic concepts of real time operating system, skills necessary to design and develop embedded applications by means of real time operating systems.
- To get acquaint with the Unix / Linux and RTLinux basic concepts and programming.

Learning Outcomes

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

- apply the concepts of real time operating system.
- develop software for embedded systems using the system design techniques.
- identify how to port RTOS on a microcontroller based development board.
- model real-time applications using Unix/Linux and RTLinux programming.

Course Content

UNIT - I: Introduction to Real Time Operating Systems

Multiple processes and multiple threads in an application, tasks, task states, task and data, OS services, process management, timer functions, event functions, memory management, device, file and IO systems management, interrupt routines in RTOS environment and handling of interrupt source calls, Real-Time Operating Systems, basic design using an RTOS.

UNIT - II: Real Time Operating Systems

RTOS task scheduling models interrupt latency and response of the tasks as performance metrics, OS security issues, basic functions and types of RTOS for embedded systems, basic features of RTOS mCOS-II, Vx works, Windows CE and OSEK.

UNIT - III: Target Image Creation

Off-the-shelf operating systems, operating system software, target image creation for Windows XP embedded, porting RTOS on a micro controller based development board.

UNIT - IV: Programming in Linux

Overview and programming concepts of Unix/Linux, shell programming, system programming – fork demo, semaphores and Mutex.

UNIT - V: Programming in RTLINUX

Overview of RT Linux, Core RT Linux API, program to display a message periodically, Semaphore management, Mutex management.

UNIT - VI: Case Studies-Program Modeling with RTOS

Case study - digital camera hardware and software architecture, coding for sending application layer byte streams on a TCP/IP network using RTOS Vx works. Case study of embedded systems - for an adaptive cruise control system in a car and for a smart card.

Text Books

1. Rajkamal: "Embedded Systems-Architecture, Programming and Design", Tata McGraw Hill Publications, 2nd Edition, 2008 (For units: I, II & VI).
2. Dr. K.V.K.K. Prasad: "Embedded/Real-Time Systems", Dream Tech Publications, 2003. (For units: I, III, IV & V)

Reference Books

1. Jean J.Labrosse, "Embedding system building blocks", CMP publishers, 2nd Edition.
2. Rob Williams, "Real time Systems Development", Butterworth Heinemann Publication, 2006.

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Professional Elective - V

SPEECH PROCESSING

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To familiarize with speech production, speech analysis and speech processing.
- To introduce the concepts of coding of speech, speech enhancement, speech and speaker recognition systems

Learning Outcomes

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

- understand how speech is produced.
- perform speech analysis and homomorphic processing of speech signals.
- code the speech signals using linear predictive analysis.
- enhance the speech signals and recognize speech as well as speaker.

Course Content

UNIT - I: Speech Production

Anatomy and Physiology of Speech organs- Lungs, Larynx and vocal tract, Articulatory Phonetics, Acoustic Phonetics, Acoustic theory of speech production, Lossless Tube Models, Digital Models for Speech Signals.

UNIT - II: Speech Analysis

Short–Time Speech Analysis: Windowing, Spectra of Windows, Time domain parameters- Signal analysis in time domain, Short time average energy, magnitude, zero-crossing rate and auto correlation function, Frequency domain (Spectral) Parameters : Short–Time Fourier Transform Analysis, Spectral Displays, Formant Estimation and Tracking, Energy separation.

UNIT - III: Homomorphic Speech Processing

Homomorphic systems for Convolution, Complex cepstrum of speech, Pitch detection, formant estimation, Homomorphic Vocoder.

UNIT - IV: Linear predictive coding (LPC) of Speech

Basic principles of Linear predictive Analysis, Computation of Gain, Solution of LPC Equation- Cholesky Decomposition solution for covariance method and Durbin's Recursive Solution for the Autocorrelation Equations, Prediction error

Signal, Frequency domain interpretation of mean squared prediction error, Applications of LPC parameters –pitch detection and Formant analysis using LPC parameters.

UNIT - V: Speech enhancement

Nature of interfering sounds, Spectral subtraction, Filtering and adaptive noise cancellation, Multi-Microphone Adaptive Noise Cancellation.

UNIT - VI: Networks for speech recognition

Hidden Markov Model (HMM), training and testing using HMMs, adapting to variability in speech.

Speech Recognition Systems: Isolated Digit Recognition system and continuous Digit Recognition system, LPC Distance measures .

Speaker Recognition Systems: Verification vs Recognition, Speaker verification system and speaker identification system

Text Books

1. Douglas O Shaughnessy, "Speech Communications", Second Edition, Oxford University Press, 2000 (Units I, II, V,VI).
2. L.R. Rabiner and S.W. Schafer, "Digital Processing of Speech Signals", Person Education (Units I,III, IV, VI).

Reference Books

1. Thomas F. Quatieri , "Discrete –Time Speech signal Processing Principles and Practice", Person Education.
2. Dr. Shaila D. Apte, "Speech and Audio Procesing" , WILEY Precise Textbook.
3. Claudio Becchetti and Klucio Prina Ricotti, "Speech Recognition Theory and C++ Implementation",WILEY.

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Professional Elective - V

ADAPTIVE SIGNAL PROCESSING

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the concepts of Wiener and Kalman filtering.
- To familiarize with the concepts of linear and non-linear adaptive signal processing techniques.

Course Outcomes:

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

- understand the concept of adaptive filters.
- apply Wiener and Kalman filters for signal processing applications.
- apply LMS and RLS algorithms for adaptive filter applications.
- understand the concepts of linear and non-linear adaptive signal processing techniques.

Course Content

UNIT - I: Introduction To Adaptive Filtering

Introduction to stochastic processes, linear adaptive filter structure, real and complex forms of adaptive filter, non-linear adaptive filter, adaptation approaches: Wiener filter theory method of least squares.

UNIT - II: Optimal Wiener Filtering

Mean-Square Error criterion, linear optimum filtering statement, principle of orthogonality, Wiener-Hopf equation, error performance surface, numerical examples, channel equalization, linear constrained minimum variance filter.

UNIT - III: Kalman Filtering

Statement of Kalman filtering problem, estimation of state using innovation, variance of Kalman filtering, extended Kalman filtering.

UNIT - IV: Linear Adaptive Filtering

Method of steepest descent, stability of steepest descent, least mean square algorithm, adaptive prediction, adaptive equalization, robustness of LMS algorithm, block adaptive filter, fast LMS algorithm, unconstrained frequency-domain adaptive filtering, methods of least squares.

UNIT - V: Recursive Least Squares

Matrix inversion lemma, weighted recursive least squares algorithm, adaptive noise canceller, convergence analysis of RLS algorithm, adaptive equalization, state-space formulation of RLS problem, adaptive beam-forming, order recursive adaptive Filter.

UNIT - VI: Non-Linear Adaptive Filtering

Introduction to blind de-convolution, back-propagation learning, radial basis function learning, stochastic gradient approach, Markov model, singular value decomposition.

Text Books

1. Simon Haykin,"Adaptive Filter Theory", Prentice Hall International", 3rd Edition., 2002.
2. Bernard Widrow and Samuel Stearns,"Adaptive Signal Processing", Pearson Education, 2nd Edition., 1995.

Reference Books

1. Ali H. Sayed,"Fundamentals of Adaptive Filtering", Wiley, 1st Edition., 2003.
2. Farhang-Boroujeny B.,"Adaptive Filters Theory and Applications", John Wiley & Sons, 1st Edition.,1998.
3. Mohamed Ibnkahla(Edited),"Adaptive Signal Processing in Wireless Communications", CRC Press, Taylor &Francis Group, 1st Edition., 2009.

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Professional Elective - VI

ASIC DESIGN

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce design issues and tools related to ASIC.
- To familiarize placement and routing algorithms.

Learning Outcomes

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

- understand the different types of ASICs and its Design Flow.
- analyze the Characteristics and Performance of Programmable ASICs, Logic cells, I/O Cells and Interconnects.
- measure goals and objectives related to Floor planning, Placement and Routing.

Course Content

UNIT - I: Programmable ASICs and ASIC Logic Cells

Programmable ASICs: Antifuse, Static RAM, EPROM and EEPROM Technology.

Programmable ASIC Logic Cells: Actel ACT and Xilinx LCA

UNIT - II: Programmable ASIC I/O Cells and Interconnect

Programmable ASIC I/O Cells: DC Output, AC Output, DC Input, AC Input, Clock Input and Power Input.

Programmable ASIC Interconnect: Xilinx LCA and Xilinx EPLD.

UNIT - III: ASIC Construction

Physical Design, CAD Tools, System Partitioning, Estimating ASIC Size and Power Dissipation

UNIT - IV: Floorplanning

Floorplanning Goals and Objectives - Measurement of Delay in Floorplanning - Floorplanning Tools - Channel Definition - I/O and Power Planning - Clock Planning.

UNIT - V: Placement

Placement Terms and Definitions, Placement Goals and Objectives – Measurement of Placement Goals and Objectives - Placement Algorithms - Timing-Driven Placement Methods, A Simple Placement Example.

UNIT - VI: Routing

Global Routing - Goals and Objectives - Measurement of Interconnect Delay - Global Routing Methods - Global Routing Between Blocks – Timing Driven Methods

Detailed Routing - Goals and Objectives - Measurement of Channel Density – Left Edge Algorithm - Constraints and Routing Graphs - Area Routing Algorithms - Multilevel Routing

Special Routing - Clock Routing - Power Routing

Text Books

1. M.J.S. Smith, "Application – Specific Integrated Circuits" Pearson Education, India.
2. H.Gerez, "Algorithms for VLSI Design Automation", John Wiley, 1999.

Reference BookS

1. J.M.Rabaey, A. Chandrakasan, and B. Nikolic, "Digital Integrated Circuit Design Perspective (2/e)", PHI 2003
2. D. A.Hodges, "Analysis and Design of Digital Integrated Circuits (3/e)", MGH 2004.

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Professional Elective - VI

EMBEDDED C

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the basic concepts of embedded systems, processors, and programming languages.
- To familiarize with various interfaces, memory, and power consumption.

Learning Outcomes

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

- distinguish C and Embedded C.
- select the processor, memory and operating system for an application.
- design and develop an application using Embedded C.

Course Content

UNIT - I: Embedded Hardware and Software

Introduction to embedded system, selection: processor, programming language and operating system; steps in developing embedded software.

Programming 8051 in C: data types and time delay, I/O programming, logical operations, data conversion, data serialization

UNIT - II: Programming 8051 in C

8051 Timer programming: simple programs on timers 0 and 1 with some delay in mode1 and mode 2, 8051 serial port programming: Transmitting and receiving data in 8051.

UNIT - III: I/O Port Programming

Basic techniques for reading from port pins, reading and writing bytes, reading and writing bits, reading and writing bits, need for pull-up resistors, dealing with switch bounce, reading switch inputs.

UNIT - IV: Object Oriented Concepts

Object-oriented programming with C, the project header (MAIN.H), the port header (PORT.H), restructuring the goat-counting example.

UNIT - V: Real-time Constraints

Introduction, creating 'hardware delays' using timer 0 and timer 1, generating a precise 50 ms delay, creating a portable hardware delay, use of timer 2, need for 'timeout' mechanism, creating loop timeouts, testing loop timeouts, reliable switch interface, creating hardware timeouts, testing a hardware timeout.

UNIT - VI: Creating an Embedded Operating System

Introduction, the basis of simple embedded OS, Introducing sEOS, using Timer 0 or Timer 1, important design considerations when using sEOS

Text Books

1. Michael J. Pont, "Embedded C", Pearson Education, 2nd Edition, 2008.(Units I,III,IV,V,VI)
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2nd Edition, 2008. (Units I,II)

Reference Books

1. Zdravko Karakehayov, Knud Smed Christensen, Ole Winther, "Embedded Systems Design with 8051 Microcontrollers", Marcel Dekker, Special Indian Edition, 2010.
2. Michael Barr, "Programming Embedded Systems in C and C++", Oreilly, 2003.

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Professional Elective - VI

RADAR ENGINEERING

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objectives

- To introduce the fundamentals concepts in radar.
- To familiarize with working of different radar systems.
- To impart the knowledge of detection of radar signals in noise.

Learning Outcomes

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

- compute different parameters from radar data.
- conceptualize the radar operation.
- distinguish moving target and pulse Doppler radars.
- understand the operation of different radar receivers.
- track different objects by using radar in different noise conditions.
- realize radar systems for electronic warfare.

Course Content

UNIT - I: Introduction

The Radar equation- introduction, detection of signals in noise, receiver noise and S/N ratio, probability function, probability of detection and false alarm, radar cross section of targets, transmitter power, pulse repetition frequency.

UNIT - II: CW Radar

Principle, doppler effect, block diagram, operation, measurement of velocity and elevation of target, applications. FMCW radar: block diagram, principle of operation, applications, salient features.

UNIT - III: MTI and Pulse Doppler Radar

Introduction, principle, MTI Radar with- power amplifier transmitter and power oscillator transmitter, delay line cancellers, frequency response, blind speeds, staggered PRFs.

UNIT - IV: Tracking Radar

Tracking with Radar, mono-pulse tracking, conical scan, sequential lobing. Radar receivers – noise figure and noise temperature, duplexers and receiver protectors, radar displays.

UNIT - V: Detection of Radar Signals in Noise

Introduction, matched filter receiver – response characteristics and derivation, correlation detection, detection criteria, detector characteristics, automatic detection, constant false alarm rate receiver

UNIT - VI: Electronic Warfare

Electronic counter measures and electronic counter-counter measures, introduction, electronic counter measures, radar jamming, electronic counter-counter measures, electronic support, stealth applications.

Text Books

1. Merrill I Skolnik "Introduction to Radar Systems", 3rd Edition, TMH, 2006
2. G.S.N.Raju "Radar Engineering and fundamentals of Navigational Aids", I.K International, 2008.

Reference Books

1. KK Sharma "Fundamentals of RADAR", sonar and Navigation Engineering, SK Kataria&Sons, 4th Edition,2014.
2. Byron Edde "Radar: Principles, Technologies, Applications", Pearson Education.

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Professional Elective - VI

MULTI RATE SIGNAL PROCESSING

IV Year – II Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	External Marks	: 60

Course Objective

- To familiarize with the concepts of interpolation and Decimation
- To familiarize with the concepts of different types of filter banks and structures.

Learning Outcomes

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

- acquire the knowledge of multirate signal processing .
- design perfect reconstruction and near perfect reconstruction filter bank system and to learn to assess the computational efficiency of multirate systems.
- analyze the quantization effects in filter banks.
- recognize the use of filter banks in applications such as speech processing and communication

Course Content

UNIT - I: Basic Multirate Operations

Decimation and Interpolation, time-domain characterization, frequency-domain characterization, cascade equivalences, filters in sampling rate alteration systems.

UNIT - II: Uniform DFT Filter Banks

Polyphase decomposition,digital filter banks- uniform DFT filter banks, polyphase implementation of uniform filter banks, Nyquist filters.

UNIT - III: Two Channel Quadrature-Mirror Filter (QMF) Bank

Filter bank structure, analyses of two channel QMF bank, alias free filter bank, alias free realization, alias free FIR QMF bank, alias free IIR QMF bank, perfect reconstruction two channel QMF bank.

UNIT - IV: 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.

UNIT - V: Paraunitary 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.

UNIT - VI: Cosine Modulated Filter Banks

Cosine modulated pseudo QMF Bank- alas cancellation, eliminating phase distortion, closed form expression for the filters, polyphase structure, PR systems

Text Books

1. P. P. Vaidyanathan. "Multirate systems and filter banks." Prentice Hall. PTR. 1993.
2. Sanjit K. Mitra. " Digital Signal Processing: A computer based approach." McGraw Hill. 1998.

Reference Books

1. J.G. Proakis. D.G. Manolakis. "Digital Signal Processing: Principles. Algorithms and Applications", 3rd Edn. Prentice Hall India, 1999.
2. N.J. Fliege. "Multirate digital signal processing ." John Wiley 1994.
3. R.E. Crochiere. L. R. "Multirate Digital Signal Processing", Prentice Hall. Inc.1983.

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