ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABUS

MECHANICAL 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 become a competent centre in moulding students as professional mechanical engineers having ethical standards and social consciousness

Mission:

- To impart value based education and to enhance competencies of students through effective design and delivery of the curriculum that fulfils the needs of the industry.
- To instill desire and confidence in the students to cater the needs of the society through their activities of excellence.
- To impart technical skills and nurture values, and mould the students as professionals to offer solutions to the technological challenges.
- To guide and support the students for enhancing nation's wealth through entrepreneurship.

III. PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

- Graduates of the program will have bright careers in Mechanical Engineering domain and allied areas.
- Graduates of the program will have life skills, sense of ethical conduct and social responsibility.
- Graduates of the program will continue to learn and update their competencies to face dynamically changing technological environment.

IV. PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

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

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

V. PROGRAM SPECIFIC OUTCOMES (PSOs)

- design and analyze thermal systems related to power generation and human comfort for sustainable environment.
- develop eco friendly products and manufacturing processes.
- effectively use various mechanical engineering software tools for design, analysis and optimization.

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)	16	10.00	10 - 15
3	Engineering Sciences (ES)	27	16.87	10 - 20
4	Professional Core (PC)	52	32.50	25 - 35
5	Professional Electives (PE)	18	11.25	8 - 12
6	Open Electives (OE) & Self Study Course	12	7.50	5 - 10
7	Others (Project, Survey Camp, Internship, etc.)	14	8.75	8 - 10
8	Mandatory Non-Credit Courses	-	-	-

COURSE STRUCTURE

&

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	PH2502	Physics for Engineers	3	1	-	3
4	EN2501	Environmental Studies	3	-	-	2
5	CT2501	Problem Solving Using C *	4	-	2	4
6	ME2505	Engineering Graphics	1	-	4	3
7	EG2502	Functional English Lab	-	-	2	1
8	PH2503	Engineering Physics Lab	-	-	2	1
		Total	**19**	**2**	**10**	**21**

* **Integrated Course with Theory and Laboratory**

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	MA2503	Integral Transforms and Multiple Integrals	3	1	-	3
3	EN2502	Engineer & Society	3	-	-	2
4	CH2505	Industrial Chemistry	3	1	-	3
5	CE2501	Engineering Mechanics	4	1	-	4
6	ME2506	Computer Aided Engineering Drawing	-	-	2	1
7	ME2507	Engineering Workshop	-	-	2	1
8	EG2504	Professional Communication Lab	-	-	4	2
9	ME2508	Industrial Chemistry Lab & Engg. Mechanics Lab	-	-	2	1
		Total	**16**	**3**	**10**	**19**

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

II Year - I Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week L	T	P	No.of Credits
1	EE2501	Elements of Electrical and Electronics Engineering	3	1	-	3
2	ME2510	Engineering Thermodynamics	3	1	-	3
3	ME2511	Kinematics of Machines	3	1	-	3
4	ME2512	Solid Mechanics	3	1	-	3
5	ME2513	Engineering Metallurgy	4	-	-	3
6	EE2502	Electrical and Electronics Engineering Lab	-	-	2	1
7	ME2514	Solid Mechanics and Metallurgy Lab	-	-	4	2
8	ME2515	Computer Aided Modeling Lab	-	-	2	1
		Total	**16**	**4**	**8**	**19**
9	SG2501	Sports and Games / Cultural (Mandatory Non-Credit Course)	-	-	2	-

II Year - II Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week L	T	P	No.of Credits
1	ME2516	Manufacturing Processes	4	-	-	3
2	ME2517	Applied Thermodynamics	3	1	-	3
3	ME2518	Dynamics of Machines	3	1	-	3
4	ME2519	Fluid Mechanics	3	1	-	3
5		**Open Elective-I** (see list of Open Electives)	4	-	-	3
6	ME2522	Thermal Engineering Lab	-	-	4	2
7	ME2523	Manufacturing Processes Lab	-	-	4	2
8	ME2524	Machine Dynamics Lab	-	-	2	1
		Total	**17**	**3**	**10**	**20**
9	NS2501	NSS /Fine Arts / Yoga / Self Defense (Mandatory Non-Credit Course)	-	-	2	-
10	 EE2512 ME2525 CT2506	**Optional Elective - I** i) Control Systems ii) Nano Technology iii) Digital Logic Design	-	-	-	3
11	ME2526	**Optional Elective - II (MOOCs)** Student shall opt from teh list of MOOCs given by the Department)	-	-	-	2

III Year - I Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	MA2509	Numerical and Statistical Methods	3	1	-	3
2	ME2527	Metal Cutting and Machine Tools	4	-	-	3
3	ME2528	Turbo Machinery	3	1	-	3
4		**Professional Elective - I**	4	-	-	3
5		**Open Elective-II** (see list of Open Electives)	4	-	-	3
6	ME2534	Fluid Mechanics and Turbo Machinery Lab	-	-	4	2
7	ME2535	Machine Tools Lab	-	-	4	2
8	ME2536	Computer Aided Machine Drawing Lab	-	-	4	2
		Total	**18**	**2**	**12**	**21**
9	CT2514 EE2503 EC2520	**Optional Elective - III** i) Computer Graphics ii) Fuzzy Logic Systems iii) Micro Processors and Interfacing	-	-	-	3
10	ME2537	**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			No.of Credits
			L	T	P	
1	BA2503	Engineering Economics and Accountancy	4	-	-	3
2	ME2538	Metrology and Instrumentation	3	1	-	3
3	ME2539	Design of Machine Members	3	1	-	3
4	ME2540	Heat Transfer	3	1	-	3
5		**Professional Elective - II**	4	-	-	3
6		**Open Elective-III**(see list of Open Electives)	4	-	-	3
7	ME2546	Heat Transfer Lab	-	-	4	2
8	ME2547	Metrology and Instrumentation Lab	-	-	4	2
9	ME2548	Computer Aided Engineering Analysis Lab	-	-	2	1
		Total	**21**	**3**	**10**	**23**
10	CT2507 ME2549 EC2512	**Optional Elective - V** i) Object Oriented Programming through Java ii) Mechatronics iii) Embedded System Design	-	-	-	3
11	ME2550	**Optional Elective - VI (MOOCs)** Students shall opt from the list of MOOCs given by the Department)	-	-	-	2

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

IV Year - I Semester

Sl. No.	Course Code	Name of the Course / Laboratory	No.of Periods per week			No.of Credits
			L	T	P	
1	ME2551	Industrial Engineering and Management	3	1	-	3
2	ME2552	CAD / CAM	3	1	-	3
3		**Professional Elective - III**	4	-	-	3
4		**Professional Elective - IV**	4	-	-	3
5		**Open Elective-IV** (see list of Open Electives)	4	-	-	3
6	ME2562	Simulation Lab	-	-	4	2
7	ME2563	Mini Project	-	-	4	2
8	ME2564	Internship / Industrial Training / Practical Training	-	-	-	2
		Total	**18**	**2**	**8**	**21**
9		**Optional Elective - VII**	-	-	-	3
	CT2534	i) Big Data Analytics				
	CT2512	ii) Computer Organization and Architecutre				
	ME2565	iii) Cryogenics				
10	ME2566	**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			No.of Credits
			L	T	P	
1		**Professional Elective - V**	4	-	-	3
2		**Professional Elective - VI**	4	-	-	3
3	ME2575	**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			No.of Credits
				L	T	P	
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			No.of Credits
				L	T	P	
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 L	T	P	No.of Credits
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 L	T	P	No.of Credits
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			No.of Credits
			L	T	P	
		Professional Elective - I	4	-	-	3
	ME2529	i) Non Conventional Sources of Energy				
	ME2530	ii) Mechancial Vibrations				
	ME2531	iii) Mechancis of Composite Materials				
	CT2505	iv) Data Structures				
		Professional Elective - II	4	-	-	3
	ME2543	i) Principles of Finite Element Method				
	ME2544	ii) Robotics				
	ME2545	iii) Automobile Engineering				
	CT2513	iv) Database Management Systems				
		Professional Elective - III	4	-	-	3
	MA2515	i) Optimization Techniques				
	ME2555	ii) Refrigeration and Air Conditioning				
	ME2556	iii) Unconventional Machining Process				
	ME2557	iv) Tribology				
		Professional Elective - IV	4	-	-	3
	ME2558	i) Total Quality Management				
	ME2559	ii) Computational Fluid Dynamics				
	ME2560	iii) Condition Monitoring				
	ME2561	iv) Design of Transmission Elements				
		Professional Elective - V	4	-	-	3
	ME2567	i) Design for Manufacturing and Assembly				
	ME2568	ii) Production Planning and Control				
	ME2569	iii) Power Plant Engineering				
	ME2570	iv) Theory of Elasticity				
		Professional Elective - VI	4	-	-	3
	ME2571	i) Rapid Prototyping				
	ME2572	ii) Gas Dynamics and Jet Propulsion				
	ME2573	iii) Automation in Manufacturing				
	ME2574	iv) Non Destructive Techniques				

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 4.1 and 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)*.

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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PHYSICS FOR ENGINEERS

I Year – I Semester

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

Course Objectives

- To solve oscillating systems problems.
- To understant crystal structures and defects.
- To apply principles of optics for engineering applications.

Learnaing Outcomes

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

- derive expression for oscillations (SHM).
- analyze crystal parameters to investigate crystal structures and defects.
- explore the possibilities of using nuclear energy for power generation.
- apply principles of interference, diffraction and polarization and Lasers to engineering situations.

Course Content

UNIT - I: Simple Harmonic Oscillations

Characteristics of sound - Simple harmonic motion-Displacement-Amplitude-period-frequency-phase-wavelength - equation for simple harmonic motion -Theoretical analysis : (a) free vibrations, (b)Damped vibrations, (c) Forced vibrations – Resonance.

UNIT - II: Crtstal Structure

Lattice, basis, unit cell - Crystal systems - Miller indices - Crystal planes – Von Lave formula for inter planar distance - Packing Fraction -X-Ray diffraction - Bragg's law.

UNIT - III : Crystal Imperfections

Imperfections in crystals-Point defects-Schottky and Frenkel defects-Energy for formation of a vacancy –Equilibrium concentration of Schottky and Frenkel defects-Line defects-Edge and Screw dislocation-Burger's vector.

UNIT - IV: Nuclear Energy – Source of Power

Mass defect & Binding Energy – Fusion and Fission as sources – Fast breeder Reactors.

UNIT - V: Physical Optics

Interference due to thin films – Interferometry - Newton's rings – Fraunhofer Diffraction – Fraunhofer diffraction due to circular aperture – Resolving power of Telescope - Polarization - Double refraction - Half wave and quarter wave plates - polarimeter.

UNIT - VI: Laser

Basic characteristics - Basic requirements - Spontaneous and stimulated emission - Einstein's coefficient - Ruby laser - Helium-Neon Laser – Semiconductor Laser - Application of laser.

Text Books

1. RK Gaur & SL Gupta, Engineering Physics (Edition 2011), Dhanapat rai publications.
2. M.N. Avadhanulu, P.G. Kshirsagar , Engineering Physics(9th Edition), S.Chand Publications.

Reference Books

1. Ajoy Ghatak, Optics(5th Edition), Tata McGraw-Hill
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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ENVIRONMENTAL STUDIES
(Common to ME, CSE & IT)
I Year – I 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 watertreatment-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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PROBLEM SOLVING USING C
(Common to CE, EEE & ME)
I Year – I Semester

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

Course Objectives
- To emphasize the use of flowcharts and pseudo code in problem solving.
- To gain knowledge in C language
- To develop C Programs to solve problems.
- To familiarize with the discrete components of a computer, MS Office

Learning Outcomes

Upon successful completion of the course, the students will be able to
- design flowcharts and pseudo code for solving problems.
- understand C tokens and control statements.
- gain knowledge on arrays, strings, pointers, functions, structures and files.
- use C language for solving problems
- self-learn advanced features of C.
- prepare applications using MS-Office.

Course Content

UNIT - I

Problem Solving Steps – Understanding problem, developing algorithm, flow chart, coding, debugging and testing. General form of a C program, C Tokens, basic data types, type conversion, variable declaration, console i/o statements, order of evaluation. Sample Problems such as evaluating formulae.

Programs :
1. Creating a document using MS Word.
2. Familiarizing with the usage and applications of MS Excel.
3. Creating a presentation using MS PowerPoint.
4. Write a C program to calculate the area of triangle using the formula area = $(s(s-a)(s-b)(s-c))^{1/2}$ where $s=(a+b+c)/2$
5. Write a C program to find the largest of three numbers using ternary operator

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: Calculate the sum of first N numbers, check the given number is prime or not.

Programs : Implement a C program for the following:
1. Find the roots of a quadratic equation.
2. 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)

3. Display first N natural numbers.
4. Check whether given number is Prime (or) not.

UNIT - III

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

Problem Solving: Perform addition and subtraction of two matrices.

Programs: Implement a C program for the following

1. To search whether the given element is in the array.
2. To perform Addition and multiplication of two matrices.

UNIT - IV

Pointers – Declaration, Initialization and operations.

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

Problem Solving: Develop c program to illustrate string handling functions-strlen(), strcmp(), strcat(), strcpy(), strrev().

Programs: Implement a C program for the following:

1. To find the factorial of a given integer using recursive function.
2. Function to exchange (Swap) values of two integers using call by reference.
3. To Illustrate string handling functions-strlen(), strcmp(), strcat(), strcpy(), strrev()

UNIT - V

Structures -Definition, declaration, initialization, accessing structure members, nested structures, array of structures, array within structures, unions.

Problem Solving: Implement a structure to read and display the Name, date of Birth and salary of an Employee.

Programs :

1. Write a C Program to implement a structure to read and display the Name, date of Birth and salary of n Employees.

UNIT - VI

File Handling- Text and binary files, file handling functions, random access to files.

Problem Solving: Implement a C program to copy contents of one file to another.

Programs:

1. Implement a C program to count the number of lines, words and characters 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, ReemaThareja, 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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ENGINEERING GRAPHICS

I Year – I 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 impart basic knowledge and skills required to prepare engineering drawings.

Learning Outcomes

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

- Apply principles of drawing to represent dimensions of an object.
- Construct polygons, scales and curves.
- Draw projections of points, lines and planes.
- Draw projections of solids with axis inclined to one plane.

Course Content

UNIT - I: Geometrical Constructions and Scales

Principle of Dimensioning, Geometrical Construction- Polygons.
Plain, Vernier and Diagonal Scales.

UNIT - II: Conic Sections

Ellipse, Parabola, Hyperbola –General Method. Curves – Epi Cycloid, Hypocycloid; Involute

UNIT - III: 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 - IV: Projections of Straight Lines

Projections of Straight Lines inclined to both planes, determination of true lengths, angle of inclinations and traces.

UNIT - V: Projections of Planes

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

UNIT - VI: Projections of Solids

Prisms, Cylinders, Pyramids and Cones with the axis inclined to one Plane and for both the reference planes.

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. Engineering Drawing by N.D. Bhatt, Chariot Publications.
2. Engineering Drawing by K. Venugopal, V. Prabhu Raja, G. Sreekanjana, New Age International Publishers.

Reference Books

1. Engineering Drawing by M.B. Shah and B.C. Rana, Pearson Publishers.
2. Engineering Drawing by Dhananjay A. Jolhe, Tata McGraw Hill Publishers.
3. Engineering Graphics for Degree by K.C. John, PHI Publishers.

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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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ENGINEERING PHYSICS LAB

I Year – I Semester

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

Course Objectives

- To make the students gain practical knowledge to co-relate with the theoretical studies.
- To impart skills in measurements.
- To design and plan the experimental procedure and to record and process the results.

Learning Outcomes

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

- use function generator, spectrometer, travelling microscope for making measurements.
- test optical components using principles of interference and diffraction of light
- determine the rigidity, coupling constant, velocity and fundamental laws pertinent to vibrations.
- determine the width of narrow slits, spacing between close rulings using lasers and appreciate the accuracy in measurements.

List of Experiments

S.No.	Name of the experiment- Aim
1	Determine the rigidity modulus of given wire-Torsional Pendulum.
2	Determine the velocity sound-Volume Resonator.
3	Determine the coupling constant of Coupled oscillator.
4	Verification of laws of vibrations of stretched strings.
5	Study of normal modes in string using Forced vibrations in rods-Melde's experiment.
6	Draw the frequency response curves of LCR Series and Parallel circuits
7	Determination of lattice constant – lattice dimensions kit.
8	Determine the radius of curvature of plano convex lens-Newton Rings.
9	Determine the thickness of thin object-wedge method.
10	Laser beam divergence and spot size determination.
11	Determination of wave length of source using diffraction grating.
12	Determine the dispersive power of a given material of the prism.

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.

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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 MULTIPLE INTEGRALS
(Common to CE & ME)
I Year – II Semester

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

Course Objectives

- To gain the knowledge of Laplace and inverse Laplace transforms.
- To understand the concept of Fourier Transforms.
- To know vector integral theorems such as Green's, Gauss & Stoke's.

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.
- find Fourier transforms and inverse transforms for a given function.
- evaluate Areas and Volumes using multiple integrals.
- apply the concepts of vector differentiation and integration to the surface and volume integrals.

Course Content

UNIT - I: Laplace Transforms (Without Proofs)

Laplace transform of standard functions, Properties: Change of scale, Shifting Theorems, Laplace transform of derivatives and integrals, multiplication and division by t. Unit step function, Dirac Delta function.

UNIT - II: Inverse Laplace Transforms

Inverse Laplace transforms - by partial fractions – by Convolution theorem (without proof). **Application**: Solution of ordinary differential equations.

UNIT - III: Fourier Transforms

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

UNIT - IV: Multiple Integrals (only Cartesian form)

Double integrals - areas, triple integrals – volume.

UNIT - V: Vector Differentiation

Vector Differentiation: Gradient- Divergence – Curl- Scalar potential.

UNIT - VI: Vector Integration

Integral theorems: Greens - Stokes - Gauss Divergence Theorems (Without proof) and related problems.

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

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ENGINEER AND SOCIETY
(Common to ME, CSE & IT)
I Year – II 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 patent 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- Unviersity 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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INDUSTRIAL CHEMISTRY

I Year – II Semester

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

Course Objectives

- To impart knowledge of corrosion prevention methods and water treatment technologies.
- To enable the students to obtain the knowledge on various types of electro chemical energy systems, polymers, fuels, lubricants and their applications in engineering.

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.
- apply a suitable method of corrosion prevention for a given problem.
- apply a suitable method of water treatment depending on the quality requirement.
- explain the analysis of fuels, to calculate the calorific value and air requirement for combustion of a given fuel and to explain the synthesis and extraction methods of different liquid fuels.
- explain the preparation, properties and applications of polymers and composite materials.
- explain the characteristic features of a lubricant and their applications.

Course Content

UNIT - I: Electro Chemical Energy Systems

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, Phosphoric acid fuel cell.

UNIT - II: Corrosion and its Prevention

Dry and wet corrosion and their mechanisms. Pilling - Bedworth Rule. Types of Corrosion – galvanic corrosion, concentration cell corrosion, pitting corrosion and stress corrosion – Factors influencing the rate of corrosion –Temperature, pH and dissolved oxygen – Corrosion Prevention methods – Cathodic protection-Sacrificial Anodic method and Impressed current method – Metallic coatings –galvanization and tinning methods. Corrosion problems in boilers and heat exchangers and preventive measures.

UNIT - III: Water and its Treatment

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 and Colloidal conditioning. Desalination of Brackish water by RO method.

UNIT - IV: Fuels

Definition and classification of fuels. Calorific value of a fuel – Characteristics of a good fuel. Coal – Types of Coal. Analysis of Coal – Proximate and Ultimate analysis. Bomb Calorimeter and Junker's gas Calorimeter. Problems on calculation of calorific value. Liquid fuels – Petroleum Extraction – Fractional distillation. Synthetic Petrol – Bergius process and Fisher Tropsch process. Problems on air requirement for combustion.

UNIT - V: Polymers and Composites

Polymers – Definition of a polymer and polymerization – Degree of polymerization – Functionality – Types of polymerization – addition, condensation and co-polymerization with examples.

Plastics – thermo plastics and thermo setting plastics. Compounding of plastics. Moulding techniques – Compression, Injection and Blow film moulding. Preparation, properties and applications of PVC, Polystyrene, Teflon and Bakelite.

Composites – Definition of matrix and reinforcement. Fibre reinforced plastics – Glass fibre, Carbon fibre reinforced plastics. Preparation methods – hand layup method, matched metal die moulding method, Properties – applications

UNIT - VI: Lubricants

Definition and classification of lubricants. Functions of a good lubricant. Mechanism of lubrication. Experimental determination of properties of a liquid lubricant – Viscosity, Aniline point, Flash and Fire point, Pour and Cloud point. Additives to lubricants. Lubrication by nano films. Applications of lubricants.

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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ENGINEERING MECHANICS
(Common to CE & ME)
I Year – II Semester

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

Pre-Requisites
- Linear Algebra and Differential equations]

Course Objectives
- To impart the basic concepts of force systems, free body diagram and equilibrium conditions
- To familiarize on calculating the geometric properties like centroid, moment of inertia of various sectional areas and masses and introduce the concept of friction and virtual work.
- To develop the knowledge on basic principles of kinematics and kinetics with simple applications.
- To introduce applications on using work-energy principle and Impulse-momentum methods.

Learning Outcomes

Upon successful completion of the course, the students will be able to
- explain the concept on resultant and equilibrium of a force system.
- determine centroid, moment of inertia of areas.
- determine center of mass, centre of gravity and moment of inertia of bodies.
- apply the principle of friction to connected bodies, ladders and virtual work principle to simply supported beam and connected systems
- distinguish between kinematics and kinetics.
- apply the work energy and impulse momentum methods of various engineering problems.

Course Content

UNIT–I : Force systems-Resultant and Equilibrium Conditions, Moment and Couple

Introduction to engineering mechanics –Types of forces-Coplanar, Concurrent and parallel forces – Resultant – Composition and resolution of forces, method of projections – Types of supports, Free Body Diagrams, Equations of Equilibrium of Coplanar Systems. Lami's Theorem -Moment of force systems in plane and its Application – Couples- Equilibrium of Coplanar concurrent force systems – Conditions of equilibrium.

UNIT–II: Friction, Virtual work Principle

Introduction, limiting friction and impending motion - Coefficient of friction, Laws of static friction, cone of static friction, applications of friction- Impending motion of connected bodies between blocks, ladder friction.

Virtual work - virtual displacement, Principle of virtual work – Applications to connected systems and reactions of simply supported beam.

UNIT–III: Centroid, Centre of Gravity and Area Moment of Inertia

Centroids of standard figures (from basic principles) – Centroids of Composite Figures, Centre of gravity of standard bodies (from basic principles), centre of gravity of composite bodies, Moment of Inertia - definition, Moment of Inertia of standard figures –Parallel axis theorem- Polar Moment of Inertia, Moment of Inertia of composite figures.

UNIT–IV: Centre of Mass, Moment of Inertia of Bodies

Center of Mass- Definition, Moment of Inertia - definition, Transfer Formula for Mass moment of Inertia, Mass moment of Inertia of standard bodies.

UNIT–V: Kinematics and Kinetics

Kinematics: Rectilinear and Curve linear motions –Time, Displacement, Velocity and Acceleration & their relations – Linear & Angular.

Kinetics: Newton's laws of motion and D'Alembert's principle simple applications -Rotation of a body about a fixed axis- Applications.

UNIT–VI: Work – Energy Method

Work – Energy principles, Law of conservation of energy, Power, Work-Energy Applications to Particle motion, connected bodies.

Impulse and Momentum: Principle of momentum and Impulse, Law of conservation of momentum, Impulse and momentum method, collision of bodies, simple applications.

Text Books

1. Engineering Mechanics, Timoshenko, Young and J.V. Rao, Tata Mc Graw – Hill education (India) Pvt. Ltd.
2. Engineering Mechanics, R.K.Bansal, Laxmi publications Pvt. Ltd.

Reference Books

1. Singer's Engineering Mechanics Statics and Dynamics, K.Vijay Kumar Reddy and J.Suresh Kumar, B.S publications, Hyderabad.
2. Engineering Mechanics statics and dynamics, Nelson e.w, Tata Mc Graw – Hill publishing company limited, New Delhi.
3. Engineering. Mechanics, S.S.Bhavikatti and K.G.Rajashekarappa, New age International Pvt. Ltd., Publishers.
4. Engineering Mechanics, Basudeb Bhattacharya, Oxford University Press.

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COMPUTER AIDED ENGINEERING DRAWING

I Year – II Semester

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

Course Objectives

- To impart knowledge and skills required to draw projections of solids in different contexts.
- To impart the skills required for drafting using drafting package.

Learning Outcomes

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

- represent sectional views of solids using drafting package.
- develop the surfaces of regular solids using drafting package.
- Draw isometric and orthographic projections using drafting package.

Introduction to Drafting Package

Draw commands, *Modify* Commands , *Dimensioning* Commands

Exercises for Practice using Package

- Sections and Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone
- Development of Surfaces of Right Regular Solids – Prisms, Cylinder, Pyramid, Cone.
- Isometric Views of Lines, Plane Figures, and simple solids
- Conversion of Orthographic Views to Isometric Views

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ENGINEERING WORKSHOP

I Year – II Semester

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

Course Objectives

- To impart hands-on training on basic engineering trades.

Learning Outcomes

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

- use various tools to prepare basic carpentry, fitting and welded joints.
- prepare jobs of various shapes using black smithy.
- make basic house wire connections.
- fabricate simple components using tin smithy.
- Prepare mould cavity using single and multipiece pattern.

List of Trades

Practice any two experiments from each trade of any six trades

1) **Carpentry** :
   a) T-Lap Joint
   b) Cross Lap Joint
   c) Dovetail Joint.
2) **Fitting**
   a) V-Fit
   b) Square Fit
   c) Half Round Fit
3) **Black Smithy**
   a) Round to Square
   b) S-Hook
   c) Round to Ring.
4) **House Wiring**
   a) Parallel / Series Connection
   b) Stair Case wiring
   c) Florescent Lamp connection.
5) **Tin Smithy**
   a) Taper Tray
   b) L - Pipe
   c) Funnel
6) **Welding**
   a) Lap joint
   b) Butt joint
   c) T-joint
7) **Foundry**
   a) Mould making using Single piece pattern
   b) Mould making using multi piece pattern
8) **Plumbing**
   a) Screwed pipe joint – For GI Pipes, PVC Pipes
   b) Glued or cemented pipe joint – for PVC pipes
9) **Handling of Power Tools**
   a) Jig Saw
   b) Circular Saw
   c) Hand Drill
   d) Hand Grinder

Reference Books

1. Elements of Workshop Technology vol.-1 & vol.-2 by A. K. Hajra Choudhury, S. K. Hajra Choudhury, Nirjhar Roy
2. Workshop Manual , P.Kannaih,K.L. Narayana , Scitech Publishers Engineering Drawing by Dhananjay A. Jolhe, Tata McGraw Hill 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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INDUSTRIAL CHEMISTRY LAB & ENGINEERING MECHANICS LAB

I Year – II Semester

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

Course Objectives

- To impart skills for testing lubricating oils and finding calorific value of a fuel.
- To impart skills for testing the pH of water smaple and to calculate the rate of corrosion of a metal.
- To impart knowledge on basic engineering applications.

Learning Outcomes

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

- test suitability of lubricating oil for a given conditon.
- determaine teh calorific value of a fuel by bomb calorimeter and Junker's gas calorimeter.
- determine the corrosion rate of a given metal in a given environment by gravimetric method.
- determine the pH of the given water sample.
- calculate axial forces in trusses ,moment of force and angle of deflection
- verify lamies theorem.

Industrial Chemistry Lab

List of Experiments (Any six of the below experiemetns may be perfomed)

1. Determination of viscosity of given lubricating oil by using redwood viscometer.
2. Determination of flash and fire point of the given Lubricating oil
3. Determination of pour and cloud point of the given lubricating oil.
4. Determination of calorific value of fuel by bomb calorimeter.
5. Determination of calorific value of gaseous fuel by Junker's gas calorimeter.
6. Determination of pH of given water sample.
7. Determination of rate of corrosion of carbon steel metal in acid medium int he absence and presence of Thiourea inhibitor by gravimetric method.

Text books

1. Engineering chemistry laboratory manual & record by Srinivasulu D, Parshva publications.
2. Engineering Chemistry lab manual by K.Mukkanti, B.S.Publications, 2009.

Engineering Mechanics Lab

List of Experiments

1. Calculation of moment of a force using weight balancing technique and system of pulleys
2. Determination of angle of deflection of T bar due to eccentric loading
3. Calculation of centroid of the plane lamina
4. Determination of axial forces in members of a loaded truss
5. Verification of lamie’s theorem
6. Analysis of trapezoidal trusses for different loads
7. Understanding the vector and vector quantities

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ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING

II Year – I Semester

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

Course Objectives

- To introduce the basic concepts of electrical circuits.
- To familiarize with the constructional details, working principles of DC and AC machines.
- To familiarize with the operation of diode and transistors.

Learning Outcomes

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

- apply the basic laws and theorems to solve any electrical circuit.
- demonstrate the operational characteristics of the DC machines & AC machines.
- choose an appropriate machine to meet specified performance requirements for a particular application.
- outline the working principles of special motors.
- demonstrate the characteristics of diode and transistors.

Course Content

UNIT - I: Electrical Circuits

Basic definitions, Types of elements, Ohm's Law, Kirchhoff's Laws, Series, Parallel circuits, Mesh and nodal analysis, Superposition, Thevenin's and maximum power transfer theorems for simple dc circuits.

UNIT - II: DC Machines

Operating principle of DC Generator, emf equation, types of DC Generators, DC motor operating principle, types of DC motors, torque equation, applications, three point starter.

UNIT - III: Transformers

Principle of operation of single phase transformers, emf equation, losses in transformer, efficiency and regulation.

UNIT - IV: Induction Machines

Construction and operating principle of induction motor, slip-torque characteristics, applications.

UNIT - V: Special Purpose Motors

Construction, working principle and applications of stepper motors, A.C. and D.C servomotors, universal motors, Industrial applications.

UNIT - VI: Diode and Transistor

P-N junction diode, symbol, V-I Characteristics, Diode Applications, Rectifiers – Half wave, Full wave and Bridge rectifiers (simple Problems), PNP and NPN Junction transistor, Transistor as an amplifier, SCR Characteristics.

Text Books

1. David V. Kerns, JR. J.David Irwin , Essentials of Electrical and Computer Engineering ,Pearson.
2. V.K.Mehta, Principles of Electrical and Electronics Engineering S.Chand & Co.

Reference Books

1. M.S Naidu and S. Kamakshaiah, Introduction to Electrical Engineering , TMH Publ.
2. Kothari and Nagarath , Basic Electrical Engineering ,TMH Publications.
3. Rajendra Prasad ,Fundamentals of Electrical Engineering , PHI publications.
4. Ashfaq Husain, Fundamentals of Electrical Engineering’, Dhanpat Rai & Co.

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ENGINEERING THERMODYNAMICS

II Year – I Semester

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

Course Objectives

- To familiarize with basic concepts of system, properties and cycles.
- To introduce the laws of thermodynamics and their applications to various thermodynamic processes and cycles.

Learning Outcomes

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

- distinguish between closed, open and isolated systems and different types of energy interactions
- find the internal energy, enthalpy, work and heat energy interactions for various thermodynamic processes and cycles
- calculate the performance of a heat engine, refrigerator and heat pump and apply the principle of increase of entropy to various processes occurring in nature
- calculate available and unavailable energies in various thermodynamic processes, and formulate various thermodynamic relationships by combining first and second laws of thermodynamics
- evaluate the properties of a pure substance and determine the work and heat interactions for various phase change processes
- perform gravimetric and volumetric analysis of mixture of gases
- evaluate the efficiency and mean effective pressures of various gas power cycles.

Course Content

UNIT - I: Basic Concepts

System, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic approaches. Concept of Continuum, properties, Thermodynamic Equilibrium, State, Path, Process, Cycle, Quasi–static Process, Irreversible Process, Causes of Irreversibility. Energy in State and in Transition, Work and Heat, Point and Path functions, various forms of Work. Zeroth Law of Thermodynamics, Concept of Temperature, Principles of Thermometry, Reference Points, Const. volume gas thermometer, scales of temperature - Ideal Gas Temperature.

UNIT - II: First Law of Thermodynamics

First law for a system undergoing a cycle and for a change in state of system, internal energy and enthalpy, constant volume and constant pressure specific heats and their relation to internal energy and enthalpy of ideal gases.

First law of thermodynamics for a control volume, Steady flow energy equation and its application to engineering equipment, Perpetual Motion machine of first kind.(PMM-I)

UNIT - III: Second Law of Thermodynamics

Limitations of first law, Heat engines and Refrigerators, Kelvin- Planck and Clausius statements of Second law, PMM of second kind (PMM-II), Carnot cycle and Carnot theorems, Absolute thermodynamic scale.

Entropy: Inequality of Classius, Entropy change in reversible process, T-dS relations, Entropy change of a system during an irreversible process, Principle of increase of entropy, Entropy change of an ideal gas, Available and unavailable energies, Availability function for closed and open system. Max well's relations.

UNIT - IV: Properties of pure substances

Pure Substance, Phase, Phase Transformation, P-V, P-T, T-S, and h-s diagrams of a Pure substance (water), Triple point, Critical point, P-V-T surfaces, Dryness Fraction, Determination of steam Properties using steam tables and Mollier Chart. Measurement of steam Quality – Steam Calorimetry.

UNIT - V: Perfect Gases and Gas Mixtures

Equation of State, specific and Universal Gas constants, Mixtures of perfect Gases – Mole Fraction, Mass fraction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes, Equivalent Gas constant and Internal Energy, Enthalpy, specific Heats and Entropy of Mixture of perfect Gases.

UNIT - VI: Gas Power Cycles

Otto, Diesel, Dual Combustion cycles and comparison of Otto, diesel, duel Cycles, Brayton cycle, Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressure on Air standard basis.

Text Books

1. PK Nag "Engineering Thermodynamics", Tata McGraw Hill Publishing Company Ltd., 6th Edition.
2. Richard E Sonntag, Claus Borgnakke, Gordon J. VanWylen "Fundamentals of Thermodynamics", 7th edition.

Reference Books

1. Yunus A. Cengel & Michael A. Boles "Thermodynamics-An Engineering Approach" Tata McGraw Hill Education. 7th edition.
2. Micheal J Moran and Howard N Shapiro "Fundamentals of Engineering Thermodynamics" wiley 8th Edition.
3. Y.V.C.Rao-"Engineering Thermodynamics"; University Press.
4. Kenneth Wark Jr " Thermodynamics" Tata McGraw Hill Education.

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KINEMATICS OF MACHINES

II Year – I Semester

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

Course Objectives

- To introduce the concepts to study the relative motion between the links of mechanisms.
- To familiarize with the kinematic analysis of machines.

Learning Outcomes

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

- distinguish different mechanisms with their applications.
- determine the velocities and accelerations of links in mechanisms.
- construct cam profiles for different types of follower motions.
- perform kinematic analysis of gears and gear trains.

Course Content

UNIT - I: Mechanisms

Link , kinematic pair, constrained motion, kinematic chain, degrees of freedom, Kutzbach criterion for planar mechanism, Grashoff's law, mechanism, inversion of mechanism , inversions of four bar, single slider and double slider mechanisms, pantograph, Hooke's Joint - single and double Hooke's joint, velocity ratio, polar diagram.

UNIT - II: Velocity Analysis of Mechanisms

Instantaneous center, Kennedy theorem, velocity analysis using instantaneous centre method, absolute and relative velocities, velocity analysis using relative velocity method .

UNIT - III: Acceleration Analysis of Mechanisms

Acceleration analysis of slider crank and four bar mechanism using relative acceleration method , Coriolis component of acceleration

Synthesis of mechanisms: Introduction, function generation for four bar mechanism, Freudenstein equation for four bar mechanism, Chebychev spacing.

UNIT - IV: Cam And Followers

Types, terminology, types of follower motion- uniform velocity, simple harmonic motion, uniform acceleration and retardation, construction of cam profiles.

UNIT - V: Gears

Types, terminology, law of gearing, velocity of sliding, forms of teeth, path of contact, arc of contact, phenomena of interference.

UNIT - VI: Gear Trains

Types- simple, compound, reverted and epicyclic gear train, kinematic analysis of gear trains - differential of an automobile.

Text Books

1. S.S Ratan, Theory of Machines , Tata McGraw Hill Publications.
2. Design of Machinery : An Introduction to the Synthesis and Analysis of Mechanisms and Machines, Robert L. Norton, McGraw-Hill.

References Books

1. Thomas Bevan ,Theory of Machines , Pearsons Education.
2. J.S.Rao and R.V.Dukkipati , Mechanism and Machine Theory, New Age Publishers.
3. A. Ghosh, A. K. Mallik, Theory of Mechanisms and Machines, East West Press Pvt. Ltd.

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SOLID MECHANICS

II Year – I Semester

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

Course Objectives

- To impart the knowledge on internal behaviour of mechanical elements under the action of applied loads.

Learning Outcomes

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

- determine stresses and strains in structural members subjected to various loads
- draw shear force and bending moment diagrams for beams
- calculate the deflections in beams subjected to transverse loads
- evaluate the crippling load for columns with different end conditions.
- design shafts subjected to torsion based on strength and rigidity.
- determine the stresses induced in thick and thin cylinders subjected to pressures

Course Content

UNIT - I: Stresses & Strains

Elasticity and plasticity – types of stresses & strains–Hooke's law – stress – strain diagram for mild steel – working stress – factor of safety – lateral strain, poisson's ratio & volumetric strain – bars of varying section – composite bars – temperature stresses- relation between elastic constants, principal stresses , Mohr's circle.

UNIT - II: Shear Force and Bending Moment Diagrams

Introduction, types of beams, shear force diagrams and bending moment diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed load, uniformly varying loads, point of contra flexure relation between shear force and bending moment and rate of loading

UNIT - III: Bending Stress and Shear Stresses

Bending Stress : Theory of simple bending, bending equation, neutral axis, determination bending stresses, section modulus of standard cross sections.

Shear Stresses: Shear stress equation, shear stress distribution across various beams with standard cross sections.

UNIT - IV: Deflection of Beams

Bending into a circular arc – slope, deflection and radius of curvature, differential equation for the elastic line of a beam, double integration and Macaulay's methods, Mohr's theorems, moment area method, determination of slope and deflection for beams subjected different loads.

UNIT - V: Torsion and Columns & Struts

Torsion: Introduction-derivation of torsion equation- torsion of circular shafts- pure shear-transmission of power by circular shafts, shafts in series, shafts in parallel.

Columns & Struts : Crippling load, derivation of Euler's equation for columns with different end conditions, limitations of Euler's formula, Rankine's Formulae.

UNIT - VI: Thin and Thick Pressure Vessels

Thin Cylinders: Thin seamless cylindrical shells, Derivation of formula for longitudinal and circumferential stresses, volumetric strain in thin cylinders, thin spherical shells.

Thick Cylinders: Lame's equation, cylinders subjected to inside & outside pressures, compound cylinders.

Text Books

1. S.Ramamrutam, R.Narayanan," Strength of materials", Dhanpat Rai Publications, 14th edition
2. James M. Gere And Barry Goodier ,"Mechanics of materials", CENGAGE Learning Custom Publishing, 8th edition.

Reference Books

1. Beer and Johnson, "Mechanics of Materials", Tata Mc GrawHill publications, 5th edition.
2. Popov and Egor P., "Engineering Mechanics of Soilds", Prentice Hall India.
3. S.S. Rattan, "Strength of materials", Tata Mc Graw-Hill Publications, 2nd edition.
4. Dr. R K Bansal, "A text book of strength of materials", Lakshmi Publications, 3rd edition.

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ENGINEERING METALLURGY

II Year – I Semester

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

Course Objectives

- To familiarize with the fundamentals of crystallography, metallurgy, heat treatment and metal properties.

Learning Outcomes

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

- understand the production of iron.
- Classify the steels based on their production process.
- illustrate crystallization and grain growth of metals.
- identify the effect of alloying elements and invariant reactions on the behavior of metals.
- choose a suitable heat treatment process to impart desired properties of metals.
- appraise nature of non ferrous & composite materials.
- select suitable material and characterization technique for an application.

Course Content

UNIT - I: Iron and Steel Making

Iron Making: Introduction to iron making - blast furnace, operations of blast furnace, coke oven batteries, types of reduction reactions in blast furnace,.

Steel Making: Production of cast iron –cupola furnace; production of steel - bessemer converter, open hearth furnace& electric furnace.

UNIT - II: Solidification of Pure Metals and Alloys

Mechanism of solidification, nucleation-homogeneous and heterogenous nucleation- growth -single crystal -polycrystalline materials, crystal growth-planar growth – dendritic growth – solidification time - cooling curves - non-crystalline solids- glass transition temperature. crystal defects: one, two and three dimensional defects.

Solid solutions: Hume Rothary rule substitutional, and interstitial solid solutions, intermediate phases

UNIT - III: Phase Diagrams and Iron Carbon Equilibrium Diagram

Phase Diagrams: Construction of equilibrium diagrams involving complete and partial solubility, Gibbs phase rule, lever rule. different types invariant reactions – eutectic, eutectoid, peritectic, peritectectoid reactions etc.

Iron Carbon Equilibrium Diagram: Description of phases- steels, cast iron, different reactions of the iron-iron carbide equilibrium system, alloy groups - properties, composition and uses (wrought iron, grey cast iron, malleable iron, SG iron and steels)

UNIT - V: Heat Treating of Steels

TTT curves, continuous cooling curves, heat treatment processes – annealing, normalizing, hardening, tempering, martempering, austempering, hardenability, surface hardening methods - carburizing, cyaniding, nitriding, flame hardening and induction hardening, age hardening.

UNIT - V: Non Ferrous Metals and Alloys and Composite Materials

Properties and applications of titanium - titanium alloys, copper – copper alloys, and aluminium – aluminium alloys.

Composite materials: Classification of composites, various methods of component manufacture of composites, particle – reinforced materials, fiber reinforced materials, metal – matrix composites and C – C composites.

UNIT - VI: Material Selection and Characterization

Classification of engineering materials, engineering requirements of materials, criterion for selection of materials for engineering applications through structure properties-performance correlationship, levels of internal structure like macro, micro, crystal and atomic and their correlated properties.

Materials Characterization: Scanning Electron Microscope - SEM, X-ray diffraction XRD, - Thermogravimetric Analysis (TGA).

Text Books

1. Sidney H. Avener, “Introduction to physical metallurgy”, Tata Mc Graw Hill Publications, 2nd edition.
2. Donald R.Askeland and Wendelin J.Wright , “Essential of Materials science and engineering”, CL Engineering publications, 2nd edition.
3. Sir Alan Cottrell, “An Introduction to Metallurgy”, Universities Press, 2nd edition.

Reference Books

1. V.D.Kodgire, S.V Kodgire. “Material science and Metallurgy for Engineers”, Everest publishing house,42nd edition.
2. Agarwal, “Science of engineering materials”, S.Chand Publications.
3. William D.collister, David G.Rethwich, “Materials science and engineering an introduction”, Loose leaf publications, 8th edition.
4. W.G.Vinas & HL Mancini, “An introduction to material science”.
5. R. A Flinn and P K Trojan, “Engineering Materials and Their Applications”, Published by Houghton Mifflin, Wilmington, Massachusetts, U.S.A , 2nd edition.

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ELECTRICAL AND ELECTRONICS ENGINEERING LAB

II Year – I Semester

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

Course Objectives

- Information to supplement the Electrical & Electronics Engineering course.
- To conduct tests on various electrical & electronic circuits and to familiarize experimental procedures of those Circuits.

Learning Outcomes

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

- apply the concepts of theorems for a given electrical circuit.
- evaluate the performance of AC and DC Machines.
- relate physical observations and measurements involved in electrical circuits to theoretical principles.
- illustrate the characteristics of PN Junction diode and its application in rectifier circuits.
- describe amplifier circuit using NPN transistor

List of Experiments

Any 10 of the following experiments are to be conducted:

1. Verification of Kirchhoff's Laws
2. Verification of Superposition Theorem
3. Verification of Maximum Power Transfer Theorem
4. Experimental Verification of Thevenin's Theorem
5. Speed Control of DC Shunt Motor
6. Open Circuit and Short Circuit Test on Single Phase Transformer
7. Brake Test on DC Shunt Motor
8. Brake Test on Three Phase Induction Motor
9. P-N Junction Diode Characteristics
10. Rectifiers With and Without Filters (Half Wave and Full Wave)
11. Transistor CE Characteristics
12. SCR Characteristics

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SOLID MECHANICS AND METALLURGY LAB

II Year – I Semester

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

Any 6 experiments are to be conducted from each of the following

A) SOLID MECHANICS LAB

Course Objectives

- To impart hands on training to examine the mechanical properties of materials.

Learning Outcomes

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

- determine the young's modulus, rigidity modulus of materials and stresses induced in bars and beams of uniform cross section.
- determine the hardness number.
- determine the stiffness of spring.
- determine the impact strength of materials.
- determine the shear stress under single shear and double shear.

List of Experiments

1. Determination of modulus of elasticity using universal Testing machine.
2. Determination of modulus of elasticity and bending stress in
   a) Simply Supported Beam b) Cantilever beam
3. Determination of modulus of rigidity using torsion testing machine.
4. Determination of Hardness number using
   a) Brinells hardness test.
   b) Rockwell hardness test.
5. Determination of stiffness of springs using Spring Testing machine.
6. Determination of Impact strength using Impact Testing Machine
   a) Izod test
   b) Charpy test
7. Determination of shear strength using Universal testing machine.
8. Detemination of compressive strength using compression testing machine.

B) METALLURGY LAB

Course Objectives

- To impart hands on training in preparation of metal specimen so as to observe the microstructure.

Learning Outcomes

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

- prepare the Specimen using rough grinding, finish grinding and polishing.
- use different types of etchants to expose the microstructure of metal and alloys.
- observe the microstructure and ascertaining the same.
- performe Jominy End Quench test.
- observe the behavior of metal during fracture.

List of Experiments

1. Preparation and study of the Microstructure of pure metals like Cu and Al.
2. Preparation and study of the Microstructure of Mild steels, low carbon steels, high – C steels.
3. Preparation and study of the Micro Structures of Cast Irons.
4. Preparation and study of the Micro Structures of Non-Ferrous alloys.
5. Preparation and study of the Micro structures and hardness of Heat treated steels.
6. Hardenability of steels by Jominy End Quench Test.

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COMPUTER AIDED MODELING LAB

II Year – I Semester

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

Course Objectives

- To impart hands on training for part modeling and assembly using Modeling Package.

Learning Outcomes

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

- draw sketches and models of parts using modelling package
- assemble the parts using assembly module.

List of experiments

1. Drawing of sketch of part - I
2. Drawing of sketch of part - II
3. Modeling of a part.
4. Modeling of a part and generation of orthographic views – I
5. Modeling of a part and generation of orthographic views - II
6. Creating detailed drawing with sectional views –I
7. Creating detailed drawing with sectional views -II
8. Modeling and assembly of parts - I
9. Modeling and assembly of parts - II
10. Modeling and assembly of parts - III
11. Creating Schematic Diagrams
12. Creating a model of the sheet metal part

Reference Book

1. Reference Manual on Solid Edge fundamentals by Siemens Product Lifecycle Management Software Inc.

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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 molding method based on the geometry and quantity.
- design a pattern and gating system for producing a casting.
- 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, Design of pattern for a given casting

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

Melting: Types of Furnaces ,cupola, crucible, Electric arc.

UNIT - II: Gating & Riser Design

Gating System: Elements and their functions, Types of Gating systems, Types of Gates,

Riser Design & Location: Types of Risers, Riser Design (Size & Location), Design Considerations for casting.

Solidification: Progressive & Directional solidification, Solidification time .

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, Welding techniques.

Fusion Welding: Principle of Oxy Acetylene welding, Equipment Setup, Types of flames , Applications Principle of Arc welding, Equipment setup, Arc blow, Types of Arc welding processes :SMAW,TIG, MIG, Plasma Arc Welding, Thermit welding.

Characteristics of arc welding process. :- Heat & power requirements in Arc welding.

UNIT - IV:

Pressure Welding: Principle of Resistance welding, Equipment set up, Different resistance welding methods, Heat & power requirements in resistance welding.

Solid State Welding: Friction welding, Induction welding and Explosive welding

Welding Defects: Their causes - remedies

Welding Allied Processes: Soldering, Brazing and Braze welding

UNIT - V:

Metal Forming: Classification of metal working processes.

Rolling: Forces and geometrical relationship in Rolling, Analysis of Rolling load, Torque and power - Types of Rolling mills, Rolling defects and remedies.

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

Extrusion: Classification of Extrusion process, Mechanics of Extrusion, Impact Extrusion, Hydrostatic Extrusion and Extrusion Defects.

UNIT - VI:

Forging: Basic forging operations ,Open die forging, Closed die forging, press forging, Drop forging, Roll forging , calculation of forging load in closed die forging, Defects

Sheet Metal Forming Operations: Blanking and piercing, Bending, Spring back in sheet metal operation Deep drawing, Stretch forming, Embossing, Coining.

Presses – Classification Dies.

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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APPLIED THERMODYNAMICS

II Year – II Semester

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

Course Objectives

- To introduce the principles of operation of heat engines and compressors along with the performance characteristics.
- To familiarize with various thermodynamic cycles of Refrigeration and psychrometric processes.

Learning Outcomes

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

- distinguish between 2-stroke and 4- stroke, S.I and C.I engines and draw the heat balance sheet
- determine the indicated power of single and multistage reciprocating air compressors
- analyze the performance of steam power cycle under various conditions
- design a steam nozzle for the given pressure drop
- illustrate the principle of working of steam condensers and evaluate the vacuum and condenser efficiencies
- describe the working of gas turbines and evaluate the effect of operating variables on thermal efficiency
- explain the working principles of refrigeration cycles and determine the C.O.P
- find the change in moisture and energy during various psychrometric processes.

Course Content

UNIT - I:

IC Engines: IC Engine Components, Classification, SI and CI engines, Four Stroke and Two Stroke Engines, Valve and Port Timing Diagrams, Comparison of 2-stroke and 4-stroke, SI and CI Engines.

Testing and Performance of I.C Engines: Measurement of Fuel consumption, Air consumption, Brake power, Frictional Power and Indicated Power, Performance tests, Heat balance sheet.

UNIT – II:

Reciprocating Compressors: Principle of operation, single stage compressor - equation for work (with and without clearance volume), Isothermal efficiency and volumetric efficiency, effect of clearance. Multi stage compression - Inter cooling, saving of work, minimum work condition for Multistage stage compression.

UNIT - III:

Steam Power Cycles: Rankine cycle - schematic layout, Thermodynamic analysis, concept of mean temperature of heat addition, Methods to improve cycle performance - Regeneration & Reheating cycles.

Boilers: Classification, working of water tube and fire boilers, Mountings and Accessories.

UNIT - IV:

Steam Nozzles: Working principle, functions of a nozzle, applications, Types of nozzles, flow through nozzles, thermodynamic analysis, velocity of fluid at nozzle exit, Ideal and actual expansion in a nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio, general relationship between area velocity and pressure in a nozzle flow, Super saturated flow.

Steam Condensers: Requirements of steam condensing plant, classification of condensers, working principle of different types condensers, vacuum efficiency and condenser efficiency, air leakage -sources and its affects.

UNIT - V:

Gas Turbines: Simple gas turbine plant ideal cycle - open & closed cycles, Effect of operating variables on thermal efficiency, actual cycle, Methods of improving efficiency – regeneration, inter cooling and reheating.

Jet propulsion: Principle of Jet propulsion, Classification of jet propulsive Engines, working principle of Turbo-Jet, Turbo-Propeller, Turbo Fan, Ram-Jet, Pulse-Jet Engines, and Rocket Engines.

UNIT - VI:

Refrigeration: Need for Refrigeration, Methods of refrigeration, Bell - Coleman cycle, Refrigerating effect, COP, vapor compression refrigeration system, Vapor absorption refrigeration system.

Air Conditioning: Introduction, Psychrometric Properties -Atmospheric air, dry air, Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapor pressure, Degree of saturation, Adiabatic Saturation, Carrier's Equation, Psychrometric chart, Psychrometric processes, Types of Air conditioning systems.

Text books

1. V.P. Vasandani and D.S. Kumar "Treatise on Heat Engineering" Metropolitan Book co, New Delhi. 4th edition.
2. M. L. Mathur, R. P. Sharma " A Course in Internal Combustion Engines" Dhanpat Rai & Sons, 2010.
3. C P Arora "Refrigeration and Air Conditioning" TMH. 3rd edition.

Reference Books

1. V.Ganesan "I.C. Engines" T.M.H., New Delhi. 4th edition.
2. Manohar Prasad "Refrigeration and Conditioning" New Age publications. 3rd edition.
3. R. Yadav "Thermodynamics and Heat Engines" Vol. II, central Publishing House Allahabad. 7th edition.

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DYNAMICS OF MACHINES

II Year – II Semester

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

Course Objectives

- To familiarize with the dynamic force analysis of machines and their effect.

Learning Outcomes

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

- analyze simple mechanisms with and without considering the inertia forces
- design the flywheel for different applications
- estimate the effect of gyroscopic couple on the stability of moving vehicles.
- analyze and design the governors.
- evaluate the effect of friction on power transmission in devices like bearings, clutches and brakes
- analyze balancing problems in rotating and reciprocating machinery
- determine the natural frequencies in vibrating systems.

Course Content

UNIT - I:

Static and Dynamic Force Analysis: Analysis of four bar and slider crank mechanism.

Flywheel : Turning moment diagrams , fly wheels, fluctuation of energy and speed.

UNIT - II:

Gyroscope*:* Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, aero plane and ship.

Governor*s*: Watt, porter , proell and Hartnell governor, governor performance - sensitiveness, isochronism and hunting.

UNIT - III:

Bearings & Clutches: uniform pressure theory, uniform wear theory-pivot and collar bearings, clutches - single disc, multiple disc clutch, cone clutch, centrifugal clutch.

Brakes*:* block brakes, band brakes, band and block brakes, internal expanding brake.

Dynamometers: Introduction , types - prony, rope brake , epi cyclic, Bevis Gibson and belt transmission dynamometers.

UNIT - IV:

Balancing of Rotating Masses*:* Balancing of rotating masses, single and different planes, analytical and graphical methods

UNIT - V:

Balancing of Reciprocating Masses: primary and secondary balancing , balancing of single cylinder and multi cylinder in line engine, V-Engine and radial engines .

UNIT - VI:

Vibrations*:* Introduction, types of vibrations, free longitudinal vibrations, damped vibrations, logarithmic decrement, forced vibrations, vibrations isolation and transmissibility, transverse vibrations, whirling of shafts, critical speeds.

Text Books

1. S.S Ratan, Theory of Machines , Tata McGraw Hill Publications
2. A. Ghosh, A. K. Mallik, Theory of Mechanisms and Machines, East West Press Pvt. Ltd.

References Books

1. Design of Machinery : An Introduction to the Synthesis and Analysis of Mechanisms and Machines, Robert L. Norton, McGraw-Hill, 2012
2. Thomas Bevan ,Theory of Machines ,Pearsons Education.
3. J.S.Rao and R.V.Dukkipati , Mechanism and Machine Theory, New Age Publishers.

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FLUID MECHANICS

II Year – II Semester

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

Course Objectives

- To familiarize the fluid properties, basic laws and principles used to describe equilibrium and motions of fluids.
- To introduce the principles of conservation of mass, momentum and energy and their application in study of fluid flow.

Learning Outcomes

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

- elaborate the properties of fluid and analyze the hydrodynamic forces acting on submerged /floating bodies
- classify the motion of fluids and describe flow field
- apply the concepts of continuity, momentum and Bernoulli's equations in solving fluid flow problems
- determine the various losses of fluid flow in a closed conduit
- apply the dimensional analysis and derive the equations governing the fluid flow.
- apply the concept of boundary layer theory and evaluate lift and drag forces acting on submerged bodies

Course Content

UNIT - I:

Introduction: Physical properties of fluids – Mass density, specific weight, specific gravity, viscosity, vapor pressure Compressibility, surface tension and Capillarity.

Fluid statics: Fluid pressure - Variation of fluid pressure in a fluid, Pascal's law, Atmospheric, Absolute, Gauge and Vacuum pressure. Measurement of Pressure – Piezometer, U- tube and differential manometers, Mechanical gauges. Hydrostatic forces on plane and curved surfaces, Buoyancy and Flotation.

UNIT - II:

Fluid kinematics: Flow fields and description of fluid Motion- Lagrangian Method and Eulerian Method, Types of fluid flows, Stream line, path line, streak lines and stream tube. Equation of continuity in differential form, acceleration of a fluid particle, Translation and Rotation, Vorticity, Velocity Potential, Stream function.

UNIT - III:

Fluid dynamics: Surface and body forces, Forces acting on Fluid in Motion – Euler's Equations of Motion, Bernoulli's equations for flow along a stream line, momentum equation and its applications-Force on pipe bend, nozzle.

Application of Bernoulli's equation: Pitot tube, Venturimeter, Orifice meter.

UNIT - IV:

Viscous Flow: Navier-Stokes equations of motion, Laminar Fully Developed Pipe Flow, Flow between parallel plates – both plates at rest, one plate is moving and other at rest. Introduction to turbulent flows, Moody's diagram.

UNIT - V:

Closed conduit flow: Reynolds' experiment, Laws of Fluid friction, Darcy Weisbach equation, Minor losses in pipes, pipes in series, equivalent pipe, pipes in parallel.

Dimensional Analysis: Need for dimensional analysis ,dimensional homogeneity, methods of dimensional analysis, similitude, types of similitude, dimensionless numbers, model analysis.

UNIT - VI:

Boundary Layer Theory: Introduction, Development of boundary layer along a thin flat plate, Boundary layer thickness, Displacement thickness, Momentum thickness, Energy thickness, Laminar sub layer, boundary layer separation, Drag and lift forces on submerged bodies.

Text Books

1. Frank M. White, "Fluid Mechanics", McGraw-Hill Companies, Inc., New York. 7th Edition.
2. S K Som, Gautam Biswas & Suman Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines" Tata McGraw Hill Education Pvt Ltd. 3rd edition.

Reference Books

1. P.N. Modi, S.M. Seth, "Hydraulics and Fluid Mechanics Including Hydraulics Machines", Rajsons publication Pvt Ltd.
2. Yunus A. Cengel & John M. Cimbala, "Fluid Mechanics Fundamentals and Applications" Tata McGraw Hill Education Pvt Ltd. (SIE) 2nd edition.
3. D.S. Kumar, "Fluid Mechanics and Fluid Power Engineering" S.K. Kataria & Sons.

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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, 16^{th} 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.

Course Content

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

Course Content

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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THERMAL ENGINEERING LAB

II Year – II Semester

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

Course Objectives

- To study experimentally the performance of IC engines, compressors, refrigeration and air conditioning systems.

Learning Outcomes

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

- conduct various performance tests on I.C engines and plot the performance characteristic curves
- conduct the load test and evaluate the performance of a reciprocating air compressor
- conduct a performance test on refrigeration and air conditioning test rigs and determine the C.O.P for the given conditions.

List of Experiments

1. Valve/port timing diagrams of a single cylinder diesel engine.
2. Disassembly / assembly of 4- stroke single cylinder petrol engine.
3. Load test on 4-stroke single cylinder diesel engine.
4. Load test on 4-stroke twin single cylinder diesel engine.
5. Load test on 2-stroke single cylinder petrol engine.
6. Morse test on 4-stroke multi cylinder petrol engine.
7. Motoring and retardation test on 4-stroke single cylinder diesel engine.
8. Draw the heat balance sheet on 4 - stroke single cylinder diesel engine.
9. Load test on 4 - stroke single cylinder variable compression ratio petrol engine.
10. Performance test on reciprocating air compressor.
11. Performance test on Refrigeration test rig.
12. Performance test on Air conditioning and Heat Pump test rig.

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MANUFACTURING PROCESSES LAB

II Year – II Semester

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

Course Objectives

- To impart hands on training in the areas of casting, welding, press working and processing of plastics.

Learning Outcomes

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

- design a pattern.
- test the properties of sand and prepare a casting.
- perform pre welding operations.
- perform Arc welding, Spot welding, TIG welding and Plasma Welding operations.
- understand the features of simple, compound and progressive dies.
- perform blanking, piercing and bending operations.
- operate injection and blow moulding machines to manufacture plastic components.

List of Experiments

1. Pattern making for the given specifications.
2. Testing of molding sand properties.
3. Manufacturing of the given component using casting.
4. Preparation of lap and butt joints using arc welding.
5. Preparation of lap and single strap butt joints using spot welding.
6. Preparation of butt joints using Plasma welding.
7. Preparation of butt joints using TIG welding.
8. Preparation of lap joints using brazing.
9. Blanking and piercing operations using hydraulic press.
10. Preparation of a component using injection moulding.
11. Study of preparation of a bottle using blow moulding.
12. Study of gas welding process.

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MACHINE DYNAMCIS LAB

II Year – II Semester

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

Course Objectives

- To demonstrate the experimental determination of dynamic response of machine elements.

Learning Outcomes

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

- determine the whirling speed of shaft.
- determine the natural frequency of beam and rotor.
- determine gyroscopic effect of a rotating body.
- perform dynamic balancing of rotating and reciprocating masses.
- determine the centrifugal force and equilibrium speed acting on the governors.
- perform modal analysis on beam and plate like structure.

List of Experiments

1. Whirling speed of shaft.
2. Torsional vibrations of a shaft (a)without damping (b) with damping
3. Longitudinal Vibrations of a beam(a) without damping(b)with damping
4. Model analysis of structural beams by using FFT Analyzer
5. Motorized Gyroscopic Couple Apparatus
6. Balancing of Rotating Masses
7. Determination of centrifugal force at different speeds by using Governor apparatus
8. Balancing of Reciprocating Masses
9. Forced vibrations of beam
10. Determination of Friction and Wear.
11. Determination of moment of inertial of bifilar and trifilar systems.
12. Natural frequency of single and two rotor systems.

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Optional Elective - I

CONTROL SYSTEMS

II Year – II Semester

Lecture	: -	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.

Course 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. 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.
4. Feed back and control system – Joseph J Distefa.

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Optional Elective - I

NANO TECHNOLOGY

II Year – II Semester

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

Course Objectives

- To familiarize with principles of quantum mechanics on which nano materials behave
- To elucidate applications of nanotechnology.

Learning Outcomes

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

- analyze the concepts and preparation methods of Nano materials
- understand the nano material properties and their behavior
- use various techniques for investigating nano material
- know the importance of Nano Technology for advanced materials processing.

Course Content

UNIT - I:

Introduction: Basics of quantum mechanics**,** harmonic oscillator, magnetic phenomena ,band structure in solids, mossbauer and spectroscopy , optical phenomena bonding in solids ,anisotropy. process of synthesis of nano powders , electro deposition , important nano materials.

UNIT - II:

Silicon carbide: Application of silicon carbide , nano materials preparation ,sintering of sic,x-ray diffraction data ,electron microscopy sintering of nano particles.

Nano Particles Of Alumina And Zirconia: Nano materials preparation , charecterization ,wear materials and nano composites.

UNIT - III:

Mechanical Properties: Strength of nano crystalline SiC , preparation for strength measurements, mechanical properties , magnetic properties

Electrical Properties: Switching glasses with nano particles, electronic conduction with nano particles.

Optical properties: optical properties , special properties and the coloured glasses.

UNIT - IV:

Investigating And Manipulating Materials In The Nano Scale: Electron microscopics , scanning probe microscopic ,optical microscopic for nano science and technology, X-ray diffraction.

UNIT - V:

Nanobiology: Interaction between biomolecules and nanoparticle surface. Different types of inorganic materials used for the synthesis of hybrid nano-bio assemblies. Application of nano in biology,nano probe for analytical applications- new methodology in medical diagnostics and biotechnology,future perspectives of nanobiology , nanosensors.

UNIT - VI:

Nanomedicens: Developing of nanomedicens nano systems in use, protocols for nanodrug Administration , nanotechnnology in diagnostics applications, materials for used in diagnostics and therapeutic applications, molecular nanomechanics , molecular devices , nanotribology , studying tribology at nanoscale , nanotribology applications.

Text Book

1. A.K.Bandyopadhyay ,"Nano materials" , New Age publishers.

Reference Book

1. T.Pradeep, ''Nano Essentials'', TMH publications.

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Optional Elective - I

DIGITAL LOGIC DESIGN

II Year – II Semester

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

Course Objectives

- To familiarize with the concepts of designing digital circuits.

Learning Outcomes

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

- translate number given in one number system to another number system.
- apply complements to perform addition and subtraction of signed numbers.
- reduce Boolean function using Boolean laws, theorems and K-Maps.
- design combinational logic circuits such as adders, subtractors, decoders, encoders, Mux and De-Mux.
- prepare characteristic equation and excitation tables of SR, JK, T and D flip-flops.
- design counters and registers using flip-flops.

Course Content

UNIT - I: Number Systems

Binary, octal, decimal, hexadecimal number systems, conversion of numbers from one radix to another radix, r's, (r-1)'s complements, signed binary numbers, addition and subtraction of unsigned and signed numbers, weighted and un-weighted codes.

UNIT - II: Logic Gates and Boolean Algebra

NOT, AND, OR, universal gates, X-OR and X-NOR gates, Boolean laws and theorems, complement and dual of a logic function, canonical and standard forms, two level realization of logic functions using universal gates, minimizations of logic functions (POS and SOP) using Boolean theorems, K-map (upto four variables), don't care conditions.

UNIT - III: Combinational Logic Circuits - 1

Design of half adder, full adder, half subtractor, full subtractor, ripple adders and subtractors, ripple adder / subtractor.

UNIT - IV: Combinational Logic Circuits - 2

Design of decoders, encoders, priority encoder, multiplexers, demultiplexers, higher order decoders, demultiplexers and multiplexers, realization of Boolean functions using decoders, multiplexers.

UNIT - V: Sequential Logic Circuits

Classification of sequential circuits, latch and flip-flop, RS- latch using NAND and NOR Gates, truth tables, RS, JK, T and D flip-flops, truth and excitation tables, conversion of flip- flops, flip-flops with asynchronous inputs (preset and clear).

UNIT - VI: Registers and Counters

Design of registers, shift registers, bidirectional shift registers, universal shift register, design of ripple counters, synchronous counters and variable modulus counters, ring counter, Johnson counter.

Text Books

1. M. Morris Mano, Michael D Ciletti, “Digital Design”, 5th edition, PEA.

Reference Books

1. Kohavi, Jha, “Switching and Finite Automata Theory”, 3rd edition, Cambridge.
2. Leach, Malvino, Saha, “Digital Principles and Applications”, 7th edition, TMH.
3. Roth, “Fundamentals of Logic Design”, 5th edition, Cengage.

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NUMERICAL AND STATISTICAL METHODS

III Year – I Semester

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

Course Objectives

- To understand the various numerical techniques.
- To introduce the concepts of probability and statistics.
- To know the importance of the correlation coefficient & lines of regression
- To know sampling theory and principles of hypothesis testing.

Course 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.
- find polynomial for unequal intervals using Lagrange's interpolation.
- compute probabilities in different situations.
- use probability distribution in appropriate scenario.
- measure of correlation between variables and obtain lines of regression.
- construct sampling distribution and calculate its mean and standard deviation
- apply the appropriate tests to give valid inference.

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, backward and central difference operators – relation between operators, Newton's formulae for interpolation – Lagrange's interpolation.

UNIT - III: Numerical Solutions of 1st Order Ordinary Differential Equations

Solution by Taylor's series, Euler, modified Euler methods and fourth order Runge-Kutta method.

UNIT - IV: Probability and Expectation of Random Variable

Introduction to probability, additive, conditional and multiplicative laws of probability and their applications, applications of Baye's Theorem.

Introduction to random variables (discrete and continuous), concept of expectations (mean and variance) and properties, probability distributions and related applications.

UNIT - V: Probability distributions and Correlation & Regression

Review on Binomial and Poisson Distributions; normal distribution and its properties (statements only); applications of uniform and exponential distributions; introduction to Correlation and Linear Regression.

UNIT - VI: Sampling and Statistical Inference

Basic terminology in sampling, sampling techniques (with and without replacements), sampling distribution and its applications.

Introduction to statistical inference-test for means and proportions (one sample and two samples when sample size is large); exact sample tests- Chi-Square test (goodness of fit) and F-test (test for population variances), introduction to t-test.

Text Books

1. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi
2. Ravindranath. V, and Vijayalaxmi. A., A Text Book on Mathematical Methods, Himalaya Publishing House.
3. T. K. V. Iyengar, B. Krishna Gandhi, S. Ranganatham and M.V. S. S. N. Prasad, Probability and Statistics, S. Chand & Company Ltd.
4. Miller, John E. Freund, Probability and Statistics for Engineers, PHI.

Reference Books

1. Dr. T. K. V. Iyengar, Dr. B. Krishna Gandhi, S. Ranganatham and Dr. M.V. S. S. N. Prasad,Mathematical Methods : 6th edition,S. Chand & Company Ltd.
2. B.V.Ramana, Engineering Mathematics : 4th Edition, Tata McGraw Hill, 2009, New Delhi.
3. Erwin Kreyszig, Advanced Engineering Mathematics : 8th edition, Maitrey Printech Pvt. Ltd, 2009, Noida.
4. S.C. Gupta & V.K. Kapoor, Fundamentals of Mathematical Statistics, S.Chand & Company Ltd.

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METAL CUTTING AND MACHINE TOOLS

III Year – I Semester

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

Course Objectives

- To expose the students to the mechanics of metal cutting, so as to equip them with adequate knowledge about elements of metal cutting process.
- To emphasize upon the prominent theories, concepts and constructional features of machine tools related to turning, shaping, planning, drilling, milling and grinding operations.

Learning Outcomes

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

- apply principles of metal cutting in machining operations.
- calculate force, work done and power in metal cutting process using theories of machining process.
- explain the components and operations of lathe machine.
- select appropriate machine tool to process prismatic parts.
- use principles of drilling, boring and milling in machining various components.
- distinguish grinding, lapping and honing operations.

Course Content

UNIT - I:

Theory of Metal Cutting : Importance of material removal , elements of metal machining , tool, work, chip, fluid - types of cutting tools & tool materials , nomenclature of single point tool , systems of tool nomenclature , nomenclature of multi point tools ,milling cutter, drill, broach tool , orthogonal & obligue cutting , chip formation ,velocity relationships, types of chips , chip breakers.

UNIT - II:

Mechanics of orthogonal cutting : Modern theories in Mechanics of cutting , review of Merchant and Lee Shaffer theories , stress, strain, workdone and power required in cutting , forces in turning, drilling and milling , cutting force measurement techniques ,dynamometers, machining parameters ,tool life ,effect of parameters on tool life ,tool failure.

UNIT - III:

Machine tools : Introduction , classification of machine tools , generating and forming ,methods of generating surfaces , basic elements of machine tools.

Centre lathe – constructional features ,specifications , operations , taper turning methods , thread cutting methods , tool and work holding devices , speed, feed, depth of cut , material removal rate , machining time calculations, capstan and turret lathes , difference between turret lathes and centre lathe.

UNIT - IV:

Shaping, Slotting, and Planning machines: Principle of working , principal parts , specifications, types , operations performed , machining time calculations.

UNIT - V:

Drilling & Boring Machines: principle of working , specifications , types , operations performed , machining time calculations.

Milling Machine: Principle of working , specifications ,types , operations performed, types of cutters , methods of indexing.

UNIT - VI:

Grinding: Theory of grinding , classification of grinding machines ,grinding wheel , characteristics , specification and selection of a grinding wheel , methods of grinding , cutting speed, feed, depth of cut and machining time calculations.

Lapping and Honing : Working principle ,comparison of lapping, honing and grinding.

Text Books

1. R.K. Jain and S.C. Gupta, “Production Technology”, Khanna Publications.
2. P.N.Rao “Manufacturing Technology: Metal Cutting and Machine Tools”, Volume 2, 3rd Edition, Tata McGraw-Hill Education.

Reference Books

1. M.C.Shaw, “Metal cutting Principles”, Oxford University Press.
2. Winston A.Knight, Geoffrey Boothroyd, “Fundamentals of Metal cutting and Machine Tools”, 3rd Edition, TMH publications.
3. B.S.Raghuwanshi, “ A course in Workshop Technology”, Vol II(Machine Tools), 2nd edition, Dhanapat Rai publications.
4. K.C Jain & A.K Chitaley , “Production Engineering”, PHI Publishers.

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TURBO MACHINERY

III Year – I Semester

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

Course Objectives

- To introduce the principles of hydraulic turbines and pumps, steam turbines and compressors along with their performance characteristics.

Learning Outcomes

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

- understand the fundamental principles and operation of rotating machines.
- illustrate the working of hydraulic turbines and pumps and draw their performance characteristics
- select a suitable hydraulic turbine and pump for the given conditions
- design the hydraulic turbines for the given conditions
- evaluate the performance of impulse and reaction steam turbines
- assess the performance of dynamic compressors.

Course Content

UNIT - I: Basics of Turbo Machinery

Impulse momentum principle, Euler's equation of motion, force exerted by jet on stationary and moving plates, velocity diagrams, energy conversion in turbo-machinery, concept of degree of reaction, application of model testing, work done and efficiency.

UNIT - II: Centrifugal Pumps

Introduction, classification, working principle, work done by the Impeller, Head of pump - static head, manometric head, losses and efficiencies. Minimum starting speed, specific speed, model testing of pumps. Multistage Pumps– pumps in series and parallel. Performance characteristic curves, NPSH, cavitation.

UNIT - III: Hydraulic Turbines

Elements of hydro-electric power plant, classification of hydraulic turbines, Pelton wheel, Francis turbine and Kaplan turbine - working principle, work done, efficiencies, hydraulic design. Draft Tube - theory, function and efficiency.

Performance of hydraulic turbines under unit head - unit quantities, performance under specific conditions, Performance characteristic curves.

UNIT - IV: Steam Turbines and Impulse Turbines

Steam Turbines: Principle of operation of steam turbine, Classification of steam turbines.

Impulse Turbines: Mechanical details, velocity diagrams, combined velocity diagram, effect of friction, power developed, axial thrust, blade efficiency, condition for maximum efficiency. Methods to reduce rotor speed - compounding of turbines.

Reaction Turbine: Mechanical details, principle of operation, velocity diagram for impuse reaction turbine, degree of reaction, velocity diagram, Parson's reaction turbine – condition for maximum efficiency.

UNIT - V:

Rotary compressors (positive displacement type): Mechanical details and working - Roots blower, vane blower.

Centrifugal Compressors: Mechanical details and principle of operation – velocity and pressure variation. Ideal energy transfer, blade shapes and velocity triangles, analysis of flow through the compressors, slip factor, performance parameters - power input factor, pressure coefficient, compressor efficiency. Surging and choking.

UNIT - VI:

Axial Flow Compressors: Mechanical details and principle of operation – stage velocity triangles, work input to the compressor, work done factor, compressor stage efficiency, degree of reaction, comparison of centrifugal and axial compressors. Surging and stalling.

Text Books

1. S L Dixon and C A Hall, "Fluid Mechanics and Thermodynamics of Turbo-machinery" 7th edition.
2. S M Yahya, "Turbines, compressors and fans", Mc Graw Hill Education, 4th edition.

Reference Books

1. R Yadav "Steam and Gas Turbines and Power Plant Engineering," Vol. II, Central publishing house, 7th Edition, Allahabad.
2. P.N. Modi, S.M. Seth, "Hydraulics and Fluid Mechanics Including Hydraulics Machines", Rajsons publication Pvt Ltd.
3. G.Goplakrishnan & D.Prithvirah , "A Treatise on Turbo Machines" Scitech Publications (India) Pvt. Limited.
4. V Ganesan, "Gas Turbines", Mc Graw Hill Education, 3rd edition.

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Professional Elective - I

NON CONVENTIONAL SOURCES OF ENERGY

III Year – I Semester

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

Course Objectives

- To impart knowledge on 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

- significance of renewable energy and describe the principles of solar radiation
- analyze various solar collectors.
- know the various storage methods and application of solar energy.
- understand the concept of converting wind energy into electrical energy using both horizontal and vertical axis wind machines.
- know biomass disasters, functional operation of geothermal systems.
- generalize the operation of ocean, tidal and wave energy systems.
- understand the operating principle of direct energy conversion systems .and to recognize the need and ability to engage in lifelong learning for further developments in this field.

Course Content

UNIT - I: Introduction

Energy sources and their availability- commercial and non commercial energy sources. Need of Renewable Energy Sources (RES), classification of RES, Role and potential of RES in India.

Solar Radiation: Structure of the sun, Solar constant, environmental impact of solar radiation, Radiation at the earth surfaces, solar radiation Geometry, extraterrestrial and terrestrial solar radiation, Spectral Distribution of Extraterrestrial Radiation, solar radiation on tilted surfaces and Empirical equations for predicting the availability of solar radiation at any given location. Solar energy - Thermal applications.

UNIT - II: Solar Collectors

Principle of solar energy conversion into heat, classification of solar collectors, Flat plate collectors, basic energy balance equation, collector efficiency, thermal analysis of flat plate collector. Concentrating collectors and its advantages and disadvantages. Performance analysis of concentrating collectors, selection of absorber coating materials.

UNIT - III: Solar Energy Storage and Applications

Solar Energy Storage: Different storage methods- sensible, latent heat and stratified storage, solar ponds.

Solar Energy Applications: Solar water, space heating /cooling, solar thermal electric conversion, direct solar electric power generation- solar photovoltaic, solar distillation, Solar Pumping, Solar furnace, Solar cocking and solar green house.

UNIT - IV: Wind Energy, Biomass Energy Conversion Systems and Geothermal Thermal Energy

Wind Energy: Working principle of wind energy conversion, Wind patterns, Components of wind energy conversion system (WECS), Types of Wind machines – horizontal axis and vertical axis, Betz coefficient.

Biomass Energy Conversion Systems: Biomass Energy: Fuel classification – Pyrolysis – Different digesters and sizing.

Geothermal Thermal Energy: Classification – Dry rock and acquifer – Energy analysis

UNIT - V: Ocean Thermal Energy, Tidal Power System and Wave Energy

Ocean Thermal Energy: Method s of Ocean Thermal Electric power generation-Open cycle systems, closed cycle systems

Tidal Power System: Working principle, components of Tidal Power plant, single basin and double basin tidal energy system advantages and limitations .

Wave Energy: Wave energy conversion Devices-wave energy conversion by floats, high level reservoir wave machine and dolphin type wave power machine. Advantages and disadvantages

UNIT - VI: Direct Energy Conversion, MHDPower Generation and Fuel Cell

Direct Energy Conversion (DEC): Need for DEC, limitations, principles of DEC. Thermoelectric Power – See-beck, Peltier, Joule -Thomson effects, Thermo-electric Power generators

MHD Power Generation: Principles, dissociation and ionization, Hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion.

Fuel Cell: working principle, classification – Efficiency – VI characteristics.

Text Books

1. SP Sukhatme, “Solar Energy: Principles of thermal collection and storage” Tata McGraw Hill
2. Tiwari and Ghosal, “Renewable energy resources”, Narosa

Reference Books

1. B.H.Khan “Non – conventional Energy Resources” Tata McGraw Hill education Pvt. Ltd.
2. G.D. Rai, “Non-Conventional Energy Sources”, Dhanpat Rai and Sons
3. Twidell & Weir, “Renewable Energy Sources “.

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Professional Elective - I

MECHANICAL VIBRATIONS

III Year – I Semester

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

Course Objectives

- To familiarize with the concepts of mathematical model and solution methods for vibrations of the mechanical systems.

Learning Outcomes

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

- appreciate the need and importance of vibration analysis in mechanical design of machine parts that operate in vibratory conditions.
- analyze the mathematical model of a linear vibratory system to determine its response
- model single degree and two degree vibratory systems and determine their responses
- determine the natural frequencies and mode shapes of continuous vibratory systems using numerical methods
- choose appropriate instrument to measure the vibrations

Course Content

UNIT - I: Fundamentals of Vibration

Introduction, Elements of vibrating system , types of vibrations, methods of vibration analysis , spring elements , mass or inertia elements, damping elements , simple harmonic motion.

UNIT - II: Free Vibrations of Single Degree of Freedom Systems

Undamped Free Vibrations: Governing differential equation , Newton's method , Energy method, Rayleigh's method, torsional system – equations of motion and solution.

Damped Vibrations: Governing differential equation, critical damping coefficient and damping ratio, damped natural frequency, logarithmic decrement, energy dissipated in viscous damping.

UNIT - III: Forced Vibrations of Single Degree of Freedom Systems

Sources of Excitation , Equations of motion , Response of undamped system under harmonic excitation, Total response , beating phenomenon , Response of damped system under harmonic excitation, frequency response , quality factor and band width , response under harmonic excitation of the base, vibration isolation, transmissibility, force transmission to foundations, response of a damped system under rotating unbalance.

UNIT - IV: Two Degree of Freedom Systems

Vibrations of undamped system , torsional system , damped free vibrations, forced harmonic vibration , coordinate coupling and principal coordinates , torsional vibration absorber , centrifugal pendulum absorber

UNIT - V: Vibrations of Continuous Systems

Lateral Vibrations of springs, longitudinal vibrations of bars , transverse vibrations of beams.

UNIT - VI: Vibration Measurement

Transducers - variable resistance transducers , piezoelectric transducers, electro dynamic transducers, linear variable differential transformer, transducer vibration pickups- vibrometer, accelerometer , velometer , frequency measuring instruments , vibration exciters- mechanical exciters, electrodynamic shaker , signal analysis- spectrum analyzers

Text Books

1. S. S. Rao , Mechanical Vibrations , 4^{th} Edition, Pearson-Prentice Hall
2. William T. Thomson and Marie Dillon Dahleh ,Theory of Vibration with Application,Pearson New International Edition,5th Edition.

References Books

1. G.S. Grover &S.P.Nigam ,Mechanical Vibrations ,Nem Chand & Bros, 8^{th} edition,
2. V.P.Singh ,Mechanical vibration,Dhanpat Rai & Co ,4^{th} Edition.
3. Mechanical vibration Schaum Series , McGraw Hill ,2nd Edition.

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Professional Elective - I

MECHANICS OF COMPOSITE MATERIALS

III Year – I Semester

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

Course Objectives

- To familiarize with the composite materials and their mechanical behaviour.

Learning Outcomes

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

- explain the concepts of composite materials.
- select a best technique for fabrication of composite material.
- analyze macro and micro mechanical behaviour of a lamina.
- develop governing equations for bending, buckling and vibrations in laminated plates.
- analyze and design composite structures used in automobile and aerospace applications.

Course Content

UNIT - I: Introduction to Composite Materials

Introduction, What is a composite material, Current and potential advantages of fibre reinforced composites, Applications of composite materials, Military, civil, space, automotive and commercial applications.

UNIT - II: Fabrication of Composites

Fabrication of Metal Matrix Composites, Fabrication of Polymer Matrix Composites, Fabrication of ceramic matrix composites, Fabrication of nano-composites.

UNIT - III: Macro and Micro Mechanical Behaviour of a Lamina

Stress strain relations for anisotropic materials, Restrictions on engineering constants, Strengths of an orthotropic lamina, Biaxial strength criteria for orthotropic lamina.

UNIT - IV: Micro Mechanical Behaviour of Lamina and Laminates:

Mechanical of material approach to stiffness, Elasticity approach to stiffness, Classification lamination theory, Special cases, strength of laminates

UNIT - V: Bending, Buckling and Vibration of Laminated Plates

Governing equations for bending buckling and vibration of laminated plates, Deflection of simply supported laminated plates, Vibration of simply supported laminated plates

UNIT - VI: Design of Composite Structures

Introduction, design philosophy, Anisotropic analysis, Bending extension coupling, Micromechanics, Non linear behaviour, Interlaminar stresses, transverse shearing, Laminate optimization.

Text Books

1. Ronald F. Gibson, Principles of composite material mechanics, CRC Press, 2011.
2. Robert M Jones, Mechanics of Composite Materials, Taylor & Francis, 2000V.

Reference Book

1. Lawrence E. Nielsen, Nielson, Paul Nielsen, Mechanical Properties of Polymers and Composites, Second Edition, CRC press, 2000.

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Professional Elective - I

DATA STRUCTURES

III Year – I Semester

Lecture	: 4	Internal Marks	: 40
Credits	: 3	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.
- choose appropriate collision resolution techniques to resolve collisions.
- compare array and linked list representation of data structures.

Course Content

UNIT - I: Sorting and Searching

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

Searching: Linear search, Binary search.

Sorting (Internal): Basic concepts, sorting by: insertion (insertion sort), selection (selection sort), exchange (bubble sort).

UNIT - II: Linked Lists

Linked Lists- Basic concepts and operations of single linked list, circular linked list and double linked list.

UNIT - III: Stacks and Queues

Stack: Introduction, representation using arrays and linked list, operations on stack, evaluation of arithmetic expression.

Queue: Introduction, representation using arrays and linked list, operations on queue, circular queue.

UNIT - IV: Trees

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

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: Heap Trees and Graphs

Heap Trees: Basic concepts, operations, application-heap sort.

Graphs- Basic concepts, representations of graphs, graph traversals-breadth first search and depth first search techniques.

UNIT - VI: Hashing

Hashing: Basic concepts, hashing functions (division method, multiplication method), collision resolution techniques- open hashing and closed hashing.

Text Books

1. Horowitz, Sahani, Anderson Freed, “Fundamentals of Data Structure in C”, 2nd edition, University Press.
2. Richard F, Gilberg, Forouzan, “Data Structures”, 2nd edition, Cengage.

Reference Books

1. G. A. V. Pai, “Data Structures and Algorithms”, TMH.
2. Debasis Samanta, “Classic Data Structures”, 2nd edition, PHI.

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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 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.

Course Content

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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FLUID MECHANICS AND TURBO MACHINERY LAB

III Year – I Semester

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

Course Objectives

- Determine experimentally the co-efficient of discharge of various flow measuring devices and study the performance of various turbo machines.

Learning Outcomes

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

- measure the fluid flow using different flow measuring devices
- conduct a performance test on turbomachines at different operating conditions.

List of experiments

1. Determine coefficient of discharge of Venturimeter/orifice meter.
2. Determination of friction factor for a given pipe line.
3. Determine the type of flow through a pipe line using Reynolds Apparatus.
4. Verification of Bernoulli's theorem.
5. Determine the efficiency of jet.
6. Performance Test on Pelton Wheel.
7. Performance Test on Francis Turbine.
8. Performance Test on Kaplan Turbine.
9. Performance Test on Single Stage Centrifugal Pump.
10. Performance Test on Reciprocating Pump.
11. Performance test on centrifugal blower.
12. Performance test on Axial flow compressor.

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MACHINE TOOLS LAB

III Year – I Semester

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

Course Objectives

- To impart hands on training in the operation of basic machine tools.

Learning Outcomes

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

- operate lathe machine to carry out step turning, taper turning, knurling, thread cutting, drilling and boring operations.
- perform drilling operation and distinguish tap set and perform tapping operation.
- perform shaping and planing operations.
- perform indexing operation to prepare gear on milling machine.
- carry out cylindrical and surface grinding operations.
- carry out grinding operation on single point cutting tool to obtain different tool angles.

List of Experiments

1. Step turning on lathe machine.
2. Taper turning on lathe machine.
3. Thread cutting and knurling on lathe machine.
4. Drilling and boring on lathe.
5. Drilling using radial drilling machine and tapping.
6. Shaping.
7. Planing.
8. Slotting.
9. Spur Gear cutting on milling machine.
10. Helical Gear cutting on milling machine.
11. Cylindrical grinding.
12. Grinding of tool angles.

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COMPUTER AIDED MACHINE DRAWING LAB

III Year – I Semester

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

Course Objectives

- To impart hands on training for drafting ,modeling and assembly of machine parts using modeling package.

Learning Outcomes

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

- draft different views of machine elements and parts
- model individual parts and assemble them.

List of Experiments

1. Drafting of Cotter joint
2. Drafting of Coupling
3. Drafting of bearing
4. Drafting of riveted joint
5. Modeling of Stuffing Box parts.
6. Modeling of Steam engine cross head parts.
7. Modeling of Lathe single way tool post parts.
8. Modeling and Assembly of Knuckle joint parts.
9. Modeling and Assembly of Plummer Block parts
10. Modeling and Assembly of Screw Jack parts
11. Modeling and Assembly of IC engine piston parts
12. Modeling of parts of Eccentric and generation of orthographic views.

Text Books

1. S.Trymbaka Murthy , Computer Aided Machine Drawing Using Solid Edge , CBS Publishers & Distributors-New Delhi.
2. K.L.Narayana, P.Kannaiah & K. Venkata Reddy, “Machine Drawing”, New Age Publications.
3. Solid works 2017 for Designer by Prof. Sham Tickoo, BPB Publications; 15th Edition edition (2017)
4. Reference Manual on Solid Edge fundamentals , Siemens Product Lifecycle Management Software Inc.

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Optional Elective - III

COMPUTER GRAPHICS

III Year – I Semester

Lecture	: -	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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Optional Elective - III

FUZZY LOGIC SYSTEMS

III Year – I Semester

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

Course Objectives

- To impart knowledge on fundamentals of fuzzy sets and defuzzification.
- To familiarize with the Fuzzy Logic systems

Learning Outcomes

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

- describe applications regarding fuzzy mathematics.
- describe and develop decision making mechanism with fuzzy logic.
- analyze fuzzy logic sets to develop fuzzy logic controllers.
- analyze fuzzy logic system components to develop fuzzy logic controllers.

Course Content

UNIT - I:

Introduction – Fuzzy subsets – Lattices and Boolean Algebras – L fuzzy sets. Operations on fuzzy - *á* levels sets – properties of fuzzy subsets of a set.

UNIT - II:

Algebraic product and sum of two fuzzy subsets – properties satisfied by addition and product – Cartesian product of fuzzy subsets.

UNIT - III:

Algebra of fuzzy relations – logic – connectives, Fuzzy invariant subgroups - fuzzy subrings.

UNIT - IV:

Fuzzy sets, Membership, operations, properties, fuzzy relations, cardinalities, membership functions.

UNIT - V:

Fuzzification, Membership value assignment, development of rule base and decision making ystem,

UNIT - VI:

Defuzzification to crisp sets, Defuzzification methods.Fuzzy Logic

Text Books

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by Rajasekharan and Rai – PHI Publication.
2. Neural Networks and Fuzzy logic System by Bart kosko, PHI Publications
3. Recommended Text S.Nanda and N.R.Das "Fuzzy Mathematical concepts, Narosa Publishing House, New Delhi.

Reference Books

1. Fuzzy Logic with Engineering Applications, Second Edition, Wiley Publications, Timothy J.Ross.
2. Fuzzy Set Theory and Its Applications, Fourth Edition,Yes Dee Publishing Pvt. Ltd., Springer, H.-J. Zimmermann.

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Optional Elective - III

MICRO PROCESSORS AND INTERFACING

III Year – I Semester

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

Course Objectives

- To familiarize with the architecture of 8086 microprocessor.
- To introduce the assembly language programming concepts of 8086 processor.
- To impart knowledge on I/O interfacing.

Learning Outcomes

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

- understand the architecture of 8086 microprocessor.
- develop programs to run on 8086 microprocessor based system.
- design system using memory chips and peripheral chips for 8086 microprocessor.
- know the concepts of interrupts and serial communication using 8086.

Course Content

UNIT - I: Introduction to 8086

Features of 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 Addressing Modes of 8086

Instruction formats, instruction set, addressing modes

UNIT - III: Assembly language programming of 8086

Assembler directives, macros, simple programs involving logical, branch and call instructions, sorting, evaluating arithmetic expressions, string manipulations.

UNIT - IV: Basic Peripheral Interfacing to 8086

8255 PPI-Various modes of operation and interfacing to 8086, interfacing keyboard, display, stepper motor interfacing, D/A and A/D converter.

UNIT - V: Memory Interfacing and Interrupt Structure of 8086

Memory interfacing to 8086, need for DMA, architecture of 8257,interfacing DMA controller 8257 to 8086,interrupt structure of 8086, vector interrupt table, interrupt service routine, interfacing 8259 to 8086.

UNIT - VI: Serial Communication Using 8086

Serial communication standards, serial data transfer schemes, 8251 USART architecture and interfacing, RS- 232, IEEE-4-88, prototyping and trouble shooting.

Text Books

1. D. V. Hall, "Microprocessors and Interfacing", TMGH, 2nd edition.
2. Barry B.Brey, "The Intel Microprocessors –architecture, interfacing and programming", PHI, 8th edition.

Reference Books

1. A.K.Ray and K.M.Bhurchandi, "Advanced Microprocessors and Peripherals", 2nd edition, TMGH.
2. Triebel & Singh, "The 8088 & 8086 Microprocessors-Programming, interfacing, Hardware & Applications", PHI.

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ENGINEERING ECONOMICS AND ACCOUNTANCY

III Year – II Semester

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

Course Objectives

- To familiarize with the concepts of managerial economics and accountancy principles.

Course Outcomes

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

- apply managerial economic concepts in business decision making.
- identify the influencing factors of Demand for a product.
- categorize Production with respect to time and cost.
- relate the market structures and pricing to a product.
- establish the suitable business organisation with available resources
- analyze the investment patterns to minimize the risk.

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

Characteristics and features of Business, Features and evaluation of Sole Proprietorship, Partnership, Joint Stock Company, Public Enterprises and their types.

UNIT - V: Financial Accountancy

Introduction to Accountancy, Types of Accounts, Journal, Ledgers, Trial Balance, Introduction to Final Accounts and Problems, Problems with simple adjustments.

UNIT - VI: Capital Budgeting and Financial Analysis

Introduction to capital budgeting - traditional methods and discounted cash flow methods (simple problems). Introduction to financial Analysis, Interpretation of financial statements through ratios.

Text Books

1. Aryasri , Managerial Economics and Financial Analysis TMH.
2. H. Craig Peterson & W. Cris Lewis , Managerial Economics PHI.

Reference Books

1. Ambrish Gupta , Financial Accounting for Management, Pearson Education, New Delhi.
2. Varshney & Maheswari, Managerial Economics, S Chand Pubications.
3. Suma Damodaran , Managerial Economics, Oxford University Press.
4. Lipsey & Chrystel, Economics, Oxford University Press.
5. S. A. Siddiqui & A. S. Siddiqui , Managerial Economics & Financial Analysis, New Age International Space Publications.
6. Domnick Salvatore , Managerial Economics in a Global Economy, Thomson.
7. Narayanaswamy , Financial Accounting - A Managerial Perspective: PHI.

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METROLOGY AND INSTRUMENTATION

III Year – II Semester

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

Course Objectives

- To impart the principles of measurement of dimensional and geometric parameters of mechanical elements.
- To introduce working of various temparature, pressure, flow and strain measuring instruments.

Learning Outcomes

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

- determine tolerances and allowances to realize interchangeable manufacture.
- design of limit gauges.
- distinguish between line standards and end standards.
- apply the principles of interferometry in measurement of flatness and straightness.
- evaluate the surface roughness parameters.
- elaborate the basic principles of measurement systems.
- choose the appropriate instrument to measure the physical parameters like pressure, temperature, force, torque, displacement, speed and strain.

Course Content

UNIT - I:

Systems of limits and fits: Introduction, normal size, tolerance limits, deviations, allowance, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – Interchangeability, deterministic & statistical tolerance, selective assembly. International Standard system, limits and fits.

Limit Gauges: Taylor's principle – Design of go and No go gauges, plug, ring, snap, gap, taper, profile and position gauges.

UNIT - II:

Linear Measurement: Length standard, line and end standard, slip gauges – calibration of the slip gauges, Dial indicator, micrometers. Measurement of Angles and Tapers: Different methods – Bevel protractor – angle slip gauges – spirit levels – sine bar – Sine plate, rollers and spheres used to determine the tapers.

Optical Measuring Instruments: Tool maker's microscope and its uses – collimators, optical projector – optical flats and their uses. Interference of light, Michaleson's interferometer, NPL flatness interferometer and NPL gauge interferometer.

UNIT - III:

Flat Surface Measurement: Measurement of flat surfaces – instruments used – straight edges – surface plates – auto collimator. Surface Roughness Measurement : Differences between surface roughness and surface waviness-Numerical assessment of surface finish – CLA, R.M.S, Rz values, Methods of measurement of surface finish – profilograph, Talysurf

UNIT - IV:

Measuring Instruments – Measurement systems, generalized configuration and functional descriptions of measuring instruments, Static and Dynamic performance characteristics, sources of error - Classification and elimination of error.

Measurement of Displacement: Theory and construction of various transducers to measure displacement – Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers.

UNIT - V:

Measurement of Temperature: Classification – Ranges – Various Principles of measurement – Expansion, Electrical Resistance – Thermistor , Thermocouple , RTD, Optical and total radiation pyrometers.

Flow Measurement: Rotameter, magnetic, Ultrasonic, Turbine flow meter, Hot wire anemometer, Laser Doppler Anemometer (LDA).

Measurement of Speed: Mechanical Tachometers, Electrical tachometers, Stroboscope.

UNIT - VI:

Measurement of Force: Elastic force meters, load cells.

Measurement of Strain: Various types of strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge – bending, torque, compressive and tensile load, Strain gauge Rosettes.

Text Books

1. R.K. Jain, “Engineering Metrology”, Khanna Publishers.
2. BeckWith, Marangoni,Linehard, “ Mechanical Measurements”, 6th edition, PHI / PE.

Reference Books

1. Mahajan,”Engineering Metrology “,Danpath Rai Publications.
2. D.S.Kumar, “Measurement Systems: Applications & design”,Anuradha Agencies.
3. I.C.Gupta ,”Engineering Metrology”, Danpath Rai Publications.
4. Connie Dotson “Fundamentals of Dimensional Metrology 4e “,Thomson Publications.
5. Doeblin Earnest. O. Adaptation by Manik and Dhanesh,”Measurement systems: Application and design”, Tata Mc Graw Hill Publications.
6. S.Bhaskar, “Instrumentation and Control systems “, Anuradha Agencies.

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DESIGN OF MACHINE MEMBERS

III Year – II Semester

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

Course Objectives

- To impart the knowledge of the basic engineering design against static and fluctuating loads by considering strength and rigidity.

Learning Outcomes

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

- apply the concepts of design to perform stress analysis on members under the action of static and fluctuating forces
- design structural members having riveted, bolted and welded joints
- design various mechanical elements like cotter joints, bearings, springs.

Course Content

UNIT - I: Introduction

General considerations in the design of engineering materials and their properties – selection –manufacturing consideration in design, BIS codes of steels - preferred numbers.

Simple Stresses- axial, bending, shear, principal stresses, theories of failure.

UNIT - II: Design for Fatigue Strength

Fluctuating stresses – Introduction to cyclic loading, fatigue failure, S-N curve - endurance limit–estimation of endurance strength, stress concentration– theoretical stress concentration factor , fatigue stress concentration factor, notch sensitivity, design for finite and infinite life-Goodman's line , Soderberg's line , modified Goodman's line.

UNIT - III: Riveted Joint, Welded Joint and Bolted Joint

Riveted Joint: Types, efficiency of a riveted joint, eccentrically loaded riveted joints.

Welded Joint: Types, strength of parallel and transverse fillet weld, strength of welded joint subject to bending, Torsion, eccentrically loaded welded joints.

Bolted Joint – design of bolts with pre-tension – design of joints under eccentric loading

UNIT - IV: Design of Cotter and Knuckle Joints

Cotter joints-spigot and socket, sleeve and cotter, gib and cotter joints, knuckle joint.

UNIT - V: Journal Bearings, Ball and Roller Bearings

Journal Bearings: classification of bearings, journal bearing materials – full and partial bearings- lubrication – bearing modulus —heat dissipation of bearings – design of journal bearing.

Ball and Roller Bearings: classification and selection of ball and roller bearings, static and dynamic load rating, bearing life- reliability, load-life relations.

UNIT - VI: Springs

Springs: Classification, Stresses and deflections of helical springs – open and closed coiled springs– springs subjected to fatigue loading, co-axial springs, leaf springs.

Text Books

1. Joseph Edward Shigley, Charles R.Mischke , "Mechanical engineering design", TMH Publishers.
2. V.B.Bandari "Introduction to Machine Design", TMH Publishers.

Reference Books

1. Robert L.Norton, "Machine Design – An integrated approach", 2nd edition, Pearson education India
2. Dr. N.C. Pandya& Dr. C. S. Shah "Machine design" Charotar Publishing House Pvt. Limited.
3. Sadhu Singh, Design of Machine Elements, Khanna Publishers

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HEAT TRANSFER

III Year – II Semester

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

Course Objectives

- To introduce various modes of heat transfer and their significance in the design of various heat transfer equipment.

Learning Outcomes

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

- determine the rate of heat transfer through simple geometries in steady state and find the critical radius of insulation in case of steam pipes and electrical cables
- evaluate the rate of heat transfer from a finned surface and the time of cooling or heating in transient heat conduction problems
- compute convective heat transfer coefficients in forced and natural convection, both for internal and external flows
- find the convective heat transfer coefficient in boiling and condensation
- design a heat exchanger using LMTD or NTU method
- calculate the radiation heat exchange between the surfaces and interpret the significance of radiation shields.

Course Content

UNIT - I:

Introduction: Modes of heat transfer, Basic laws of heat transfer, applications of heat transfer.

Conduction Heat Transfer: Fourier Law of Heat conduction, General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates. Simplification and forms of the field equation, steady, unsteady heat transfer, Initial and boundary conditions.

One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders and spheres, Electrical Analogy, Composite slabs, cylinders and spheres, Thermal Contact Resistance, Critical radius of insulation, Variable Thermal conductivity, systems with heat generation.

UNIT - II

Extended surface (fin) Heat Transfer: Long Fin, Fin with insulated tip and Short Fin, Efficiency and effectiveness of fins.

One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance, Significance of Biot and Fourier Numbers, Chart solutions of transient conduction systems.

UNIT - III

Convective Heat Transfer: Classification of Convective Heat Transfer, Dimensional analysis- Buckingham Pi Theorem for forced and Natural convection, Continuity, Momentum and Energy Equations.

Forced convection: Concepts of hydrodynamic and thermal boundary layer, use of empirical correlations for forced convective heat transfer -Internal flows and External flows.

UNIT - IV

Free Convection: Development of Hydrodynamic and thermal boundary layer along a vertical plate, Use of empirical relations for Vertical plates and cylinders.

Heat Transfer with Phase Change:

Boiling: Pool boiling, Regimes - Nucleate boiling and Film boiling, Critical Heat flux, Flow boiling.

Condensation: Film wise and drop wise condensation, Film condensation on vertical and horizontal cylinders, using empirical correlations.

UNIT - V

Heat Exchangers: Classification, overall heat transfer Coefficient, fouling factor, Design of Heat Exchangers - LMTD and NTU methods.

UNIT - VI

Radiation Heat Transfer: Basic concepts, Emission characteristics, concept of black body, laws of black-body radiation **-** Planck's law, Wien's displacement law, Stefan Boltzmann law, radiation incident on a surface, solid angle and radiation intensity, lambert's cosine law, heat exchange between two black surfaces, shape factor, heat exchange between non-black surfaces, radiosity, electrical analogy for radiation networks, radiation shields.

Text Books

1. Yunus Cengel, Afshin Ghajar, "Heat and Mass Transfer", Tata McGraw Hill, 6th Edition.
2. P.K.Nag, "Heat And Mass Transfer", Tata Mc Graw Hill Publications, 3rd edition.

Reference Books

1. Incropera & Dewitt, "Fundamentals of Heat Transfer & Mass Transfer", John Wiley Publications, 6th edition.
2. J.P.Holman, "Heat transfer", Mc Graw Hill, 8th edition.
3. Ozisic M.Necati- "Heat transfer- A basic Approach", McGraw Hill company.

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Professional Elective - II

PRINCIPLES OF FINETE ELEMENT METHODS

III Year – II Semester

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

Course Objectives

- To familiarize with the basic concepts of finite element method and its applications to structural and heat transfer problems

Learning Outcomes

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

- derive displacement and stress-strain relationships and solve differential equations by variational and weighted residual methods.
- determine the elongation, stresses and strains in one dimensional bars and trusses subjected to different loads.
- determine the deflections in beams subjected to concentrated and distributed loads.
- compute stress and strains in two dimensional problems using constant strain triangle and iso parametric elements.
- analyze plate bending problems using bending elements.
- evaluate the temperature distribution in one dimensional thin plates and fins

Course Content

UNIT - I:

Introduction: stress and equilibrium, strain – displacement relations, stress – strain relations, plane stress and plane strain conditions, variational Rayleigh-Ritz and Galerkin weighted residual methods

Finite Element Method: Discretization, types of elements, interpolation functions, local and global coordinates, steps in finite element method, applications of finite element method.

UNIT - II:

Bars and trusses: One dimensional bar element - shape functions – stiffness matrix and load vector– assembly of matrices – treatment of boundary conditions, one dimensional quadratic element, stiffness matrix for plane truss, simple trusses problems.

UNIT - III:

Analysis of Beams: Beam element - shape functions and element stiffness matrix, load vector for concentrated and uniformly distributed load, simple problems on beams.

UNIT - IV:

Two Dimensional Problems: Finite element modeling of two dimensional problems – plane stress and plane strain , constant strain triangular element: strain and nodal displacement relations, load vectors for traction forces on the edges. isoparametric, subparametric and super parametric elements.

UNIT - V:

Plate bending elements: Bending of thin plates, formulation of triangular and rectangular elements, bending of thick plates-basic principles of formulation, shear locking.

UNIT - VI:

Steady state heat transfer analysis: One dimensional thermal analysis of thin plane walls, element conductivity matrix and load vector-assembly of matrices-treatment of boundary conditions, composite wall and analysis of a fin.

Text Books

1. Chandraputla, Ashok and Belegundu, "Introduction to Finite Elements in Engineering" Prentice – Hall.
2. JN Reddy, "Introduction to Finite Element Method", McGrawHill Education.

Reference Books

1. S.S. Rao, "The Finite Element Methods in Engineering",Butter Worth Hienmann Publishers.
2. Daryl L Logan, "A first course in finite element method", Cengage Learning.
3. P.Seshu , Finite Element Analysis, Prentice Hall Publishers.

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Professional Elective - II

ROBOTICS

III Year – II Semester

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

Course Objectives

- To familiarize with anatomy, kinematics, sensors and dynamics of a programmable machine, robot.

Learning Outcomes

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

- distinguish between fixed automation and programmable automation.
- identify various components of robot.
- select appropriate type of actuator for a joint.
- illustrate robot applications in manufacturing.
- analyze kinematics of a robot.
- develop equations of motion of a manipulator for a given application.
- create a trajectory plan for execution of a work cycle.

Course Content

UNIT - I:

Introduction: Automation and Robotics, Components of Robot – Mechanical manipulator-control system and end effectors-Types of end effectors — Requirements and challenges of end effectors classification of robots by coordinate system and control system. Control resolution, accuracy, repeatability and work volume of robot.

UNIT - II:

Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric &

stepper motors. Feedback components: position sensors – potentiometers, resolvers, encoders – Velocitysensors.

UNIT - III:

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading- Processing operations - spot and continuous arc welding & spray painting - Assembly and Inspection.

Future applications of robots.

UNIT - IV:

Motion Analysis: Homogeneous transformations as applicable to rotation and translation – Problems.

Manipulator Kinematics: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems.

UNIT - V:

Differential transformations and manipulator Jacobian – Problems,

Dynamics: significance of dynamic modelling of a robot, Lagrange – Euler formulation- LE formulation for inverted pendulum and two degree of freedom RR manipulator

Newton – Euler formulation –basic treatment.

UNIT - VI:

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint integrated motion

straight line motion – Robot programming, lead through programming and textual language programming.

Text Books

1. Groover M P ,"Industrial Robotics", TMH.
2. Mittal R K &Nagrath I J,"Robotics and Control", TMH.

Reference Books

1. Richard D. Klafter,"Robotic Engineering", Prentice Hall.
2. P. Coiffet and M. Chaironze,"An Introduction to Robot Technology", Kogam Page Ltd. 1983 London.
3. Asada,"Robot Analysis and Intelligence", Wiley Inter-Science.
4. John J Craig ,"Introduction to Robotics",Pearson Edu.
5. Mark W. Spong and M. Vidyasagar,"Robot Dynamics &Control",John Wiley & Sons (ASIA) Pvt Ltd.

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Professional Elective - II

AUTOMOBILE ENGINEERING

III Year – II Semester

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

Course Objectives

- To impart knowledge on IC engines, engine systems and combustion phenomenon.
- To familiarize with the various automotive systems such as transmission system, steering system, suspension system, braking system, safety systems and hybrid vehicles.

Learning Outcomes

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

- illustrate working of IC engine components.
- analyze the combustion phenomenon in S.I and C.I engines.
- explain transmission, suspension, steering and braking , and safety systems of an automobile.
- list out various emission norms and propose various emission control methods.
- describe the importance of hybrid vehicles.

Course Content

UNIT - I:

I.C. Engine Components: Construction and working of S.I and C.I engines, Engine Systems: Simple and modern Carburettors, Fuel Injection System, Ignition, Cooling and Lubrication, Super charging and Turbo charging.

UNIT - II:

Combustion in S.I. Engines: Stages of combustion, Effect of engine variables on Ignition lag and flame propagation, abnormal combustion- pre-Ignition and knocking, effect of engine variables on Knocking, Octane rating.

Combustion in C.I. Engines: Stages of combustion, Delay period and its importance, Effect of engine variables, Diesel Knock, Cetane rating, comparison of knocking in SI and CI engines.

UNIT - III:

Automobile components: Chassis, Body, Power unit, Power transmission- front wheel drive, rear wheel drive, four-wheel drive, classification of automobiles.

Transmission system: Functions and types of 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.

UNIT - IV:

Steering System: steering geometry, condition for correct steering, steering gears, power steering.

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

UNIT - V:

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

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

UNIT - VI:

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

Hybrid vehicles: Introduction, classification of electrical drive vehicles, types of hybrid vehicles, Concepts of hybrid electric drive train, series and parallel hybrid electric drive train, merits and demerits.

Text books

1. M. L. Mathur, R. P. Sharma "A Course in Internal Combustion Engines", Dhanpat Rai & Sons (2010).
2. Kirpal Singh, "Automobile Engineering Vol-1 & Vol-2", Standard Publishers Distributors, 11th edition.

Reference Books

1. V. Ganesan "Internal Combustion Engines", Tata McGraw Hill Education
2. William H Crouse & Donald L Anglin, Automotive Mechanics, Tata Mc Graw Hill Publications, 10th edition.
3. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, New York, 2011.
4. Jack Erjavec and Jeff Arias, "Hybrid, Electric and Fuel Cell Vehicles", Cengage Learning, 2012.

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Professional Elective - II

DATABASE MANAGEMENT SYSTEMS

III Year – II Semester

Lecture	: 4	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.

Learning Outcomes

Upon successful completion of the course, the 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 concepts", 3rd edition, MH.
2. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", 3rd edition, MH

Reference Books

1. Elmasri Navate, "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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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

BIO-MEDICAL 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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HEAT TRANSFER LAB

III Year – II Semester

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

Course Objectives

- To determine experimentally the conductive and radiating properties of materials and heat transfer coefficients in single and two phase flows.

Learning Outcomes

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

- determine conductive and radiating properties of materials and heat transfer coefficients in single and two phase flows.

List of Experiments

1. Determination of Thermal Conductivity of a given insulating powder.
2. Determination of Thermal Conductivity of a given liquid.
3. Determination of Thermal Conductivity of a lagged pipe.
4. Determination of efficiency of a pin-fin.
5. Determination of heat transfer coefficient in Transient Heat Conduction.
6. Determination of heat transfer coefficient in forced convection.
7. Determination of heat transfer coefficient in natural convection.
8. Determination of Emissivity of a test plate.
9. Determination of Stefan Boltzmann constant.
10. Determination of heat transfer coefficient in drop and film wise condensation.
11. Determination of Critical Heat flux during pool boiling.
12. Determination of overall heat transfer coefficient in a double pipe heat exchanger.

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METROLOGY AND INSTRUMENTATION LAB

III Year – II Semester

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

Any 6 experiments are to be conducted from each of the following

A) METROLOGY LAB

Course Objectives

- To impart hands on training in measuring methods and metrology instruments.

Learning outcomes

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

- operate equipment like tool maker's microscope, profile projector etc.
- use instruments like vernier callipers, bevel protractor etc.
- apply various metrology instruments in carrying out measurement of dimensional parameters.

List of Experiments

1. Measurement of lengths, heights, diameters by vernier callipers, micrometers etc.
2. Measurement of bores by internal micrometers and dial bore indicators.
3. Use of gear tooth vernier calliper for tooth thickness inspection and flange micro meter for checking the chordal thickness of spur gear.
4. Machine tool alignment test on the lathe.
5. Angle and taper measurements with bevel protractor, Sine bars, rollers and balls.
6. Use of spirit level in finding the straightness of a bed and flatness of a surface.
7. Thread inspection with two wire/ three wire method & tool makers microscope.
8. Surface roughness measurement with roughness measuring instrument.

B) INSTRUMENTATION LAB

Course Objectives

- To impart hands on training on calibration of various measuring instruments.

Learning outcomes

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

- calibrate the measuring instrument.

List of Experiments

1. Calibration of pressure gauge.
2. Calibration of LVDT transducer for displacement measurement.
3. Calibration of strain gauge.
4. Calibration of thermocouple.
5. Calibration of tachometer using photo pickup and magnetic pickup.
6. Calibration of resistance temperature detector.
7. Calibration of rotameter.

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COMPUTER AIDED ENGINEERING ANALYSIS LAB

III Year – II Semester

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

Course Objectives

- To impart hands on training for analysis of structural , vibration and fluid flow problems using analysis package.

Learning Outcomes

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

- analyze structural , vibration ,fluid flow and heat transfer problems using analysis package.

List of Experiments

1. 2- D truss analysis.
2. Static Analysis of Beam.
3. Static Analysis of 3-D structure.
4. Analysis of Axisymmetric Problem.
5. Analysis of Plane Stress problem.
6. Vibration analysis of beam.
7. Analysis and validation of laminar Flow / Turbulent flow through a Pipe.
8. Boundary layer Phenomenon over a flat plate.
9. Heat transfer through composite wall.
10. One-dimensional heat transfer through pin fin.
11. Forced convection with constant temperature / constant heat flux boundary condition.
12. Radiation and natural convection.

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Optional Elective - V

OBJECT ORIENTED PROGRAMMING THROUGH JAVA

III Year – II Semester

Lecture	: -	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.

Multithreading**-**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, checkbox group, choice, list, text field, 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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Optional Elective - V

MECHATRONICS

III Year – II 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 - V

EMBEDDED SYSTEM DESIGN

III Year – II Semester

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

Course Objectives

- To introduce the concepts of embedded system design and to show how such systems are developed using a concrete platform built around.

Learning Outcomes

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 (RT-level), 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), micro controllers 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.
2. Shibu.K.V, “Introduction to Embedded Systems” - Tata McGraw Hill Education Private Limited.

Reference Books

1. Raj kamal, “Embedded Systems”, 2nd edition , TMH.
2. Tammy Noergaard, “Embedded Systems Architecture”, 1st edition, Elsevier Publications.

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INDUSTRIAL ENGINEERING AND MANAGEMENT

IV Year – I Semester

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

Course Objectives

- To familiarize the significance of industrial engineering and its tools to enhance productivity of the systems.
- To introduce the principles and techniques for effective project management and personal management.

Learning Outcomes

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

- calculate the productivity of a system and use industrial engineering tools for enhancing productivity.
- choose a suitable inventory control policy and design suitable plant layout for a given application.
- determine the standard time of the job, interpret process charts, simo chat, and design appropriate workplace layout in light of principles of motion economy and ergonomics.
- evaluate the production process by applying the techniques of SQC.
- differentiate between job evaluation and merit rating and determine the earnings of the worker under various wage payment plans.
- determine the project duration, floats slack, probability of meeting the project schedule and crash the networks to find out optimum duration and optimum cost of the project.

Course Content

UNIT - I: Concepts of Industrial Engineering

Production, productivity, measures of productivity, definition of I.E, genesis and growth of industrial engineering. Significance of I.E, tools of I.E, Principles of scientific management, principles of modern management. functions of management.

UNIT - II: Materials management

Introduction, inventory- types of inventory, purchasing or procurement, buying techniques, the purchasing procedure, associated costs. **Inventory Control**-objectives, functions, inventory models- EOQ model (simple problems), ABC and VED analysis. **Plant layout**: principles of scientific layout, flow patterns, types of plant layout, features, applications and techniques for optimal design of layout.

UNIT - III: Work study

Concept – importance – genesis and growth of work study role of work study in productivity enhancement, work measurement – standard time and its computation, rating factor and techniques – types of elements in job breakdown, techniques of work measurement – time study, synthesis from elemental data, PMTS, analytical estimating, work sampling – applications of techniques, concepts of method study and motion study – procedure – recording techniques and tools, micro motion study — principles of motion economy – Therbligs-ergonomics.

UNIT - IV: Quality governance

Quality – significance, quality control-inspection– types of inspection- statistical quality control– significance-types of statistical quality control – techniques of SQC – control charts – importance – features of control charts – control charts for variables and attributes with numerical examples, sampling inspection – advantages – types of acceptance sampling plans – OC curve-process capability, fundamentals of TQM- ISO-9000.

UNIT - V: Human resource management

Personnel management Vs HRM, functions of human resource management – manpower planning, job analysis, recruitment, selection, induction, training and development, placement, wage administration, performance appraisal, transfer / promotion / dismissal, welfare administration, grievance handling and conflict management job evaluation objectives – types -applications. merit rating – objectives – types- applications. motivational theories- Maslow's hierarchy of needs theory, Herzberg's motivation theory, Douglas Mc-Gregor's Theory X and Y.

UNIT – VI: Project Management

Importance of project management –applications-bar charts & milestone charts – limitations – terminology-network rules-various network techniques-PERT and CPM-differences between CPM and PERT, critical path, determination of floats, standard deviation, variance and probability of completion of project-project crashing and numerical examples

Text Books

1. O.P.Kanna, "Industrial Engineering & Management ", Dhanpat Rai Publications.
2. Joseph G.Monks "Operations Management", Tata MC - Graw Hill.
3. T.R Banga N.K Agarwal, S.C Sharma," Industrial Engineering & Management Science" Khanna Publications.

Reference Books

1. Jack R. Meredith, Samuel J. Mantel, "Project management- A managerial approach" Wiley India Pvt Ltd.
2. Elwood S.Buffa and Rakesh K.Sani, "Modern production management" John Wiley & Sons Inc.
3. N.V.S. Raju," Industrial Engineering & Management", CENGAGE Learning.
4. Introduction to work study- ILO, 4^{th} Revised Edition, 1992.
5. L.S. Srinath "PERT And CPM Principles And Applications" Affiliated East-West Press (Pvt.) Ltd.

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CAD / CAM

IV Year – I Semester

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

Course Objectives

- To present the role of computers in design and manufacture

Learning Outcomes

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

- justify the role of computers in design and manufacturing.
- analyze the product cycle in the light of CAD/CAM.
- apply various transformations to manipulate a geometric model.
- illustrate various entities of wire frame, surface, and solid models.
- distinguish between a CNC machine and a conventional machine.
- develop part programs for CNC machine.
- formulate manufacturing cells based on similar attributes of parts.
- propose trends in manufacturing to improve the productivity

Course Content

UNIT - I:

Introduction: Brief review of conventional design process. Computers in design and Manufacturing, Product cycle in light of CAD / CAM, Hardware for CAD.

UNIT - II:

Computer Graphics: Raster scan graphics coordinate system, transformation of geometry, 3D transformations, mathematics of projections, line clipping, hidden surface removal, database requirements for CAD/CAM systems.

UNIT - III:

Geometric modeling: Requirements, types of geometric models, entities of wire-frame model-mathematical representation of line and circle. Significance of efficient algorithm to generate a curve. Synthetic curves-cubic spline and Bezier curves-continuity of curves Types of surfaces-brief treatment. Solid modeling-sweep representation, constructive solid geometry and boundary representation

UNIT - IV:

Numerical control: NC, NC modes, NC elements, NC machine tools, structure of CNC machine tools, features of Machining center, turning center, CNC Part Programming-manual part programming, and computer aided part programming.

UNIT - V:

Group Technology: Part family, coding and classification, production flow analysis, advantages and limitations, Computer Aided Processes Planning, Retrieval type and Generative type.

Flexible manufacturing systems: Types of Manufacturing systems, Machine tools and related equipment, material handling systems, computer control systems, human labor in the manufacturing systems, FMS benefits.

UNIT - VI:

Trends in manufacturing: Industrial Internet of things (IIoT), Cobotics, 3D printing, big data analytics.

Text Books

1. Zimmers & P.Groover, “CAD/CAM”, Pearson Education.
2. Ibrahim Zeid, “CAD / CAM Theory and Practice” Tata McGraw Hill Publication
3. The 3D Printing Handbook: Technologies, design and applications, by Ben Redwood,FilemonSchoffer Brian Garret – 3D Hubs
4. Industry 4.0 Industry Internet of things-Gilchrist, Alasdair

Reference Books

1. Groover,”Automation , Production systems & Computer integrated Manufacturing”, Pearson Education Publications.
2. Radhakrishnan and Subramanian,”CAD/CAM/CIM”, New Age International publications.

URL’s

Iot :

1. http://www2.itif.org/2016-ezell-iot-smartmanufacturing.pdf?_ga= 1.261819661.1089858538.1464487061
2. https://www.newgenapps.com/blog/8-uses-applications-and-benefits-of-industrial-iot-in-manufacturing
3. https://www.i-scoop.eu/internet-of-things-guide/internet-of-things-in-manufacturing/
4. https://www.happiestminds.com/Insights/industrial-iot/

Cobotics :

1. http://www.vinci-energies.com/en/its-already-tomorrow/towards-smart-industry/cobotics-when-people-and-robots-work-together/
2. https://fja.sciencesconf.org/conference/fja/Moulieres.pdf
3. http://jlaw.staff.shef.ac.uk/index.php/cobotics/
4. https://www.hcltech.com/blogs/cobotics-emergence-robots-ai-driven-business-transformation

Big Data Analytics:

1. www.allerin.com/blog/5-big-data-use-cases-in-the-manufacturing-industry
2. https://www.liaison.com/blog/2017/09/20/big-data-analytics-tools-manufacturing-industry/

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Professional Elective - III

OPTIMIZATION TECHNIQUES

IV Year – I Semester

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

Course Objectives

- To introduce quantitative techniques to solve resourse management problems.
- To know how to formulate allocation problems as LPP, transportation problem and assignment problems and locate solution.
- To familiarize with the concepts of queuing theory.
- To understand game theory concepts.

Course Outcomes

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

- formulate the problem as LPP and to find optimal solution.
- determine optimal distribution & optimal cost.
- find minimal sequence and total elapsed time.
- evaluate operating characteristics in queuing models.
- determine optimal strategies for players.

Course Content

UNIT - I: Linear Programming - I

Introduction to OR, definition, characteristics, Modelling in OR - Classification by structure, Linear Programming problem, Formulation, Solution by Graphical Method.

UNIT - II: Linear Programming - II

Standard form of LPP, Simplex Method, Artificial Variable Technique, Big-M method, Duality principle, Rules to convert primal to dual.

UNIT - III: Transportation-Assignment Problems (Allocation Methods)

Transportation problem – Balanced and Unbalanced, Finding IBFS(North West Corner Rule, Matrix minima Method, VAM) Optimal solution (MODI Method) Degeneracy.

Assignment problems-optimal solution by Hungarian method, Special cases - Unbalanced and maximal assignment problems, Travelling sales man Problem.

UNIT - IV: Job Sequencing

Introduction – Types of sequencing problems-Processing n jobs through two machines, Processing n jobs through three machines and Processing n jobs through m machines.

UNIT - V: Queuing Theory (Waiting line Theory)

Introduction - elements of Queuing system- Operating characteristics-Classification of queuing models: single channel-Poisson arrivals-exponential service times-with infinite and finite population capacity. Multi service channel with infinite queue size.

UNIT - VI: Game Theory

Introduction to game theory, Two Person Zero sum games, Maximin - Minimax principle, Solution of Games with and without saddle points, Dominance property and Graphical solution of 2Xn and mX2 games.

Text Books

1. Kanthi Swarup, P.K.Gupta and Man Mohan, Operations Research, 14^{th} edition, 2008, S. Chand & Sons New Delhi.
2. S.D. Sharma and Himanshu Sharma Operations Research, 15th edition, Kedarnath Ramnath Publishers, 2010.

Reference Books

1. Hamdy A. Taha, Operations Research, 8th edition, PHI Publications, 2008.
2. Billy E. Gillett, Introduction to Operations Research : A Computer-oriented Algorithmic Approach, Tata McGraw-Hill.

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Professional Elective - III

REFRIGERATION AND AIR CONDITIONING

IV Year – I Semester

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

Course Objectives

- To introduce the basic cycles of various refrigerating systems, their performance evaluation along with details of system components and refrigerant properties.
- To impart knowledge of psychrometric properties, processes which are used in air-conditioning systems for comfort and industrial applications.

Learning Outcomes

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

- describe the working of air refrigeration cycle and its application in aircrafts
- analyze various refrigeration cycles and evaluate their performance under various operating conditions
- classify various components of a refrigeration system
- select the most appropriate refrigerant for a given application and understand the impact of refrigerants on the environment
- estimate the psychrometric properties and analyze the psychrometric processes
- calculate the load acting on an air-conditioning system and select the appropriate process and equipment for the required comfort and industrial air-conditioning.

Course Content

UNIT - I:

Introduction: Need and Applications of refrigeration, Unit of refrigeration and C.O.P, Methods of refrigeration, Ideal and actual cycles of refrigeration.

Air Refrigeration: Bell Coleman cycle, Open and Dense air systems, Actual air refrigeration system. Refrigeration needs of Aircrafts - Air craft refrigeration systems - working and their analysis

UNIT - II:

Vapor Compression Refrigeration: Working principle and essential components of the plant, actual cycle, effect of sub-cooling, super-heating, evaporator and condenser pressures on system performance – use of p-h charts. Cascade refrigeration cycles - A two-stage cascade refrigeration system.

UNIT - III:

Refrigerants: Desirable properties, classification, Nomenclature, Ozone Depletion, Global Warming.

System Components: Classification and working of Compressors, Condensers, Evaporators and Expansion devices.

UNIT - IV:

Vapor Absorption System: Description and working of NH_3 – water system, Calculation of maximum COP and Description and working of Li Br –water (Two shell & Four shell) System, principle of operation of three fluid absorption system, salient features.

Steam Jet Refrigeration System - Working Principle and basic components and its analysis

Non conventional Refrigeration systems: (i) Thermoelectric refrigerator (ii) Vortex tube

UNIT - V:

Psychrometry & Pshchrometric Processes:

Review of Psychrometric Properties, Psychometric Processes: Sensible heating, sensible cooling, humidification and de-humidification, cooling and de-humidification, cooling with adiabatic humidification, heating and humidification, adiabatic mixing of two air streams.

Requirements of human comfort, concept of effective temperature, Comfort chart, Classification of equipment for cooling, heating, humidification and dehumidification.

UNIT - VI:

Design of Air-Conditioning systems: Characterization of Sensible and latent heat loads, Need for Ventilation, Consideration of Infiltration, Load concepts of RSHF, GSHF- Problems, Concept of ESHF and ADP. Comfort Air conditioning - summer air conditioning, winter air conditioning, Requirements of Industrial air conditioning, Air conditioning Load Calculations.

Text Books

1. C P Arora, "Refrigeration and Air Conditioning", Tata McGraw-Hill Education, 3rd edition.
2. S C Arora & Domkundwar, "A Course in Refrigeration and Air conditioning", Dhanpat Rai publications, 5th edition.
3. Manohar Prasad, "Refrigeration and Conditioning", New Age publications, Revised 2nd edition.

Reference Books

1. Dossat, "Principles of Refrigeration", Pearson Education.
2. Anantha Narayanan, "Basic Refrigeration and Air-Conditioning", Tata McGraw-Hill Education, 4th edition.

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Professional Elective - III

UNCONVENTIONAL MACHINING PROCESS

IV Year – I Semester

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

Course Objectives

- To impart the principles of non-traditional machining methods.

Learning Outcomes

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

- justify the need of non-traditional machining methods.
- elaborate the principle and mechanism of metal removal of various unconventional machining processes.
- interpret the various process parameters and their effect on Material Removal Rate of various unconventional machining processes.
- select appropriate unconventional machining process based on mechanism of metal removal.
- summarize the applications of different Unconventional Machining Methods.

Course Content

UNIT - I: Introduction

Need for non-traditional machining methods, classification of modern machining processes – considerations in process selection, applications. Ultrasonic machining – Elements of the process, mechanics of material removal, MRR process parameters, economic considerations, applications and limitations.

UNIT - II: Electro – Chemical Machining

Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM – Simple problems for estimation of metal removal rate, fundamentals of chemical, machining, advantages and applications, Electrostream drilling, shaped tube electrolytic machining.

UNIT - III: **Thermal Metal Removal Processes**

General principle and applications of Electric Discharge Machining, Electric Discharge Grinding and wire EDM – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, surface finish and machining accuracy, characteristics of spark eroded surface.

UNIT - IV: Exotic Machining Processes

Electron Beam Machining, Laser Beam Machining - Basic principle and theory, mechanics of material removal, process parameters, efficiency & accuracy, applications

UNIT - V: Plasma Machining

Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries.

UNIT - VI: Mechanical Methods

Abrasive jet machining, Water jet machining and abrasive water jet machining-Basic principles, equipments, process variables, mechanics of material removal, MRR, application and limitations. Magnetic abrasive finishing, abrasive flow finishing.

Text Books

1. Benedict, Non-traditional machining methods, CRC Press.
2. VK Jain , Advanced machining processes, Allied publishers.

Reference Books

1. Pandey P.C. and Shah H.S, Modern Machining Process TMH.
2. Bhattacharya A, New Technology , The Institution of Engineers, India.

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Professional Elective - III

TRIBOLOGY

IV Year – I Semester

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

Course Objectives

- To familiarize with the selection of lubricating system for different machine components

Learning Outcomes

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

- select the appropriate bearing materials.
- select the rolling element bearing for the given conditions.
- design hydrostatic, hydrodynamic and air lubrication systems used in bearings.
- minimize the boundary friction and dry friction.

Course Content

UNIT - I:

Introduction: Viscosity, flow of fluids, viscosity and its variation -absolute and kinematic viscosity, temperature variation, viscosity index determination of viscosity, different viscometers used.

Lubrication: Choice of lubricants, types of oil, grease and solid lubricants-additives- lubrication systems and their selection.

UNIT - II:

Selection of Rolling Element Bearings: Nominal life, static and dynamic capacity-equivalent load, probabilities of survival- cubic mean load -pre loading of bearings, conditioning monitoring using shock pulse method.

UNIT - III:

Hydrostatic Bearings: Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.

UNIT - IV:

Hydrodynamic bearings: Hydrodynamic theory of lubrication: Various theories of lubrication, petroffs equation, Reynold's equation in two dimensions -Effects of side leakage – Reynolds equation in three dimensions, Friction in sliding bearing, hydro dynamic theory applied to journal bearing, minimum oil film thickness, oil whip and whirl anti -friction bearing..

UNIT - V:

Air lubricated bearing: Advantages and disadvantages application to Hydrodynamic journal bearings, hydrodynamic thrust bearings. Hydrostatic thrust bearings. Hydrostatic bearing Analysis including compressibility effect

UNIT - VI:

Types of bearing materials and bearing oil pads: Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing, partial bearings -externally pressurized bearings. General requirements of bearing materials, types of bearing materials.

Text Books

1. Basu, SenGupta and Ahuja , Fundamentals of Tribology, PHI
2. Sushil Kumar Srivatsava , Tribology in Industry, S. Chand &Co.

Reference Books

1. Neale MJ, (Editor) “Tribology hand Book” ,Neumann Butterworths,1975.
2. Connor and Boyd , “Standard hand book of lubrication engineers” ASLE, McGraw Hill Book & Co.,1968.
3. Shigley J, E Charles, “Mechanical Engineering Design”, McGraw Hill Co.,6th Edition.

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Professional Elective - IV

TOTAL QUALITY MANAGEMENT

IV Year – I Semester

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

Course Objectives

- To familiarize with the concepts of Total Quality Management

Learning Outcomes

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

- investigate and analyze quality management issues in both manufacturing and service industry
- apply total quality management tools like Six sigma , QFD, Taguchi methods etc to improve quality and productivity.

Course Content

UNIT - I: Introduction

Quality and improvement, History and Stages of Evolution, Quality assurance, quality loss function, link between quality and productivity

UNIT - II: Quality Systems

Quality System – Elements, Quality Standards –Need of standardization- Bodies of standardization, ISO 9000- series - ISO 14000 series, Requirements and Benefits.

UNIT - III: Concepts of TQM

Definitions, Philosophy of TQM, Customer focus, Organization, Top management commitment, Contributions of Deming, Juran and Crosby to TQM

UNIT - IV: TQM systems

Quality policy deployment, Quality function deployment, Statistical Process Control-process chart-preparing and using control charts.

UNIT - V: TQM Tools and Techniques I

The seven traditional tools of quality, New management tools-Quality Circles, Bench Marking, KAIZEN, 5S, JIT.

UNIT - VI: TQM Tools and Techniques II

Taguchi analysis- loss function- Six Sigma approach-Application of six sigma approach to various industrial situations – Quality Function Development (QFD)-elements of QFD.

Text Books

1. Dale H.Besterfiled, at., “Total Quality Management”, Pearson Education Asia, Third Edition, Indian Reprint (2006).

2.Total Quality Management by Rose, J.E., Kogan Page Ltd., 1993.

Reference Books

1.The Essence of Total Quality Management by John Bank, PHI, 1993

2. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, 6th Edition, South-Western (Thomson Learning), 2005.

3. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd.,2006.

4. Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”, Prentice Hall (India) Pvt. Ltd.

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COMPUTATIONAL FLUID DYNAMICS

IV Year – I Semester

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

Course Objectives

- To equip students with the knowledge that is essential for application of computational fluid dynamics to solve engineering flow problems.
- To provide the essential numerical background for solving the partial differential equations governing the fluid flow.

Learning Outcomes

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

- analyze the mathematical representation of the governing equations of fluid flow.
- classify the partial differential equations
- express derivatives to difference equations through discretization techniques and solve the algebraic equations using iterative techniques
- transform the equations for grid generation and apply implicit/explicit techniques for solving partial differential equations
- solve one dimensional diffusion problems and convection - diffusion problems using finite difference techniques and finite volume method.

Course Content

UNIT - I:

Introduction: Computational Fluid Dynamics as a Research and Design Tool, Applications of Computational Fluid Dynamics.

Governing Equations of Fluid Dynamics: Introduction, Models of the flow - finite control volume, infinitesimal fluid element, Substantial Derivative, Divergence of Velocity, Three dimensional continuity, momentum and energy equations in differential and integral forms. Physical boundary conditions.

UNIT - II:

Mathematical behavior of partial differential equations: Introduction, Classification of Quasi-Linear Partial Differential Equations - Cramer's rule, Eigen value method, behavior of the different classes of differential equations - hyperbolic, parabolic and elliptical equations.

UNIT - III:

Basics Aspects of Discretization: Introduction to Finite Difference approach, Difference Equations, Explicit and Implicit Approaches, Errors and Stability Analysis, introduction to finite volume approach.

Solution Techniques for System of Algebraic Equations: iterative solution methods, direct method with Gaussian elimination, direct method with Tri-diagonal matrix algorithm.

UNIT - IV:

Grid Generation Techniques: Introduction, general transformation of the equations, Metrics and Jacobians, Stretched grids, Boundary - fitted coordinate systems

UNIT -V:

Applications of Finite Difference Method: Diffusion problem - One dimensional steady state heat conduction, transient heat conduction, One dimensional convection diffusion problems.

UNIT - VI:

Applications of Finite Volume Method: Diffusion problem - One dimensional steady state heat conduction, transient heat conduction, One dimensional convection diffusion problems.

Text Books

1. John D. Anderson, JR "Computational fluid dynamics The basic with applications", Mc Graw Hill international .
2. H. Versteeg, W Malalsekra , "An Introduction to Computational Fluid Dynamics The finite volume method", Pearson Publishers, 2nd Edition.

Reference Books

1. T. J. Chung - "Computational fluid dynamics", Cambridge university press.
2. Suhas V. Patankar, "Numerical heat transfer and fluid flow" Butter-worth Publishers
3. T. K Sengupta, "Fundamentals of Computational Fluid Dynamics", University Press.

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Professional Elective - IV

CONDITION MONITORING

IV Year – I Semester

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

Course Objectives

- To familiarize with the importance of types of maintenance with their limitations and the methods of condition monitoring in different industrial sectors.

Learning Outcomes

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

- apply different maintenance strategies for the need of plant maintenance to reduce the maintenance cost
- analyze the machine condition with the aid of measuring instruments
- select appropriate test for fault identification of given application
- carry out lubrication oil analysis and temperature analysis for given applications
- analyze the case study including the fault identification and root causes of malfunction.

Course Content

UNIT - I:

Maintenance: Introduction, maintenance strategies, introduction to condition monitoring. rotating machinery - machine faults and root causes, ISO Standards for vibration analysis.

UNIT - II:

Vibration Monitoring: Types and benefits of vibration analysis, vibration signature analysis, **Vibration Measuring Instruments :** Vibration transducers – displacement, velocity and acceleration transducers. vibrometer- introduction, laser vibrometer. accelerometers – piezo resistive, capacitive and inductive type.

UNIT - III:

Non-destructive Testing: Various techniques for fault detection, introduction to non-destructive testing, role of non-destructive testing in condition monitoring.

Flaw Detection: Discontinuity – origin and classification, ultrasonic testing and magnetic particle inspection.

UNIT - IV:

Wear Debris Analysis: Wear mechanisms, wear particles, wear process monitoring techniques – Ferrography - Applications, advantages and limitations, spectrometric oil analysis program (SOAP)

UNIT - V:

Temperature monitoring: Need for temperature monitoring, thermography, active and passive thermography, IR thermography, applications, advantages and limitations.

UNIT - VI:

Case studies: Gear box, induction motor, transformer, roller bearings, wind mill

Text Books

1. R.A. Collacott ," Mechanical Fault Diagnosis and Condition Monitoring ",John Wiley and Sons.

Reference Books

1. Isermann R., "Fault Diagnosis Applications", Springer-Verlag, Berlin, 2011.
2. Rao, J S., "Vibration Condition Monitoring", Narosa Publishing House, 2nd Edition, 2000.
3. Allan Davies,"Handbook of Condition Monitoring", Chapman and Hall, 2000.

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Professional Elective - IV

DESIGN OF TRANSMISSION ELEMENTS

IV Year – I Semester

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

Course Objectives

- To familiarize with the design of various machine elements for effective power transmission.

Learning Outcomes

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

- design the transmission elements like belts, ropes, chain drives, shafts, couplings gears, gearbox, power screws under different loading conditions.

Course Content

UNIT - I:

Flat belt Drives and Pulleys: Introduction to belt drives, belt materials, belt tensions, transmission of power by flat belt, design of flat belt drive and pulley.

V-Belt, Rope and Chain Drives: Design and selection of V- belt drives and rope drives, design of pulley for V-belt and rope drive, design of Chain drives.

UNIT - II:

Design of Shafts: Introduction**-** shaft sizes – BIS code - design of solid and hollow shafts for strength and rigidity – design of shafts for combined loading-torsion, bending and axial.

Design of Keys: Design of keys-stresses in keys.

Design of couplings: Muff, split muff, flanged and bushed pin coupling.

UNIT - III:

Design of power screws: Design of screw - Square, ACME, Buttress screws, design of nut, compound screw, differential screw.

UNIT - IV:

Design of Spur and Helical Gear Drives: Spur gears and helical gears – Forces, Lewis beam strength Equation, Wear load and Dynamic load.

UNIT - V:

Design of Bevel and Worm Gear Drives: Bevel gears and Worm gears – Forces, Lewis beam strength Equation, Wear load and Dynamic load.

UNIT - VI:

Gear box Design- Introduction – types – ray diagram, no. of speed calculation, design of multi speed gear box

Text Books

1. N.C. Pandya and C. S. Shah "Machine design" Charotar Publishing House Pvt. Limited.
2. V.B.Bandari "Introduction to Machine Design", TMH Publishers.

Reference Books

1. Joseph Edward Shigley, Charles R.Mischke , "Mechanical engineering design", TMH Publishers
2. Robert L.Norton, "Machine Design – An integrated approach", 2nd edition, Pearson education India.
3. T.V. Sundaraja Murthy, "Machine Design" Anuradha Publications.
4. Sadhu Singh, "Design of Machaine Elements" Khanna Publishers.

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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.,

Course Content

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 famialize 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", 2nd edition, Morgan Kaufman Publications.

Reference Books

1. Efraim Turban, Jay E Aronson, Teng-Peng Liang, Ramesh Sharda, "Decision Support and Business Intelligence Systems", 8th Edition, Pearson.
2. Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", 2nd edition, Morgan Kaufmann Publishers.
3. Larissa T. Moss and Shaku Atre, "Business Intelligence Roadmap: The complete Project Life Cycle of Decision Making", 1st 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, 4th 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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SIMULATION LAB

IV Year – I Semester

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

Course Objectives

- To provide hands on experience in MATLAB and to write simple codes to implement the numerical methods.
- To demonstrate the simulation of manufacturing processes using simulation package.
- To demonstrate the working principle and operation of CNC lathe, CNC Mill , Robot and 3D printer.

Learning Outcomes

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

- write MATLAB code for numerical methods used in solving ordinary and partial differential equations
- simulate manufacturing processes and produce simple components using CNC lathe , CNC Mill and 3 D printer.
- operate Robot and write code for Palletization of components.

List of Experiments

1. Determination of roots of the Algebraic equations using Newton Raphson Method.
2. Implementation of Newton's Forward Interpolation formula.
3. Implementation of Gauss Backward Interpolation formula.
4. Implementation of Langranges Interpolation formula.
5. Implementation of Numerical Differentiation methods.
6. To plot variation of displacement, velocity and acceleration of coupler and output link for four bar mechanism.
7. Solving boundary value and initial value problem differential equations with simulink model .
8. Simulation of manufacturing Processes.
9. Machining of Components using CNC Lathe.
10. Machining of Components using CNC Mill.
11. Palletization of objects using pick and place Robot.
12. Manufacturing of simple components using 3D Printer.

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Optional Elective - VII

BIG DATA ANALYTICS

IV Year – I 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

Big Data, Characteristics of Big Data - The Four V's, 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 MapReduce APIs, data flow, combiner functions, running a distributed map reduce job.

UNIT - IV: How Map Reduce works

Anatomy of a MapReduce 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”, 3^{rd} edition, O’Reilly.
2. Chuck Lam, “Hadoop in Action”, 1^{st} edition, Manning Publications.
3. Dirk deRoos, “Hadoop for Dummies”, 1^{st} edition, John Wiley & Sons.

Reference Books

1. Paul Zikopoulos, Chris Eaton, “Understanding Big Data Analytics for Enterprise Class Hadoop and Streaming Data”, 1^{st} edition, TMH.
2. Srinath Perera, Thilina Gunarathne, “Hadoop Map Reduce Cookbook”, Packt Publishing.

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Optional Elective - VII

COMPUTER ORGANIZATION AND ARCHITECTURE

IV Year – I Semester

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

Course Objectives

- To familiarize with organizational aspects of memory, processor and I/O.

Learning Outcomes

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

- identify different types of instructions.
- differentiate micro-programmed and hard-wired control units.
- analyze the performance of the hierarchical organization of memory.
- demonstrate various operations on fixed and floating point numbers.
- summarize different data transfer techniques.
- demonstrate the use of parallel processing.

Course Content

UNIT - I: Register transfer language and Micro operations

Introduction- Functional units, computer registers, register transfer language, register transfer, bus and memory transfers, arithmetic, logic and shift microoperations, arithmetic logic shift unit.

Basic Computer Organization and Design: Instruction codes, instruction cycle. register reference instructions, Memory – reference instructions, input – output and interrupt.

UNIT - II: CPU and Micro Programmed Control

Central Processing unit: Introduction, instruction formats, addressing modes.

Control memory, address sequencing, design of control unit - hard wired control, micro programmed control.

UNIT - III: Memory Organization

Memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, virtual memory.

UNIT - IV: Computer Arithmetic

Data representation- fixed point, floating point, addition and subtraction, multiplication and division algorithms.

UNIT - V: Input-Output Organization

Peripheral Devices, input-output interface, asynchronous data transfer, modes of transfer- programmed I/O, priority interrupt, direct memory access, Input –Output Processor (IOP).

UNIT - VI: Parallel Processing

Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline.

Multi Processors: Characteristics of multiprocessors, interconnection structures, inter processor arbitration, cache coherence.

Text Books

1. M. Moris Mano, "Computer Systems Architecture", 3rd edition, Pearson/PHI.

Reference Books

1. Carl Hamacher, Zvonks Vranesic, Safea Zaky, "Computer Organization", 5th edition, McGraw Hill.
2. William Stallings, "Computer Organization and Architecture", 6th edition, Pearson/PHI.
3. John L. Hennessy and David A. Patterson, "Computer Architecture a Quantitative Approach", 4th edition, Elsevier.

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Optional Elective - VII

CRYOGENICS

IV Year – I Semester

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

Course Objectives

- To study various fluid properties, applications, gas liquefaction systems, air separation techniques, Insulating materials, vacuum pumps used in cryogenics.

Learning Outcomes

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

- discuss various properties of fluids used in cryogenic industry
- describe various gas liquefaction systems
- analyze various gas separation systems
- explain various cryocoolers, heat exchangers
- analyze various vacuum pumps and list various insulating materials
- describe various instruments and sensors used in cryogenics field.

Course Content

UNIT - I:

Introduction to cryogenic engineering, Properties of cryogenic fluids - Hydrogen, Helium, Properties of materials at cryogenic temperature - Mechanical, Electrical, Thermal, super conducting properties.

UNIT - II:

Basics of Refrigeration and Liquefaction, Joule Thomson effect, J – T expansion of a real gas, Adiabatic expansion, Comparison of J – T and Adiabatic expansions, Gas liquefaction systems, Effect of heat exchanger effectiveness on liquefaction systems and Figure of merit.

UNIT - III:

Basics of Gas Separation, Ideal Gas Separation System , Properties of Mixtures and the Governing Laws , Principles of Gas Separation ,Rectification and Plate Calculations.

UNIT - IV:

Cryocoolers : Cryocooler fundamentals, Different types and their applications , Stirling, Pulse Tube, Gifford – McMahon Cryocoolers , Regenerators, Heat exchangers, Compressors.

UNIT - V:

Need of Vacuum in Cryogenics ,Vacuum Fundamentals, Conductance and Electrical Analogy, Pumping Speed and Pump Down Time, Classification and Types of Vacuum Pump, Cryogenic Insulators.

UNIT - VI:

Need of Cryogenic Instrumentation, Measurement of Thermo physical Properties, Various Sensors. Need for Safety, Basic Hazards, Protection from Hazards.

Text books

1. Randall F. Barron, “Cryogenics Systems”, Second Edition, Oxford University Press, New York (1985).
2. Timmerhaus, Flynn, “Cryogenic Process Engineering “, Plenum Press, New York (1989).
3. Pipkov, “ Fundamentals of Vacuum Engineering “, Mir Publishers, Moscow.

References Books

1. Thomas M. Flynn, “Cryogenic Engineering”, second edition, CRC press, New York (2005).
2. G.M Walker. “Cryocooler- Part 1 Fundamentals” Plenum Press, New York (1983).
3. G.M Walker. “Cryocooler- Part 2” Plenum Press, New York (1983).

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Professional Elective - V

DESIGN FOR MANUFACTURING AND ASSEMBLY

IV Year – II Semester

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

Course Objectives

- To familiarize with the design considerations for manufacturing and assembly.

Learning Outcomes

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

- apply the principles of design for manufacturing processes
- estimates the cost of dies, molds and machined components based on die life
- employ the design principles for manual assembly and automated assembly
- design typical assemblies using principles of design for X concepts
- use the design rules for machining with single point and multi point cutting tools.

Course Content

UNIT - I: Design for Manufacturing

Overview of the DFM Process, Reduce the cost of manufacturing process, understanding the process and constraints, standard components and process, consider the impact of DFM decisions and other factors.

UNIT - II: Design Consideration in Metal Casting

Mold and gating system design, directional solidification, trouble shooting and ease of assembly and automation.

UNIT - III: Design Considerations for Welding and Forging

Consideration of defects, minimization of the residual stresses and ease of assembly and automation.

UNIT - IV: Design Considerations for Sheet Metal and Powder Metal Process

Consideration of defects, minimization of the residual stresses and ease of assembly and automation.

UNIT - V: Design Considerations in Machining

By considering machinability, geometric factors, cutting conditions and ease of assembly and automation.

UNIT - VI: Selection of Materials

Selection of materials for engineering applications using properties, process, shape, charts, ranking and choice.

Text Books

1. George E. Dieter, “Engineering Design” ,McGraw Hill International, 4th Edition.

Reference Books

1. Geofrey Boothroyd, Peter Dewhurst, “Product Design for Manufacture and Assembly”, CRC Press, 3rd Edition.
2. O. Molloy , “Design for Manufacturing and Assembly: Concepts, Architectures and Implementation”,Chapman and Hall, 1st Edition.

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Professional Elective - V

PRODUCTION PLANNING AND CONTROL

IV Year – II Semester

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

Course Objectives

- To elucidate the objectives and functions of PPC department for effective running of a production system.

Learning Outcomes

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

- explain the objectives and functions of PPC.
- appraise different forecasting techniques and estimate the future demand of the product.
- optimize the inventory parameters to minimize the total variable cost.
- determine optimum production schedule.
- illustrate the duties of dispatcher and functions of follow up and outline the role of computers in PPC.
- apply modern management tools for effective planning of a production system.

Course Content

UNIT - I: Introduction

Definition-objectives and functions of production planning and control-elements of production control-organization of production planning and control department-internal organization of PPC department, types of production.

UNIT - II: Forecasting

Forecasting-importance of forecasting-types of forecasting, their uses-general principles of forecasting-forecasting techniques-qualitative methods and quantitative methods.

UNIT - III: Inventory Management

Inventory management-functions of inventories-relevant inventory costs-EOQ models-inventory control systems-P-System and Q-System - ABC analysis-VED analysis

UNIT - IV: Routing, Scheduling and Sequencing

Routing-definition-routing procedure, factors affecting routing procedure, Scheduling-definition-difference with loading, scheduling policies & techniques, standard sequencing methods, Johnson's algorithm (n job two m/c and n job three m/c).

UNIT - V: Dispatching and Follow-up

Dispatching-activities of dispatcher-dispatching procedure, Follow-up-definition-functions-types of follow up, Applications of computer in production planning and control.

UNIT - VI: Modern Production Management Tools

MRP, ERP, overview of JIT, Push/Pull production, Kanban system, Kaizen system, SCM.

Text Books

1. Samuel Eilon "Elements of Production Planning and Control" Collier Macmillan Ltd.
2. R. Panneerselvam "Production and Operations Management", 5th edition, PHI.

Reference Books

1. S.N.Chary " Production and Operations Management" 5th Edition, McGraw Hill
2. Mukhopadhyay,S.K. "Production Planning and Control Text and Cases", PHI.
3. John E. Biegel "Production Control A Quantitative Approach" Prentice Hall.
4. Daniel Sipper and Robert Bulfin "Production Planning, Control and Integration" McGraw Hill.

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Professional Elective - V

POWER PLANT ENGINEERING

IV Year – II Semester

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

Course Objectives

- To introduce the working of various power plants.
- To familiarize with estimation of unit power cost and factors affecting it.

Learning Outcomes

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

- identify the various conventional energy resources.
- explain the working principles of various power plants used in electric power generation.
- estimate unit power cost under specified conditions.
- list out power plant effluents and their impact on environment.

Course Content

UNIT - I:

Introduction to the Sources of Energy – Resources and Development of Power in India.

Steam Power Plant: Plant Layout, Components, Working of different Circuits.

Coal Handling Systems: Types of fuels, Coal handling, Choice of coal handling equipment.

Air handling system: Induced and forced draught systems.

UNIT - II:

Combustion Process: Methods of Coal firing, Overfeed and Underfeed stoker firing - Principles and types of stoker firing systems, Pulverized fuel firing - Principle, Types of burners and Mills, Fluidized Bed Combustion, Cyclone Burner.

Ash and Dust handling: Types of Ash handling systems, Working principles of various Dust collectors.

Cooling towers: Types of Cooling towers and their working.

UNIT - III:

Gas Turbine Plant: Introduction, Types of Gas Turbine Plants, Layout with auxiliaries, Principles of working of Closed and Open Cycle Gas Turbines. Combined cycle Gas Turbine power plants, Cogeneration.

Diesel power plant: Introduction- Plant layout with auxiliaries, Fuel supply system, Lubrication and Cooling system.

UNIT - IV:

Nuclear Power Station: Nuclear fuel, Nuclear Chain Reaction, Breeding and fertile materials, Nuclear reactor- Reactor Operation.

Classification of Nuclear Reactors: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast Breeder Reactor, CANDU Reactor, Homogeneous Reactor, Gas cooled Reactor.

Radiation Hazards and Shielding, Radioactive Waste Disposal.

UNIT - V:

Hydrology: Water power, Hydrological cycle, run off measurement, Hydrographs, drainage area characteristics.

Hydroelectric Power Plant: Classification of Hydroelectric Power Plants, Typical Layouts, Plant auxiliaries, Classification of dams and spill ways.

UNIT - VI:

Power Plant Economics: Capital cost, investment of fixed charges, operating costs, Load curves, and load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor and related exercises.

Environmental Aspects of Power Generation: Effluents from power plants and their impact on environment, Pollutants and Pollution standards, Methods of Pollution control.

Text Books

1. G.D. Rai, “An Introduction to Power Plant Technology”, Khanna Publishers, 2004, 3rd Edition.
2. P.K.Nag, “Power Plant Engineering”, 2nd Edition, Tata McGraw-Hill Education, 2014, 4th Edition.

Reference Books

1. S.C. Arora and S. Domkundwar “A Course in Power Plant Engineering”, Dhanpat Rai & Co. (P) Limited, 2014.
2. R. K. Rajput, “A Text Book of Power Plant Engineering”, Laxmi Publications, New Delhi, 2016, 4th Edition.
3. M.M.El-Wakil, “Power Plant Technology”, Tata McGraw-Hill Education, Revised 2nd edition.

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Professional Elective - V

THEORY OF ELASTICITY

IV Year – II Semester

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

Course Objectives

- To familiarize with the basic concepts of theory of elasticity

Learning Outcomes

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

- determine stress distribution and strain components for simple and symmetric problems
- analyze three dimensional problems using equilibrium and compatibility equations
- determine stresses induced in beams of different cross sections
- apply concepts of plasticity to determine the shear stresses and strain energy.

Course Content

UNIT - I:

Elasticity: Introduction: Elasticity - notation for forces and stress - components of stresses - components of strain - Hooks law. Plane stress and plane strain analysis - differential equations of equilibrium - boundary conditions – Strain Displacement Relations - compatibility equations - stress function

UNIT - II:

Two dimensional problems in rectangular coordinates - solution by polynomials - SaintVenants principle - determination of displacements - bending of simple beams – Simple Supported and Cantilever Beam.

UNIT - III:

Two dimensional problems in polar coordinates - stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar coordinates - displacements for symmetrical stress distributions Edge Dislocation - general solution of two-dimensional problem in polar coordinates - application to Plates with Circular Holes – Rotating Disk.

UNIT - IV:

Analysis of Stress and Strain in Three Dimensions: Analysis of stress and strain in three dimensions - principal stress - stress ellipsoid - director surface - determination of principal stresses Stress Invariants - max shear stresses Stress Tensor – Strain Tensor- Homogeneous deformation - principal axes of strain-rotation. **General theorems:** Differential equations of equilibrium - conditions of compatibility - determination of displacement - uniqueness of solution - reciprocal theorem Strain Energy.

UNIT - V:

Bending of Prismatic Bars: Stress function - bending of cantilever beam - beam of rectangular cross-section - beams of circular cross-section.

UNIT - VI:

Torsion of Circular Shafts - Torsion of Straight Prismatic Bars – Saint Venants Method - torsion of prismatic bars - bars with elliptical cross sections - membrane analogy - - solution of torsional problems by energy method - torsion of shafts, tubes , bars etc.Torsion of Rolled Profile Sections.

Text Books

1. S.P. Timoshenko & J.K Goodier , "Theory of Elasticity", McGraw-Hill,3rd Edition.
2. "Applied Elasticity" by C.T. Wang.

Reference Books

1. Theory of Plasticity by J.Chakarbarthy, McGrawhill Publications.
2. E.P. Unksov ,"An Engineering Theory of Plasticity", Butterworths scientific publications,1961.
3. Hoffman and Sacks , "Theory of Plasticity" , McGraw-Hill, New York, 1953.

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Professional Elective - VI

RAPID PROTOTYPING

IV Year – II Semester

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

Course Objectives

- To familiarize with rapid prototype tools and techniques for design and Manufacturing.

Learning Outcomes

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

- assess the need of RPT in Product development.
- use appropriate RT Software for development of Prototype model.
- judge the correct RP Process for Product/Prototype development.
- predict the technical challenges in 3D printing.
- list the applications of RPT.

Course Content

UNIT - I:

Introduction to Rapid Prototyping: Introduction to prototyping, traditional prototyping Vs. rapid prototyping (RP), need for time compression in product development, usage of RP parts, generic RP process, distinction between RP and CNC, other related technologies, classification of RP.

UNIT - II:

RP Software: Need for RP software, MIMICS, magics, surgiGuide, 3D-doctor, simplant, velocity2, voxim, solidView, 3Dview, etc., software.

Software Issues of RP: Preparation of CAD models, problems with STI, files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP.

UNIT - III:

Photopolymerization RP Processes: Sterolighography (SL), SL resin curing process, SL scan patterns, microstereolithography, applications of photopolymerization processes.

Powder Bed Fusion RP Processes : Selective laser sintering (SLS), powder fusion mechanism and powder handling, SLS metal and ceramic part creation, electron beam melting (EBM), applications of powder bed fusion processes.

UNIT - IV:

Extrusion-Based RP Systems: Fused deposition modelling (FDM), principles, plotting and path control, applications of extrusion-based processes.

Printing RP Processes: 3D printing (3DP), research achievements in printing deposition, technical challenges in printing, printing process modeling, applications of printing processes.

UNIT - V:

Sheet Lamination RP Processes: Laminated Object Manufacturing (LOM), ultrasonic consolidation (UC), gluing, thermal bonding, LOM and UC applications.

Beam Deposition RP Processes: Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), processing – structure - properties, relationships, benefits and drawbacks.

UNIT - VI:

Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, classification of rapid tooling, direct and indirect tooling methods, soft and hard tooling methods.

Errors in RP Processes: Pre-processing, processing, post-processing errors, part building errors in SLA, SLS, etc.,

RP Applications: Design, engineering analysis and planning applications, rapid tooling, reverse engineering, medical applications of RP.

Text Books:

1. Chua Chee Kai., Leong KahFai., Chu Sing Lim, “Rapid Prototyping: Principles and Applications in Manufacturing”, World Scientific

Reference Books

1. Ian Gibsn., David W Rosen., Brent Stucker., “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
2. Pham, D.T, Dimov, S.S, Rapid Manufacturing, Springer, 2001.

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Professional Elective - VI

GAS DYNAMICS AND JET PROPULSION

IV Year – II Semester

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

Course Objectives

- To analyze and solve basic problems of Subsonic and Supersonic flows of compressible fluids with Friction and Heat transfer.
- To estimate the thrust and specific impulse of a propeller engine from fluid and thermodynamic principles.

Learning Outcomes

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

- explain the physics involved in the equations of compressible one dimensional flows
- analyse one dimensional flows including shock wave with heat addition and friction.
- analyse the effect of shock waves on compressible flows
- classify propulsion engines and describe their working
- analyze the working principle of Jet and rocket engines and draw its performance characteristics.

Course Content

UNIT - I:

Definitions and basic Relations: Energy equation for flow processes, stagnation-pressure, density, temperature, velocity, Mach number, Critical Mach number, Mach Cone, Mach angle, effect of Mach number on compressibility.

Basic Equation of compressible Flow: Energy and Momentum equations for compressible fluid flow, type of waves, Wave propagation, Velocity of Sound, Subsonic and Supersonic Flow.

UNIT - II:

Steady -one dimensional Flow: Fundamental Equations, Discharge from a Reservoir, Stream tube, Area–Velocity Relation, De-laval Nozzle, diffusers, dynamic head, Measurement in Compressible Flow, Pressure Coefficient.

UNIT - III:

Normal Shock Waves: Equation of Motion for Normal Shock Waves, Normal Shock Relations, total pressure across the shock wave, determination of Mach number of supersonic flows

Oblique Shock Waves: Nature of flow through Oblique shock wave, Relations, Prandtl's equation, variation of flow parameters, Oblique Shock Relations from the normal shock equation,

UNIT - IV:

Flow with Friction: Flow in constant area duct with friction, Fanno line, Fanno flow equations, variation of flow properties,.

Flow with Heat Transfer: Flow with heating or cooling in ducts, Rayleigh line, Fundamental Equations, Rayleigh flow relations, variation of flow properties.

UNIT - V:

Propulsion: Air craft propulsion- types of jet engines- energy flow through jet engines, thrust, thrust power and propulsive efficiency, turbojet components-diffuser, compressor, combustion chamber, turbines, exhaust systems.

UNIT - VI:

Performance of Jet Propulsion Engines: Performance of turbo propeller engines, ramjet and pulsejet, scramjet engines.

Rocket propulsion- types of rocket engines, solid and liquid propellant rockets-hybrid propellant rockets, nuclear propellant rockets, propellants, analysis of rocket propulsion.

Text Books

1. S.M. Yahya, "Fundamentals of compressible flow", New Age international publications, 3rd edition.
2. E Rathakrishnan, "Gas Dynamics", Prentice Hall of India, 6th edition.

Reference Books

1. Bird G A, "Molecular Gas Dynamics and the Direct Simulation of Gas Flows", Vol-I, Oxford University, Clarendon Press.
2. Zucrwo M.J. and Hoffman J.D. "Gas Dynamics", Vol-I & Vol-II, John Wiley and Sons Inc.
3. Yahya. S.M., "Fundamental of compressible flow with Aircraft and Rocket Propulson" New Age International (p) Ltd., New Delhi, 4th edition.

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Professional Elective - VI

AUTOMATION IN MANUFACTURING

IV Year – II Semester

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

Course Objectives

- To introduce various stratagies of automation in manufacturing.

Learning Outcomes

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

- explain automation strategies and transport mechanisms in automated flow lines.
- analyze the automated flow lines with and without buffer storage.
- choose appropriate material handling system for a given application.
- explain the principles of AS/RS and carousel storage systems.
- describe the ACO and ACC strategies to reduce the machine time.
- demonstrate the automated inspection methods.

Course Content

UNIT - I: Introduction

Production system – Automation in Production System – Elements of automated system – Levels of automation - Types of Automation – Auomation principles and strategies. Automated Flow Lines: Configurations of AFL - Methods of part transport - Transfer mechanism - Buffer storage – System design considerations

UNIT - II: Analysis of Automated Flow Lines

General terminology and analysis of transfer Lines without buffer storage – upperbound approach and lowerbound approach - analysis of automated flow lines with buffer storage – analysis of two stage transfer line – analysis of more than two stages - partial automation – analysis – cost calculations.

UNIT - III: Automated Material Handling

Introduction – Design considerations in material handling - Types of equipment - Material transport equipment – AGVS – Conveyors – Hoists and cranes - analysis of material transport systems – vehicle based systems – conveyor analysis.

UNIT - IV: Automated Storage Systems

Automated storage and retrieval systems – Reasons for automating storage operations – Types of AS/RS – Applications of AS/RS – Carousel storage systems – Analysis of storage systems.

UNIT - V: Adaptive Control Systems

Introduction, adaptive control with optimization, Adaptive control with constraints, Application of A.C. in Machining operations. Use of various parameters such as cutting force, temperature, vibration and acoustic emission.

UNIT - VI: Automated Inspection

Fundamentals of Inspection – Types of inspection – Inspection procedure – Automated inspection – Off line and On-line inspection - Fundamentals types of inspection methods and equipment – CMM - Machine vision.

Text Books

1. Groover.M.P,"Automation, Production Systems and Computer Integrated Manufacturing", Pearson Publications.

Reference Books

1. Yoram Coren, "Computer Control of Manufacturing Systems", Tata McGraw Hill.
2. P. Radhakrishnan & N.Subhrammanyan, "CAD/CAM/CIM", Digital Design Publications.
3. W. Buekinsham, "Automation", PHI Publications, 3rd edition.
4. D.Y Pham & S.S Dimav Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, Springer Publication.

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NON DESTRUCTIVE TECHNIQUES

IV Year – II 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.,

Course Content

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, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry, 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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