# ACADEMIC REGULATIONS

# COURSE STRUCTURE AND

# DETAILED SYLLABUS

# MECHANICAL ENGINEERING

**B.TECH 4 YEAR UG COURSE**

(Applicable for the batches admitted from 2018-2019)

**REGULATION: R18**

(I, II, III & IV Year Syllabus)

**J.B. INSTITUTE OF ENGINEERING & TECHNOLOGY**
**UGC AUTONOMOUS**
Bhaskar Nagar, Yenkapally, Moinabad Mandal, R.R. District,
Hyderabad – 500 075, Telangana State, India
Email: principal@jbiet.edu.in, Website: www.jbiet.edu.in

**J.B. INSTITUTE OF ENGIEERING & TECHNOLOGY**
**UGC AUTONOMOUS**
**Institute Vision & Mission**

**Vision**

To be a centre of excellence in engineering and management education, research and application of knowledge to benefit society with blend of ethical values and global perception.

**Mission:**

- To provide world class engineering education, encourage research and development.
- To evolve innovative applications of technology and develop entrepreneurship.
- To mould the students into socially responsible and capable leaders.

**DEPARTMENT OF MECHANICAL ENGINEERING**
**Department Vision and Mission**

**Vision**

To nurture excellence in the field of Mechanical engineering by imparting technical core values and instruction to the learners and to mold the department into a center for academic excellence through promoting higher education and advanced research to provide technical services at global competence.

**Mission**

- To impart highest quality education to the students to build their capacity and enhancing their skills to make them globally competitive mechanical engineers and maintain state of art research facilities to provide collaborative environment that stimulates faculty, staff and students with opportunities to create, analyze, apply and disseminate knowledge.

- To develop alliances with national level R&D organizations, educational institutions, industry and alumni for excellence in teaching, research and placements.

- To provide the students with academic environment of excellence, leadership, ethical, social guidelines and lifelong learning needed for a long self-employment career.

**J.B. INSTITUTE OF ENGINEERING AND TECHNOLOGY**
**UGC AUTONOMOUS**
**Bhaskar Nagar, Yenkapally, Moinabad, Hyderabad – 500075, Telangana, India**

# ACADEMIC REGULATIONS FOR B.TECH. REGULAR STUDENTS

## WITH EFFECT FROM ACADEMIC YEAR 2018-19 (R-18)

### 1.0 Under-Graduate Degree Programme in Engineering & Technology (UGP in E&T)

J.B.Institute of Engineering and Technology (JBIET) offers a 4-year (8 semesters) **Bachelor of Technology** (B.Tech.) degree programme, under Choice Based Credit System (CBCS) with effect from the academic year 2018-19 in the following branches of Engineering:

| Sl. No. | Branch |
|---|---|
| 1 | Civil Engineering |
| 2 | Electrical and Electronics Engineering |
| 3 | Mechanical Engineering |
| 4 | Electronics and Communication Engineering |
| 5 | Computer Science and Engineering |
| 6 | Information Technology |
| 7 | Electronics and Computer Engineering |
| 8 | Mining Engineering |

### 2.0 Eligibility for admission

**2.1** Admission to the under graduate (UG) programme is made either on the basis of the merit rank obtained by the qualified student in entrance test conducted by the Telangana State Government (EAMCET) or on the basis of any other order of merit approved by the University, subject to reservations as prescribed by the government from time to time.

**2.2** The medium of instructions for the entire under graduate programme in Engineering & Technology will be **English** only.

### 3.0 B.Tech. Programme structure

**3.1** A student after securing admission shall complete the B.Tech. programme in a minimum period of **four** academic years (8 semesters), and a maximum period of **eight** academic years (16 semesters) starting from the date of commencement of first year first semester.

Each student shall secure 160 credits (with CGPA ≥ 5) required for the completion of the under graduate programme and award of the B.Tech. degree.

**3.2** **UGC/AICTE** specified definitions/descriptions are adopted appropriately for

various terms and abbreviations used in these academic regulations/norms, which are listed below.

### 3.2.1 Semester Scheme

Each undergraduate programme is divided into 4 academic years (8 semesters) with each semester of 22 weeks of duration (16 weeks for instruction), each semester having 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Promotion System (CBPS) as indicated by UGC and curriculum/course structure as suggested by AICTE are followed.

### 3.2.2 Credit Courses

All subjects/courses are to be registered by the student in a semester to earn credits which is assigned to each subject/course in an L: T: P: C (lecture periods: tutorial periods: practical periods: credits) structure based on the following general pattern.

- One credit for one hour/week/semester for theory/lecture (L) courses or tutorials.
- One credit for two hours/week/semester for laboratory/practical (P) courses.

Courses like Environmental Science, Constitution of India, Intellectual Property Rights, and Gender Sensitization lab are mandatory courses. These courses will not carry any credits.

### 3.2.3 Subject Course Classification

All subjects/courses offered for the under graduate programme in E&T (B.Tech. degree programmes) are broadly classified as follows. The College has followed almost all the guidelines issued by AICTE/UGC.

| S. No. | Broad Course Classification | Course Group / Category | Course Description |
|---|---|---|---|
| 1 | Foundation Courses (FnC) | BS – Basic Sciences | Includes Mathematics, Physics and Chemistry subjects |
| 2 | | ES-Engg Sciences | Includes fundamental engineering subjects |
| 3 | | HS – Humanities and Social sciences | Includes subjects related to humanities, social sciences and management |
| 4 | Core Courses (CoC) | PC – Professional Core | Includes core subjects related to the parent discipline/ department/ branch of Engineering. |

| | | | |
|---|---|---|---|
| 5 | | Project Work | B.Tech. project or UG project or UG major project or Project Stage I & II |
| 6 | | Industrial training/ Mini-project | Industrial training/ Summer Internship/ Industrial Oriented Mini-project/Mini-project |
| 7 | Elective Courses (EℓC) | PE – Professional Electives | Includes elective subjects related to the parent discipline/department/branch of Engineering. |
| 8 | | OE – Open Electives | Elective subjects which include inter- disciplinary subjects or subjects in an area outside the parent discipline/department/branch of Engineering. |
| 9 | | Seminar | Seminar/Colloquium based on core contents related to parent discipline/ department/ branch of Engineering. |
| 10 | Minor courses | - | 1 or 2 Credit courses (subset of HS) |
| 11 | Mandatory Courses (MC) | - | Mandatory courses (non-credit) |

**4.0 Course registration**

**4.1** A 'faculty advisor or counselor' is assigned to a group of 20 students, who will advise the students about the under graduate programme, its course structure and curriculum, choice/option for subjects/ courses, based on their competence, progress, pre-requisites and interest.

**4.2** A student is allowed to register for 160 credits in completion of B.Tech programme. However, they can register for additional credits (above 160 credits). The additional credits scored shall not be considered for award of division and also not considered for calculation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA). For such extra course(s) registered, a certificate will be issued with a letter grade indicated as a performance measure.

**4.3** **Open Electives**: The students have to choose requisite number of open electives (as prescribed in the course structure) from the list of open electives given. However, the student cannot opt for an open elective subject offered by his own (parent) department, if it is already listed under any category of the subjects offered by parent department in any semester.

**4.4** **Professional Electives**: The students have to choose requisite number of professional electives (as prescribed in the course structure) from the list of professional electives given.

**5.0 Subjects/ courses to be offered**

**5.1** A typical section (or class) strength for each semester is 60.

**5.2** A subject/ course may be offered to the students, **only if** a minimum of 30 students (1/2 of the section strength) opt for it. The maximum strength of a section is limited to 80 (60 + 1/3 of the section strength).

**5.3** More than one faculty member may offer the same subject (lab / practical may be included along with the corresponding theory subject in the same semester) in any semester. However, the selection of choice for students will be based on - 'first come, first serve basis and CGPA criterion' (i.e. first focus is on early on-line entry from the student for registration in that semester, and the second focus, if needed, will be on CGPA of the student).

**5.4** If more entries for registration of a subject come into a picture, then the Head of the Department concerned shall decide, whether or not to offer such a subject/ course (Professional Elective and Open Electives) for **two (or multiple) sections**.

**6.0 Attendance requirements:**

**6.1** A student is eligible to appear for the semester end examinations, if the student acquires a minimum of 75% of attendance in aggregate of all the subjects / courses (excluding attendance in mandatory courses) for that semester.

**The attendance of Mandatory Non-Credit courses should be maintained separately.**

**6.2** Shortage of attendance in aggregate up to 10% (65% and above, and below 75%) in each semester may be condoned on medical grounds by the committee comprising of HOD of Concerned Department, Class incharge and 2 senior faculty members.

**6.3** A stipulated condonation fee is payable for condoning of shortage of attendance. This fee will be informed time to time by the college administration.

**6.4** Shortage of attendance below 65% in aggregate shall in **no** case be condoned.

**6.5** A student detained in a semester due to shortage of attendance may be readmitted in the same semester in the next academic year for fulfillment of academic requirements. The academic regulations under which a student has been readmitted shall be applicable. However, no grade allotments or SGPA/ CGPA calculations will be done for the entire semester in which the student has been detained.

**6.6** A student fulfilling the attendance requirement in the present semester shall not be eligible for readmission into the same class.

**7.0 Academic requirements**

The following academic requirements have to be satisfied, in addition to the attendance requirements mentioned in item no.**6.**

**7.1** A student is deemed to have fulfilled the minimum academic requirements and earned the credits allotted to each theory or practical or design or drawing course or project if he/she secures not less than 35% of marks (24 out of 70 marks) in the semester end examination and a minimum of 40% of marks in the sum total of the Continuous Internal Evaluation (CIE) and Semester End Examination (SEE) taken together.

**7.2** A student is deemed to have fulfilled the minimum academic requirements and earned the credits allotted to Industrial Oriented Mini Project /Summer Internship and seminar if the student secures not less than 40% marks in each of them.

**7.3** A student may reappear once for each of the above evaluations, when they are scheduled again.

**7.4 Promotion Rules**

| S. No. | Promotion | Conditions to be fulfilled |
|---|---|---|
| 1 | First year first semester to first year second semester | Regular course of study of first year first semester. |
| 2 | First year second semester to second year first semester | (i) Regular course of study of first year second semester.<br>(ii) Must have secured at least 19 credits out of 38 credits i.e., 50% credits up to first year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not. |
| 3 | Second year first semester to second year second semester | Regular course of study of second year first semester. |
| 4 | Second year second semester to third year first semester | (i) Regular course of study of second year second semester.<br>(ii) Must have secured at least 40 credits out of 80 credits i.e., 50% credits up to second year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not. |
| 5 | Third year first semester to third year second semester | Regular course of study of third year first semester. |

| | | |
|---|---|---|
| 6 | Third year second semester to fourth year first semester | (i) Regular course of study of third year second semester.<br>(ii) Must have secured at least 61 credits out of 122 credits i.e., 50% credits up to third year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not. |
| 7 | Fourth year first semester to fourth year second semester | Regular course of study of fourth year first semester. |

**7.5** A student eligible to appear in the semester end examination for any subject/ course, but absent from it or failed (thereby failing to secure **'C'** grade or above) may reappear for that subject/ course in the supplementary examination as and when conducted. In such cases, internal marks (CIE) assessed earlier for that subject/ course will be carried over, and added to the marks to be obtained in the SEE supplementary examination for evaluating performance in that subject.

**7.6** A student **detained in a semester due to shortage of attendance may be re-admitted in the same semester in the next academic year for fulfillment of academic requirements**. The academic regulation under which a student has been readmitted is applicable. However, no grade allotments or SGPA/ CGPA calculations will be done for the entire semester in which the student has been detained.

**7.7** A student detained **due to lack of credits, is promoted to the next academic year only after acquiring the required academic credits.** The academic regulation under which the student has been readmitted is applicable to him.

**7.8** A student who fails to earn all the 160 credits as indicated in the program structure within eight academic years from the year of admission shall forfeit his seat in B.Tech Program, unless an extension is given by college Academic council to complete the program for a further period of two years.

**8.0 Evaluation - Distribution and Weightage of marks**

**8.1** The performance of a student in every subject/course (including practical and Project Stage – I & II) will be evaluated for 100 marks each, with 30 marks allotted for CIE (Continuous Internal Evaluation) and 70 marks for SEE (Semester End-Examination).

**8.2** For theory courses, during the semester there are 2 mid-term examinations (internal exams of 20 marks each), 5 unit tests of 5 marks each and 2 assignments carrying 5 marks each.

**8.3** Each mid-term examination will be of 1 hour 20 minutes consisting of Part-A (objective questions) for 10 marks and Part-B (long answer) for 10 marks. The Part-A objective paper is set with 20 bits of multiple choice, fill-in the blanks and

matching type of questions. The Part- B consists of 4 questions each carrying 5 marks and student should answer any two questions.

**8.4** Each Unit Test will be of 1 hour duration, consisting of 3 questions from that unit carrying 5 marks each and student should answer any two questions for 10 Marks. These 10 marks are scaled down to 5 for Unit Test marks calculation.

**8.5** First mid-term examination is conducted for first 2 units of syllabus and second mid-term examination is conducted for remaining 3 units of syllabus.

**8.6** The Continuous Internal Evaluation for theory course shall be made as average of marks obtained in CIE – I and CIE –II as detailed in the table below.

| CIE – I | Marks | CIE - II | Marks |
|---|---|---|---|
| MID – I | 20 | MID - II | 20 |
| Best of<br>Unit Test - I and Unit Test - II | 5 | Average of the best two of Unit Test – III, Unit Test – IV and Unit Test V | 5 |
| Assignment – I | 5 | Assignment - II | 5 |
| Total | 30 | Total | 30 |

**8.7** If a student is absent for any mid term examination, may be permitted to apply for makeup examinations within a week after completion of mid-term examinations on medical grounds. A subcommittee with the following composition will look into such cases.

**Subcommittee-composition:**

| S.No | Faculty Member | Designation |
|---|---|---|
| 1 | Concerned Head of the Department | Chairman |
| 2 | Faculty nominated by Principal | Member |
| 3 | Senior faculty member of the concerned Department | Member |
| 4 | Class Teacher of the class | Member |

**8.7.1** The Semester End Examinations (SEE) will be conducted for 70 marks consisting of two parts viz. i) **Part- A** for 20 marks, ii) **Part - B** for 50 marks.

- Part-A is a compulsory question consisting of ten sub-questions. The first five sub-questions are from each unit and carry 1 mark each. The next five sub- questions are one from each unit and carry 3 marks each.
- Part-B consists of five questions (numbered from 2 to 6) carrying 10 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there will be an “either” “or” choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

**8.7.2** For subjects like **Engineering Graphics/Engineering Drawing,** the SEE shall consist of five questions. For each question there will be an “either” “or” choice, which means that there will be two questions from each unit and the student should answer either of the two questions. There is no Part – A, and Part – B system.

**8.7.3** For subjects like **Machine Drawing Practice/Machine Drawing**, the SEE is conducted for 70 marks consisting of two parts viz. (i) Part – A for 30 marks. 3 out of 4 questions must be answered, (ii) Part – B for 40 marks. Part – B is compulsory with a single question.

**8.7.4** For the Subject **Estimation, Costing and Project Management**, the SEE paper should consist of Part- A, Part-B and Part C. (i) Part – A – 1 out of 2 questions from Unit – I for 25 Marks, (ii) Part – B – 1 out of 2 questions from Unit – II for 15 Marks, (iii) Part – C – 3 out of 5 questions from Units – III, IV, V for 30 Marks.

**8.7.5** For subjects **Structural Engineering – I & II (RCC & STEEL),** the SEE will be conducted for 70 marks consisting of 2 parts viz. (i) Part – A for 15 marks and, (i) Part – B for 55 marks. Part – A is a compulsory question consisting of ten sub-questions. The first five sub-questions are from each unit relating to design theory and codal provisions and carry 2 marks each. The next five sub-questions are from each unit and carry 1 mark each. Part – B consists of 5 questions (numbered 2 to 6) carrying 11 marks each. Each of these questions is from one unit and may contain sub-questions. For each question there is either or choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

**8.8** For practical subjects there is a continuous internal evaluation during the semester for 30 marks and 70 marks for semester end examination. Out of the 30 marks for internal evaluation, day-to-day work in the laboratory is evaluated for 20 marks and internal practical examination is evaluated for 10 marks conducted by the laboratory teacher concerned. The semester end examination is conducted with an external examiner and the laboratory teacher. The external examiner is selected and appointed by the Principal from the list submitted by Head of the Department.

**8.9** For the subject having design and/or drawing, (such as engineering graphics, engineering drawing, machine drawing, machine drawing practice and estimation), the distribution is 30 marks for continuous internal evaluation (20 marks for day-to-day work and 10 marks for internal tests) and 70 marks for semester end examination.

**8.10** There is Life Skills and Professional Skills course offered for 2 credits and will be evaluated in IV year I semester as a laboratory course.

**8.11** There is summer internship, in collaboration with an industry of their specialization, to be taken up during the vacation after II year II Semester examination and it will be evaluated in III Year I semester. A report to be submitted in prescribed format on the internship carried out by the student. The report will evaluated for 100 marks by the committee consisting of head of the department, and internship coordinator and a senior faculty member of the department. There is no semester end examination for the seminar

**8.12** There is an Industry Oriented Mini Project, in collaboration with an industry of their specialization to be taken up during the vacation after III year II semester examinations. Industry Oriented Mini Project is submitted in a report form and presented before the committee in IV year I semester. It is evaluated for 100 marks by the committee consisting of Head of the Department, supervisor of the Industrial Oriented mini project and a senior faculty member of the department.

**8.13** There is a seminar in IV year II semester. For the seminar, the student shall collect the information on a specialized topic, prepare a technical report, and submit it to the department. It is evaluated by the departmental committee consisting of Head of the Department, seminar supervisor and a senior faculty member. The seminar report is evaluated for 100 internal marks. There is no semester end examination for the seminar.

**8.14** UG project work shall be carried out in two stages: Project Stage – I during IV Year I Semester, Project Stage – II during IV Year II Semester. Each stage will be evaluated for 100 marks. Student has to submit project work report at the end of each semester. First report includes project work carried out in IV Year I semester and second report includes project work carried out in IV Year I & II Semesters. SEE for both project stages shall be completed before the commencement of SEE Theory examinations..

**8.15** For Project Stage – I, the Project Review committee (PRC) consisting of Head of the Department, project coordinator and two senior faculty members shall evaluate(SEE) the project work for 70 marks and project supervisor (CIE) shall evaluate for 30 marks. The student is deemed to have failed, if he (i) does not submit a report on Project Stage - I or does not make a presentation of the same before the evaluation committee as per schedule, or (ii) secures less than 40% marks in the sum total of the CIE and SEE taken together..

A student who has failed may reappear once for the above evaluation, when it is scheduled again; if he fails in such 'one reappearance' evaluation also, he has to reappear for the same in the next subsequent semester, as and when it is scheduled.

**8.16** For Project Stage – II, the external examiner shall evaluate the project work for 70 marks and the project supervisor shall evaluate it for 30 marks. The student is deemed to have failed, if he (i) does not submit a report on Project Stage - II, or does not make a presentation of the same before the external examiner as per schedule, or (ii) secures less than 40% marks in the sum total of the CIE and SEE taken together.

For conducting viva-voce of project stage – II, Principal selects an external examiner from the list of experts in the relevant branch submitted by the HODs of the College.

A student who has failed may reappear once for the above evaluation, when it is scheduled again; if student fails in such 'one reappearance' evaluation also, he has to reappear for the same in the next subsequent semester, as and when it is scheduled.

**8.17** For mandatory courses of Environmental Science, Constitution of India, Intellectual Property Rights, and Gender Sensitization lab, a student has to secure 40 marks out of 100 marks (i.e. 40% of the marks allotted) in the continuous internal evaluation for passing the subject/course. **These marks should also be submitted along with the internal marks of other subjects.**

**8.18** No marks or letter grades is printed in the Mark Statement for mandatory/non-credit courses. Only Pass/Fail is indicated in Grade Card.

**9.0 Grading procedure**

**9.1** Grades will be awarded to indicate the performance of students in each theory subject, laboratory / practicals, seminar, Industry Oriented Mini Project, and project Stage - I & II. Based on the percentage of marks obtained (Continuous Internal Evaluation plus Semester End Examination, both taken together) as specified in item 8 above, a corresponding letter grade is given.

**9.2** As a measure of the performance of a student, a 10-point absolute grading system using the following letter grades (as per UGC/AICTE guidelines) and corresponding percentage of marks is followed:

| % of Marks Secured in a Subject/Course (Class Intervals) | Letter Grade (UGC Guidelines) | Grade Points |
|---|---|---|
| Greater than or equal to 90% | O (Outstanding) | 10 |
| 80 and less than 90% | $A^+$ (Excellent) | 9 |
| 70 and less than 80% | A (Very Good) | 8 |
| 60 and less than 70% | $B^+$ (Good) | 7 |
| 50 and less than 60% | B (Average) | 6 |
| 40 and less than 50% | C (Pass) | 5 |
| Below 40% | F (FAIL) | 0 |
| Absent | Ab | 0 |

**9.3** A student who has obtained an '**F'** grade in any subject is deemed to have '**failed'** and is required to reappear as a 'supplementary student' in the semester end examination, as and when offered. In such cases, internal marks in those subjects will remain the same as those obtained earlier.

**9.4** To a student who has not appeared for an examination in any subject, '**Ab'** grade will be allocated in that subject, and he is deemed to have '**failed'**. A student will be required to reappear as a 'supplementary student' in the semester end examination, as and when offered next. In this case also, the internal marks in those subjects will remain the same as those obtained earlier.

**9.5** A letter grade does not indicate any specific percentage of marks secured by the student, but it indicates only the range of percentage of marks.

**9.6** A student earns grade point (GP) in each subject/ course, on the basis of the letter grade secured in that subject/course. The corresponding 'credit points' (CP) are computed by multiplying the grade point with credits for that particular subject/ course.

**Credit Points (CP) = Grade Point (GP) x Credits …. For a course**

**9.7** A student passes the subject/ course only when **GP ≥ 5 ('C' grade or above).**

**9.8** The Semester Grade Point Average (SGPA) is calculated by dividing the sum of credit points (∑CP) secured from all subjects/ courses registered in a semester, by the total number of credits registered during that semester. SGPA is rounded off to **two** decimal places. SGPA is thus computed as

**SGPA = { $\sum^{N}_{i=1} C_i G_i$ } / { $\sum^{N}_{i=1} C_i$ } …. For each semester**,

where 'i' is the subject indicator index (takes into account all subjects in a semester), 'N' is the no. of subjects '**registered'** for the semester (as specifically required and listed under the course structure of the parent department), $C_i$ is the no. of credits allotted to the $i^{th}$ subject, and $G_i$ represents the grade points (GP) corresponding to the letter grade awarded for that $i^{th}$ subject.

**9.9** The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student in all semesters considered for registration. The CGPA is the ratio of the total credit points secured by a student in **all** registered courses in **all** semesters, and the total number of credits registered in **all** the semesters. CGPA is rounded off to **two** decimal places. CGPA is thus computed from the I year II semester onwards at the end of each semester as per the formula

**CGPA = { $\sum^{M}_{j=1} C_j G_j$ } / { $\sum^{M}_{j=1} C_j$ } … for all S number of semesters registered**

**(i.e., up to and inclusive of S semesters, S ≥ 2)**,

where '**M'** is the **total** no. of subjects (as specifically required and listed under the course structure of the parent department) the student has '**registered'** i.e., from the $1^{st}$ semester onwards up to and inclusive of the $8^{th}$ semester, 'j' is the subject indicator index (takes into account all subjects from 1 to 8 semesters), $C_j$ is the no. of credits allotted to the $j^{th}$ subject, and $G_j$ represents the grade points (GP) corresponding to the letter grade awarded for that $j^{th}$ subject. After registration and completion of I year I semester, the SGPA of that semester itself may be taken as the CGPA, as there are no cumulative effects.

**Illustration of calculation of SGPA:**

| Course/Subject | Credits | Letter Grade | Grade Points | Credit Points |
|---|---|---|---|---|
| Course 1 | 4 | A | 8 | 4 x 8 = 32 |
| Course 2 | 4 | O | 10 | 4 x 10 = 40 |
| Course 3 | 4 | C | 5 | 4 x 5 = 20 |
| Course 4 | 3 | B | 6 | 3 x 6 = 18 |
| Course 5 | 3 | A+ | 9 | 3 x 9 = 27 |
| Course 6 | 3 | C | 5 | 3 x 5 = 15 |
| | 21 | | | 152 |

SGPA = 152/21 = 7.24

**Illustration of calculation of CGPA up to 3rd semester:**

| Semester | Course/Subject Title | Credits Allotted | Letter Grade Secured | Corresponding Grade Point (GP) | Credit Points (CP) |
|---|---|---|---|---|---|
| I | Course 1 | 3 | A | 8 | 24 |
| I | Course 2 | 3 | O | 10 | 30 |
| I | Course 3 | 3 | B | 6 | 18 |
| I | Course 4 | 4 | A | 8 | 32 |
| I | Course 5 | 3 | A+ | 9 | 27 |
| I | Course 6 | 4 | C | 5 | 20 |
| II | Course 7 | 4 | B | 6 | 24 |
| II | Course 8 | 4 | A | 8 | 32 |
| II | Course 9 | 3 | C | 5 | 15 |
| II | Course 10 | 3 | O | 10 | 30 |
| II | Course 11 | 3 | B+ | 7 | 21 |
| II | Course 12 | 4 | B | 6 | 24 |
| II | Course 13 | 4 | A | 8 | 32 |
| II | Course 14 | 3 | O | 10 | 30 |
| III | Course 15 | 2 | A | 8 | 16 |
| III | Course 16 | 1 | C | 5 | 5 |
| III | Course 17 | 4 | O | 10 | 40 |
| III | Course 18 | 3 | B+ | 7 | 21 |
| III | Course 19 | 4 | B | 6 | 24 |
| III | Course 20 | 4 | A | 8 | 32 |
| III | Course 21 | 3 | B+ | 7 | 21 |
| | **Total Credits** | **69** | | **Total Credit Points** | **518** |

**CGPA = 518/69 = 7.51**

The above illustrated calculation process of CGPA will be followed for each subsequent semester until 8th semester. The CGPA obtained at the end of 8th semester will become the final CGPA secured for entire B.Tech. Programme.

**9.10** For merit ranking or comparison purposes or any other listing, **only** the '**rounded off'** values of the CGPAs will be used.

**9.11** SGPA and CGPA of a semester will be mentioned in the semester Memorandum of Grades if all subjects of that semester are passed in first attempt. Otherwise the SGPA and CGPA is mentioned only on the Memorandum of Grades in which sitting he passed his last exam in that semester. However, mandatory courses will not be taken into consideration.

**10.0 Passing standards**

**10.1** A student is declared successful or 'passed' in a semester, if he secures a GP ≥ 5 ('C' grade or above) in every subject/course in that semester (i.e. when the student gets an SGPA ≥ 5.00 at the end of that particular semester); and he is declared successful or 'passed' in the entire under graduate programme, only when gets a CGPA ≥ 5.00 for the award of the degree as required.

**10.2** After the completion of each semester, a grade card or grade sheet is issued to all the registered students of that semester, indicating the letter grades and credits earned. It will show the details of the courses registered (course code, title, no. of credits, grade earned, etc.), credits earned.

**11.0 Declaration of results**

**11.1** Computation of SGPA and CGPA are done using the procedure listed in 9.6 to 9.9.

**11.2** For final percentage of marks equivalent to the computed final CGPA, the following formula may be used.

**% of Marks = (final CGPA – 0.5) x 10**

**12.0 Award of degree**

**12.1** A student who registers for all the specified subjects/ courses as listed in the course structure and secures the required number of 160 credits (with CGPA ≥ 5.0), within 8 academic years from the date of commencement of the first academic year, is declared to have '**qualified'** for the award of B.Tech. degree in the chosen branch of Engineering selected at the time of admission.

**12.2** A student who qualifies for the award of the degree as listed in item 12.1 is placed in the following classes.

**12.3** A student with final CGPA > 8.00 (at the end of the under graduate programme), and fulfilling the following conditions - is placed in '**first class with distinction'**.
However, he

(i) Should have passed all the subjects/courses in '**first appearance'** within the first 4 academic years (or 8 sequential semesters) from the date of commencement of first year first semester.

(ii) Should have secured a CGPA ≥ 8.00, at the end of each of the 8 sequential semesters, starting from I year I semester onwards.

(iii) Should not have been detained or prevented from writing the semester end examinations in any semester due to shortage of attendance or any other reason.

A student not fulfilling any of the above conditions with final CGPA ≥ 8 is placed in **'first class'.**

**12.4** Students with final CGPA (at the end of the under graduate programme) ≥ 6.50 but < 8.00 are placed in **'first class'.**

**12.5** Students with final CGPA (at the end of the under graduate programme) ≥ 5.50 but < 6.50, are placed in '**second class'**.

**12.6** All other students who qualify for the award of the degree (as per item 12.1), with final CGPA (at the end of the under graduate programme) ≥ 5.00 but < 5.50, are placed in '**pass class**'.

**12.7** A student with final CGPA (at the end of the under graduate programme) < 5.00 will not be eligible for the award of the degree.

**12.8** Students fulfilling the conditions listed under item 12.3 alone will be eligible for award of '**Gold Medal**'.

**13.0 Withholding of results**

**13.1** If the student has not paid the fees to the College at any stage, or has dues pending due to any reason whatsoever, or if any case of indiscipline is pending, the result of the student may be withheld, and the student will not be allowed to go into the next higher semester. The award or issue of the degree may also be withheld in such cases.

**14.0 Student transfers**

**14.1** Transfer of students from other colleges or universities are permitted subjected to the rules and regulations of Telanga State Council for Higher Education (Technical Education Department) and JNTUH in vogue.

**15.0 Scope**

**15.1** The academic regulations should be read as a whole, for the purpose of any interpretation.

**15.2** In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Academic Council is final.

**15.3** The College may change or amend the academic regulations, course structure or syllabi at any time, and the changes or amendments made is applicable to all students with effect from the dates notified by the College authorities.

**15.4** Where the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".

## ACADEMIC REGULATIONS FOR B.TECH. (LATERAL ENTRY SCHEME) FROM THE AY 2019-2020

**1. Eligibility for award of B. Tech. Degree (LES)**

The LES students after securing admission shall pursue a course of study for not less than three academic years and not more than six academic years.

**2.** The student shall register for 122 credits and secure 122 credits with CGPA ≥ 5 from II year to IV year B.Tech. programme (LES) for the award of B.Tech. degree.

**3.** The students, who fail to fulfill the requirement for the award of the degree in six academic years from the year of admission. However, he/she is permitted to write the examinations for two more years after six academic years of course work, failing which he/she shall forfeit his/her seat in B.Tech course.

**4.** The attendance requirement of B. Tech. (Regular) is applicable to B.Tech. (LES).

**5. Promotion rule**

| S. No | Promotion | Conditions to be fulfilled |
|---|---|---|
| 1 | Second year first semester to second year second semester | Regular course of study of second year first semester. |
| 2 | Second year second semester to third year first semester | **(i)** Regular course of study of second year second semester.<br>**(ii)** Must have secured at least 21 credits out of 42 credits i.e., 50% credits up to second year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not. |
| 3 | Third year first semester to third year second semester | Regular course of study of third year first semester. |
| 4 | Third year second semester to fourth year first semester | (i) Regular course of study of third year second semester.<br>(ii) Must have secured at least 42 credits out of 84 credits i.e., 50% credits up to third year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not. |
| 5 | Fourth year first semester to fourth year second semester | Regular course of study of fourth year first semester. |

**6.** All the other regulations as applicable to B. Tech. 4-year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme).

**MALPRACTICES RULES**

**DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS**

| S.No. | **Nature of Malpractice/Improper conduct** | **Punishment** |
|---|---|---|
| | If the student: | |
| 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 student is appearing but has not made use of (material shall include any marks on the body of 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 student orally or by any other body language methods or communicates through cell phones with any student or persons in or outside the exam hall in respect of any matter. | Expulsion from the examination hall and cancellation of the performance in the subject only of all the students 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 student is appearing. | Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and UG major project and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year.<br>The hall ticket of the student is to be cancelled and sent to the university. |
| 3. | Impersonates any other student in connection with the examination. | The student who has impersonated shall be expelled from examination hall. The student is also debarred and forfeits the seat. The performance of the original student, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and UG major project) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the |

| | | |
|---|---|---|
| | | student is subject to the academic regulations in connection with forfeiture of sea. If the imposter is and outsider, he will be handed over to the police and a case is registered against him. |
| 4. | Smuggles in the answer book or additional sheet or takes our or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination. | Expulsion from the examination hall and cancellation of performance in the subject and all the other subjects the student has already appeared including practical examinations and UG major project and shall not be permitted for the remaining examinations of the subjects of that semester year. The student is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the student 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 the 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 and around the examination hall or organizers a walk out or instigates others to walk out, 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 writer or by signs or by 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 or any of his relations, or indulges in any other act of misconduct or mischief which result 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 | 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 student(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The students 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. |

| | | |
|---|---|---|
| | duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination. | |
| 7. | Leaves the exam hall taking away answer script or intentionally tears of the script or any thereof inside or outside the examination hall. | Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and UG major project and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all university examinations. The continuation of the course by the student 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 performance in that subject and all other subjects the student has already appeared including practical examinations and UG major project and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred and forfeiture of seat. |
| 9. | If student of the college, who is not a student 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. | Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all the other subjects the student has already appeared including practical examinations and UG major project and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred and forfeiture of seat. Person(s) who do not belong to the college will be handed over to police and, a police case will be registered against them. |
| 10. | Comes in a drunken condition to the examination hall. | Expulsion from the examination hall and cancellation of performance in that subject and all other subjects the student has already appeared including practical |

| | | |
|---|---|---|
| | | examinations and UG major project and shall not be permitted for the remaining examinations of the subjects of that semester/year. |
| 11. | Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny. | Cancellation of performance in that subject and all other subjects the student has appeared including practical examinations and UG major project of that semester/year examinations. |
| 12. | If any malpractice is detected which is not covered in the above clauses 1 to 11 is reported to the Examination Result Processing Committee (ERPC) for further action to award a suitable punishment. | |

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**J.B. INSTITUTE OF ENGINEERING & TECHNOLOGY**

UGC AUTONOMOUS

Bhaskar Nagar, Yenkapally, Moinabad (M), RR Dist., Telangana-500075

**MECHANICAL ENGINEERING**

COURSE STRUCTURE – R18

**I B. Tech – I Semester**

| Sl. No. | Code | Subject | L | T-P-D | C |
|---|---|---|---|---|---|
| 1 | F110A | Mathematics - I | 3 | 1-0-0 | 4 |
| 2 | F112A | Basic Electrical Engineering | 3 | 1-0-0 | 4 |
| 3 | F113A | Engineering Drawing & Computer Graphics | 1 | 0-0-4 | 3 |
| 4 | F110E | Engineering Physics | 3 | 1-0-0 | 4 |
| 5 | F1105 | Basic Electrical Engineering Lab | 0 | 0-2-0 | 1 |
| 6 | F1103 | Engineering Physics Lab | 0 | 0-3-0 | 1.5 |
| | | **Total** | **10** | **3-5-4** | **17.5** |

**I B. Tech – II Semester**

| Sl. No. | Code | Subject | L | T-P-D | C |
|---|---|---|---|---|---|
| 1 | F120A | Mathematics – II | 3 | 1-0-0 | 4 |
| 2 | F120B | English | 2 | 0-0-0 | 2 |
| 3 | F125A | Programming for Problem Solving | 3 | 0-0-0 | 3 |
| 4 | F120D | Engineering Chemistry | 3 | 1-0-0 | 4 |
| 5 | F1201 | English Language and Communication skills Lab | 0 | 0-2-0 | 1 |
| 6 | F1206 | Programming for Problem Solving Lab | 0 | 0-4-0 | 2 |
| 7 | F1205 | Workshop and Manufacturing Practices lab | 1 | 0-4-0 | 3 |
| 8 | F1203 | Chemistry Lab | 0 | 0-3-0 | 1.5 |
| | | **Total** | **12** | **2-13-0** | **20.5** |

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**MECHANICAL ENGINEERING**

COURSE STRUCTURE – R18

**II B. Tech – I Semester**

| Sl. No. | Code | Subject | L | T-P-D | C |
|---|---|---|---|---|---|
| 1 | F210B | Biological Sciences | 2 | 0-0-0 | 2 |
| 2 | F213A | Instrumentation and Metrology | 3 | 0-0-0 | 3 |
| 3 | F213B | Thermodynamics | 2 | 1-0-0 | 3 |
| 4 | F214E | Basic Electronics Engineering | 3 | 0-0-0 | 3 |
| 5 | F213C | Materials Engineering | 3 | 0-0-0 | 3 |
| 6 | F213D | Engineering Mechanics | 2 | 1-0-0 | 3 |
| 7 | F2131 | Machine Drawing Practice | 0 | 0-0-6 | 3 |
| 8 | F2143 | Basic Electronics Engineering lab | 0 | 0-2-0 | 1 |
| 9 | F210D | Environmental science | 2 | 0-0-0 | 0 |
| | | **Total** | **17** | **2-2-6** | **21** |

**II B. Tech – II Semester**

| Sl. No. | Code | Subject | L | T-P-D | C |
|---|---|---|---|---|---|
| 1 | F220A | Probability and Partial Differential Equations | 3 | 1-0-0 | 4 |
| 2 | F223A | Theory of Machines - I | 3 | 1-0-0 | 4 |
| 3 | F223B | Manufacturing Technology | 3 | 0-0-0 | 3 |
| 4 | F223C | Mechanics of Solids | 3 | 1-0-0 | 4 |
| 5 | F220B | Managerial Economics and Financial Analysis | 3 | 0-0-0 | 3 |
| 6 | F2231 | Materials Engineering Lab | 0 | 0-2-0 | 1 |
| 7 | F2232 | Instrumentation & Metrology Lab | 0 | 0-2-0 | 1 |
| 8 | F2233 | Manufacturing Technology Lab | 0 | 0-2-0 | 1 |
| 9 | F220E | Gender Sensitization | 2 | 0-0-0 | 0 |
| | | **Total** | **17** | **3-6-0** | **21** |

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**MECHANICAL ENGINEERING**

COURSE STRUCTURE – R18

**III B. Tech – I Semester**

| Sl. No. | Code | Subject | L | T-P-D | C |
|---|---|---|---|---|---|
| 1 | F313A | Mechanics of Fluids & Hydraulic Machines | 3 | 1-0-0 | 4 |
| 2 | F313B | Metal Cutting and Machine Tools | 3 | 0-0-0 | 3 |
| 3 | F313C | Machine Design | 3 | 1-0-0 | 4 |
| 4 | F313D | Dynamics of Machinery | 2 | 1-0-0 | 3 |
| 5 | F313E | Applied Thermodynamics | 3 | 1-0-0 | 4 |
| 6 | F3131 | Mechanics of Fluids & Hydraulic Machines Lab | 0 | 0-2-0 | 1 |
| 7 | F3132 | Machine Tools Lab | 0 | 0-2-0 | 1 |
| 8 | F3133 | Thermal Engineering Lab | 0 | 0-2-0 | 1 |
| 9 | F3134 | Summer Internship | 0 | 0-2-0 | 1 |
| | | **Total** | **14** | **4-8-0** | **22** |

**III B. Tech – II Semester**

| Sl. No. | Code | Subject | L | T-P-D | C |
|---|---|---|---|---|---|
| 1 | F323A | Heat Transfer | 3 | 1-0-0 | 4 |
| 2 | F323B | Operations Research | 3 | 1-0-0 | 4 |
| 3 | | **Open Elective – I** | 3 | 0-0-0 | 3 |
| 4 | | **Professional Elective – I** | 3 | 0-0-0 | 3 |
| 5 | | **Professional Elective – II** | 3 | 0-0-0 | 3 |
| 6 | F3231 | Heat Transfer Lab | 0 | 0-2-0 | 1 |
| 7 | F3232 | Production Drawing Practice Lab | 0 | 0-0-2 | 1 |
| 8 | F3233 | Computer Aided Engineering Lab | 0 | 0-2-0 | 1 |
| | | **Total** | **15** | **2-4-2** | **20** |

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**MECHANICAL ENGINEERING**

COURSE STRUCTURE – R18

**IV B. Tech – I Semester**

| Sl. No. | Code | Subject | L | T-P-D | C |
|---|---|---|---|---|---|
| 1 | | **Open Elective – II** | 3 | 0-0-0 | 3 |
| 2 | | **Open Elective – III** | 3 | 0-0-0 | 3 |
| 3 | | **Professional Elective – III** | 3 | 0-0-0 | 3 |
| 4 | | **Professional Elective – IV** | 3 | 0-0-0 | 3 |
| 5 | F4101 | Life skills and Professional skills Lab | 0 | 0-4-0 | 2 |
| 6 | F4132 | Industry oriented Mini Project | 0 | 0-4-0 | 2 |
| 7 | F4131 | Project Stage – I | 0 | 0-8-0 | 4 |
| | | **Total** | **12** | **0-16-0** | **20** |

**IV B. Tech – II Semester**

| Sl. No. | Code | Subject | L | T-P-D | C |
|---|---|---|---|---|---|
| 1 | | **Open Elective – IV** | 3 | 0-0-0 | 3 |
| 2 | | **Professional Elective – V** | 3 | 0-0-0 | 3 |
| 3 | | **Professional Elective – VI** | 3 | 0-0-0 | 3 |
| 4 | F4232 | Project stage – II | 0 | 0-16-0 | 8 |
| 5 | F4231 | Seminar | 0 | 0-2-0 | 1 |
| | | **Total** | **9** | **0-18-0** | **18** |

**Note:** All End Examinations (Theory and Practical) are of three hours duration.

L – Lecture, T – Tutorial, P – Practical, D – Drawing, C – Credits.

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**MECHANICAL ENGINEERING**

PROFESSIONAL ELECTIVE SUBJECTS

**Professional Elective – I**

| Sl. No. | Code | Subject | L | T-P-D | C |
|---|---|---|---|---|---|
| 1 | F323C | CAD/CAM | 3 | 0-0-0 | 3 |
| 2 | F323D | Refrigeration and Air Conditioning | 3 | 0-0-0 | 3 |
| 3 | F323E | Unconventional Machining Processes | 3 | 0-0-0 | 3 |

**Professional Elective – II**

| Sl. No. | Code | Subject | L | T-P-D | C |
|---|---|---|---|---|---|
| 1 | F323F | Mechanical Vibrations | 3 | 0-0-0 | 3 |
| 2 | F323G | Machine Tool Design | 3 | 0-0-0 | 3 |
| 3 | F323H | Automobile Engineering | 3 | 0-0-0 | 3 |

**Professional Elective – III**

| Sl. No. | Code | Subject | L | T-P-D | C |
|---|---|---|---|---|---|
| 1 | F413A | Finite Element Methods | 3 | 0-0-0 | 3 |
| 2 | F413B | Design for Manufacturing | 3 | 0-0-0 | 3 |
| 3 | F413C | Jet Propulsion and Rocket Engineering | 3 | 0-0-0 | 3 |

**Professional Elective – IV**

| Sl. No. | Code | Subject | L | T-P-D | C |
|---|---|---|---|---|---|
| 1 | F413D | Robotics | 3 | 0-0-0 | 3 |
| 2 | F413E | Computational Fluid Dynamics | 3 | 0-0-0 | 3 |
| 3 | F413F | Production Planning and Control | 3 | 0-0-0 | 3 |

**Professional Elective – V**

| Sl. No. | Code | Subject | L | T-P-D | C |
|---|---|---|---|---|---|
| 1 | F423A | Manufacturing of Composites | 3 | 0-0-0 | 3 |
| 2 | F423B | CNC Technology | 3 | 0-0-0 | 3 |
| 3 | F423C | Plant Layout and Material Handling | 3 | 0-0-0 | 3 |
| 4 | F423D | Power Plant Engineering | 3 | 0-0-0 | 3 |

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**MECHANICAL ENGINEERING**

PROFESSIONAL ELECTIVE SUBJECTS

**Professional Elective – VI**

| Sl. No. | Code | Subject | L | T-P-D | C |
|---|---|---|---|---|---|
| 1 | F423E | Automation in Manufacturing | 3 | 0-0-0 | 3 |
| 2 | F423F | Quality Engineering in Manufacturing | 3 | 0-0-0 | 3 |
| 3 | F423G | Additive Manufacturing | 3 | 0-0-0 | 3 |
| 4 | F423H | Control Systems | 3 | 0-0-0 | 3 |

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COURSE STRUCTURE – R18

**List of Subjects offered by various Board of Studies**

**Open Elective – I**

| S.No. | Code | Name of the Subject | Name of the BOS offering the Subject |
|---|---|---|---|
| 1 | F32OA | Energy Audit and Green Building | Civil Engineering |
| 2 | F32OB | Environmental Impact Assessment | Civil Engineering |
| 3 | F32OC | Energy Storage systems | Electrical and Electronics Engineering |
| 4 | F32OD | Energy Auditing, Conservation and Management | Electrical and Electronics Engineering |
| 5 | F32OE | Automotive Technology | Mechanical Engineering |
| 6 | F32OF | Matlab Programming Language | Electronics and Communication Engineering |
| 7 | F32OG | Principles of communications | Electronics and Communication Engineering |
| 8 | F32OH | Database Management Systems | Computer Science and Engineering |
| 9 | F32OI | Operating Systems | Computer Science and Engineering |
| 10 | F32OJ | Introduction to Data Structures | Information Technology |
| 11 | F32OK | Introduction to web Design | Information Technology |
| 12 | F32OL | Internet of things | Electronics and Computer Engineering |
| 13 | F32OM | Introduction to Mining Technology | Mining Engineering |

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COURSE STRUCTURE – R18

**List of Subjects offered by various Board of Studies**

**Open Elective – II**

| S.No. | Code | Name of the Subject | Name of the BOS offering the Subject |
|---|---|---|---|
| 1 | F41OA | Waste Management | Civil Engineering |
| 2 | F41OB | Estimation, Quantity Surveying and Valuation | Civil Engineering |
| 3 | F41OC | Electric and Hybrid vehicles | Electrical and Electronics Engineering |
| 4 | F41OD | Materials in Electrical Systems | Electrical and Electronics Engineering |
| 5 | F41OE | Fundamentals of Operations Research | Mechanical Engineering |
| 6 | F41OF | Digital systems Using VHDL | Electronics and Communication Engineering |
| 7 | F41OG | IC Technology | Electronics and Communication Engineering |
| 8 | F41OH | Computer Networks | Computer Science and Engineering |
| 9 | F41OI | Python Programming | Computer Science and Engineering |
| 10 | F41OJ | Computer Organization | Information Technology |
| 11 | F41OK | Human Computer Interaction | Information Technology |
| 12 | F41OL | Introduction to Embedded systems | Electronics and Computer Engineering |
| 13 | F41OM | Introduction to Surface Mining | Mining Engineering |

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COURSE STRUCTURE – R18

**List of Subjects offered by various Board of Studies**

**Open Elective – III**

| S.No. | Code | Name of the Subject | Name of the BOS offering the Subject |
|---|---|---|---|
| 1 | F41ON | Elements of CIVIL Engineering | Civil Engineering |
| 2 | F41OO | Disaster Management | Civil Engineering |
| 3 | F41OP | Electric Costing And Estimation | Electrical and Electronics Engineering |
| 4 | F41OQ | Power Plant Engineering | Electrical and Electronics Engineering |
| 5 | F41OR | Fundamentals of Robotics | Mechanical Engineering |
| 6 | F41OS | Digital systems Using Verilog | Electronics and Communication Engineering |
| 7 | F41OT | Advanced Computer Architecture | Electronics and Communication Engineering |
| 8 | F41OU | Software Engineering | Computer Science and Engineering |
| 9 | F41OV | Cloud Computing | Computer Science and Engineering |
| 10 | F41OW | Java Programming | Information Technology |
| 11 | F41OX | Software Project Management | Information Technology |
| 12 | F41OY | Introduction to Intelligent System | Electronics and Computer Engineering |
| 13 | F41OZ | Introduction to Geology | Mining Engineering |

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COURSE STRUCTURE – R18

**List of Subjects offered by various Board of Studies**

**Open Elective – IV**

| S.No. | Code | Name of the Subject | Name of the BOS offering the Subject |
|---|---|---|---|
| 1 | F42OA | Industrial Waste Water Treatment | Civil Engineering |
| 2 | F42OB | Air pollution and Control | Civil Engineering |
| 3 | F42OC | Distributed Generation And Micro grid | Electrical and Electronics Engineering |
| 4 | F42OD | Renewable Energy Sources | Electrical and Electronics Engineering |
| 5 | F42OE | Digital Manufacturing | Mechanical Engineering |
| 6 | F42OF | Embedded System Design | Electronics and Communication Engineering |
| 7 | F42OG | Software Defined Radio | Electronics and Communication Engineering |
| 8 | F42OH | E-commerce | Computer Science and Engineering |
| 9 | F42OI | Big Data Analytics | Computer Science and Engineering |
| 10 | F42OJ | Computer Forensics | Information Technology |
| 11 | F42OK | E-Disaster Management | Information Technology |
| 12 | F42OL | Introduction to Neural Networks | Electronics and Computer Engineering |
| 13 | F42OM | Introduction to Mine Environment | Mining Engineering |

**J.B. INSTITUTE OF ENGINEERING & TECHNOLOGY**
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| | | | |
|---|---|---|---|
| **B. Tech. ME** | **L** | **T-P-D** | **C** |
| **I Year - I Semester** | **3** | **1-0-0** | **4** |

**(F110A) MATHEMATICS – I**

**LINEAR ALGEBRA & DIFFERENTIAL EQUATIONS**

(Common to CE, EEE,ME,ECE,CSE,IT, ECM&MIE)

**Course Objectives:** The Student will

1. understand the concept of matrices and solutions of system of linear equations
2. learn the concept of Eigen values and Eigen vectors and cayley Hamilton theorem
3. learn the concept of sequences and series & nature
4. Get an idea to find the solutions of differential equations of first order and first degree
5. Find the solutions of second and higher order.

**UNIT-I:Matrices**

Types of Matrices, Symmetric; Hermitian; Skew-symmetric; Skew-Hermitian; orthogonal matrices; Unitary Matrices; rank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss-Jordan method;

System of linear equations: solving system of Homogeneous and Non-Homogeneous equations. Gauss elimination method; Gauss Seidel Iteration Method.

**UNIT-II: Eigen Values and Eigen Vectors**

**Linear Transformation and Orthogonal Transformation:** Eigen values and Eigenvectors and their properties: Diagonalization of a matrix;

Cayley -Hamilton Theorem (without proof); finding inverse and power of a matrix by Cayley-Hamilton Theorem; Quadratic forms and Nature of the Quadratic Forms; Reduction of Quadratic form to canonical forms by Orthogonal Transformation

**UNIT-III: Sequences and Series**

**Sequence:** Definition of a Sequence, limit; Convergent, Divergent and Oscillatory sequences.

**Series:** Convergent, Divergent and Oscillatory Series; Series of positive terms; Comparison test, p-test, D-Alembert's ratio test; Raabe's test; Cauchy's Integral test; Cauchy's root test; logarithmic test.

**Alternating series:** Leibnitz test; Alternating Convergent series: Absolute and Conditionally Convergence

**UNIT-IV: First Order Ordinary Differential Equations**

**Exact, linear and Bernoulli's equations; Applications**: Newton's law of cooling, Law of natural growth and decay;

Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

**UNIT-V: ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER**

**Second order linear differential equations with constant coefficients:** Non-Homogeneous terms of the type $e^{ax}$, $\sin ax$, $\cos ax$, polynomials in $x$, $e^{ax}V(x)$ and $x\,V(x)$;

**Method of variation of parameters:** Equations reducible to linear ODE with constant coefficients: Legendre's equation, Cauchy-Euler equation.

**TEXT BOOKS**:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. R.K.Jain& S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 4th Edition, 2014.

**REFERENCES:**

1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11$^{th}$ Reprint, 2010.

**Course outcomes:** The student will be able to

1. Solve system of linear equations
2. analyze the Eigen values and Eigen vectors which come across under linear transformations
3. Find the nature of the given series by different tests.
4. Identify whether the given differential equation of first order is exact or not
5. Solve higher differential equation and apply the concept of differential equation to real world problems

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| **I Year - I Semester** | **3** | **1-0-0** | **4** |

**(F112A) BASIC ELECTRICAL ENGINEERING**

(Common to CE,ME, CSE,IT&MIE)

**Course Objectives:** The Student will

1. Learn the concept of electrical circuits using network laws and theorems.
2. Outlined and analyze single phase A.C and three phase A.C circuits.
3. Study and understand magnetic circuits and transformers.
4. Understand the different types of D.C and A.C rotating electrical machine.
5. Gain the knowledge of protection and switch gear of electrical components

**UNIT-I: DC Circuits**

Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff's current and voltage laws, analysis of simple circuits with DC excitation.

Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

**UNIT-II: AC Circuits**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor.

Analysis of single-phase AC circuits consisting of R, L, C, RL, RC and RLC series combinations, resonance in series RLC circuit. Three phase balanced circuits, voltage and current relations in star and delta connections.

**UNIT-III: Transformers**

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit.

Losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

**UNIT-IV: Rotating Electrical Machines**

D.C Motors - principle of operation, characteristics, speed control and application of series and shunt motor.

Three-phase induction motor - construction, generation of rotating magnetic fields, principle of operation, torque-slip characteristics. Single-phase induction motor - construction, working, torque-speed characteristic.

**UNIT-V: Electrical Installations**

Components of LT switchgear: Switch fuse unit (SFU), MCB, ELCB, MCCB, types of wires and cables, earthing.

Types of batteries, important characteristics for batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

**TEXT BOOKS**:


1. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.
3. L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.


**REFERENCES:**


1. E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.
2. V. D. Toro, “Electrical Engineering Fundamentals”, Prentice Hall India, 1989.


**Course outcomes:** The student will be able to

1. Illustrate and solve electrical circuits using network laws and theorem.
2. Acquire knowledge about the single phase and three phase electrical circuits.
3. Get exposure of magnetic circuits and transformers.
4. Demonstrate the working principle of electrical machines.
5. To introduce components of low voltage electrical installation.

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| **I Year - I Semester** | **1** | **0-0-4** | **3** |

**(F113A) ENGINEERING DRAWING & COMPUTER GRAPHICS**

**(Theory and Lab)**

(Common to ME, ECE & MIE)

**Course Objectives:** The Student will

1. Learn how to use the Drawing instruments, and practice lettering, dimensioning and their representation methods and learn various methods of drawing simple figures like Conic sections, Cycloid, Epicycloid, Hypocycloid, Involute, etc.,
2. Learn the principles of Orthographic Projections to show the projections of points, lines and planes effectively.
3. Learn to use the various methods for drawing the projections of solids, and their sectioning.
4. Learn to convert orthographic views into isometric views and vice versa
5. Learn the basics of computer-aided drawing with the aid of AutoCAD software.

**UNIT-I :Introduction to Engineering Drawing**

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloids, Hypocycloid and In volute.

**UNIT-II :Orthographic Projections and Projections of Points, Lines and Planes**

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes;

Projections of planes inclined to the Planes- Draw simple annotation, dimensioning and scale.

**UNIT-III: Projections of Regular Solids and Sectional Views of Right Regular Solids**

Projections of regular solids - Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Draw the sectional views of geometrical solids.

**UNIT-IV: Isometric and Orthographic Projections**

Principles of Isometric projection – Isometric Scale, Isometric Views.

Conversion of Isometric Views to Orthographic Views and Vice-versa.

**UNIT-V: Overview of Computer Graphics**

Drafting Software: Computer Aided Drafting (CAD) – Drafting Software – Manual Drafting vs Auto CAD Drafting. Auto CAD commands: Starting Auto CAD - Auto CAD commands – (Generation of Points, Lines, Curves and Polygons) - Editing and Modifications.

Drafting Settings - Dimensioning and Text - Geometrical Constructions. Projection of Points - Straight Lines - Plane surfaces – Solids - Isometric projections

Note: CAD Lab facility is required for this unit.
(Only theory Question to be set from this Unit for Examinations)

**TEXT BOOKS**:


1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. K. Venugopal & V. Prabhu Raja (2011), Engineering Drawing + Auto CAD, New Age International Publishers. Fifth Edition.
3. CAD Software Theory and User Manuals


**REFERENCES:**


1. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
2. Agrawal B. &Agrawal C. M. (2012), Engineering Graphics, TMH Publication.


**Course outcomes:** The student will be able to

1. Equipped with the basic knowledge of using the drawing instruments and dimensioning practice.
2. Able to represent any three-dimensional object with two-dimensional drawings and exposed to the visual aspects of lines and planes
3. Exposed to visualization of solids and their sectioning
4. Exposed to representation of 3D objects through isometric and orthographic views
5. Able to use AutoCAD for two dimensional drawings.

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| **I Year - I Semester** | **3** | **1-0-0** | **4** |

**(F110E) ENGINEERING PHYSICS**

(Common to CE, ME &MIE)

**Course Objectives:** The Student will

1. Understand the basic concepts and Principles of Physics in a broader sense with a view to lay foundation for the various engineering courses.
2. Understand the concepts found in Mechanics, Harmonic Oscillations, Acoustics and Ultrasonic's, Dielectric and Magnetic Properties, wave Optics, Lasers, Fiber Optics and a broad base of knowledge in physics.
3. Understand the scientific method, so that they may use the training beneficially in their higher pursuits.
4. Learn stress principles rather than specific procedures, to select areas of contemporary interest rather than of past interest, and to condition the student to the atmosphere of change he will encounter during his carrier.
5. To study the Lasers and fibre optics enable in the field of telecommunications

**UNIT-I : Harmonic Oscillations**

Mechanical simple harmonic oscillators, Complex number notation and phasor representation of simple harmonic motion.

Damped harmonic oscillator: heavy, critical and light damping, Energy decay in a damped harmonic oscillator, Quality factor, Mechanical impedance, Steady state motion of forced damped harmonic oscillator.

**UNIT-II : Acoustics and Ultrasonic's:**

Introduction, Basic requirement for the acoustically good halls, reverberation and times of reverberation, factors, effecting the architectural acoustics and their remedy, sound absorbing materials, Sabine formula, Absorption co-efficient.

Introduction to Ultrasonic's, production of Ultrasonic's, Piezo Electric method, Properties of Ultrasonic's waves, use of Ultrasonic's for non-destructive testing

**UNIT-III: Dielectric and Magnetic Properties**

Introduction, types of polarizations, calculation of total electronic polarisability, internal field clausius - mossotti equation, Ferro electricity.

Introduction to magnetism, origin of magnetic movement, Bohr Magnton, Classifications of Dia, Para, Ferro, Antiferro and Ferri Magnetic materials on the basis of magnetic movement, hysteresis loop, soft and hard magnetic materials.

**UNIT-IV: Wave Optics**

Huygen's principle, Superposition of waves and interference of light by division of wave front and amplitude, Young's double slit experiment, Newton's rings.

Difference between Frenel and Frunhofer diffraction , Frunhofer diffraction from a single slit, Diffraction grating- resolving power, Polarization, Brewster's angle, Double refraction, Nicol's prism.

**UNIT-V: Lasers and Fiber Optics**

**Lasers:** Introduction, absorption, spontaneous emission, Stimulated emission, calculation of Einstein co-efficient, Population inversion, Pumping, Lasing action, Types of Lasers: Ruby laser, He-Ne laser, Semiconductor laser, Applications of laser.

**Fiber Optics:** Introduction, Construction and working principle of Optical fiber, Acceptance angle, Acceptance cone and Numerical aperture, Types of optical fibers, Applications of optical fibers.

**TEXT BOOKS**:


1. Engineering Mechanics, 2nd Edition.- MK Harbola, Cengage Learning
2. Engineering Physics, Gaur and Gupta, McGraw Hills.
3. "Optics", Ajoy Ghatak, McGraw Hill Education, 2012A textbook of Engineering Physics


**REFERENCES:**


1. "The physics of vibrations and waves", H. J. Pain, Wiley, 2006
2. "Principles of Lasers", O. Svelto,
3. "Introduction to Mechanics", M.K.Verma, Universities Press
4. P. K. Palanisamy, "Engineering Physics", Scitech Publications, Fourth edition.


**Course outcomes:**

The student will be able to

1. The knowledge of Physics relevant to engineering is critical for converting ideas into technology.
2. Understanding of Physics also helps engineers understand the working and limitations of existing devices and techniques, which eventually leads to new innovations and improvements.
3. gain knowledge on the mechanism of physical bodies upon the action of forces on them, the generation, transmission and the detection of the waves, Optical Phenomena like Interference, diffraction, the principles of lasers and Fiber Optics.
4. Various chapters establish a strong foundation on the different kinds of characters of several materials and pave a way for them to use in at various technical and engineering applications.
5. Gain knowledge on Lasers and fibre optics enable the students to come forward to various systems like communications, solar cell, photo cells and so on.

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| **I Year - I Semester** | **0** | **0-2-0** | **1** |

**(F1105) BASIC ELECTRICAL ENGINEERINGLAB**

(Common to CE,ME,CSE &IT)

**Course Objectives:** The Student will

1. Analyze a given network by applying various electrical laws and network theorems
2. Know the response of electrical circuits for different excitations.
3. Calculate, measure and know the relation between basic electrical parameters
4. Analyze the performance of single phase and three phase Transformers.
5. Analyze the performance characteristics of DC and AC electrical machines.

**Experiment 1:** Verification of Ohms Law.

**Experiment 2:** Verification of KVL and KCL.

**Experiment 3:** Transient response of series RL and RC circuits using DC excitation

**Experiment 4:** Transient response of RLC series circuit using DC excitation.

**Experiment 5:** Resonance in series RLC circuit.

**Experiment 6:** Calculations and verification of impedance and current of RL, RC and RLC series circuits.

**Experiment 7:** B-H loop for single phase transformers.

**Experiment 8:** Measurement of voltage, current and real power in primary and secondary circuits of a single phase transformer.

**Experiment 9:** Load test on single phase transformer (Calculate Efficiency and Regulation)

**Experiment 10:** Three phase transformer: Verification of relationship between voltages and currents (Star-Delta, Delta-Delta, Delta-star, Star-Star)

**Experiment 11:** Measurement of active and reactive power in a balanced three-phase circuit.

**Experiment 12:** Performance Characteristics of a DC Shunt Motor.

**Experiment 13:** Torque-Speed Characteristics of a DC Shunt Motor.

**Experiment 14:** Performance Characteristics of a Three-phase Induction Motor.

**Experiment 15:** Torque-speed Characteristics of a Three-phase Induction Motor

**Course outcomes:** The student will be able to

1. Get an exposure to basic electrical laws.
2. Relate the response of different types of electrical circuits to different excitations.
3. Understand the measurement, calculation and relation between the basic electrical parameters
4. Inspect the basic characteristics of transformers
5. Inspect the basic characteristics of Dynamic electrical machines

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**UGC AUTONOMOUS**

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**(F1103) ENGINEERING PHYSICS LAB**

(Common to CE,ME,CSE &IT)

**Course Objectives:** The Student will

1. Demonstrate skills in scientific inquiry, problem solving and laboratory techniques.
2. Demonstrate competency and understanding of the concepts found in Mechanical, Electric and Electronic materials a broad base of knowledge in physics.
3. Solve Experimental problems that potentially draw an experimental knowledge in multiple areas of physics.
4. Study applications in engineering like Hall effect, in the field of magnetic materials.
5. Study applications in engineering like Optical fiber, LASER, Photodiode and Solar cell

**EXPERIMENT 1:** Melde's experiment

To determine the frequency of a vibrating bar or turning fork using Melde's arrangement.

**EXPERIMENT 2:** Torsional pendulum

To determine the rigidity modulus of the material of the given wire using torsional pendulum.

**EXPERIMENT 3:** Newton's rings

To determine the radius of curvature of the lens by forming Newton's rings.

**EXPERIMENT 4:** Diffraction grating

To determine the number of lines per inch of the grating.

**EXPERIMENT 5:** LCR Circuit

To determine the Quality factor of LCR Circuit (Series& Parallel).

**EXPERIMENT 6:** Stwart's and Gee's Method

To determine the Magnetic induction by using circular coil.

**EXPERIMENT 7:** Sonometer

To determine the frequency of AC Supply sonometer.

**EXPERIMENT 8:** LASER

To study the characteristics of LASER sources.

**EXPERIMENT 9:** Dielectric constant

To determine the Dielectric constant of the given material.

**EXPERIMENT 10:** Optical fiber

To determine the Numerical aperture of a given fiber.

**Note: Any 8 experiments are to be performed**

**Course outcomes:**

The student will be able to

1. Learn the experimental concepts on in Mechanical, Electric and Electronic materials.
2. Get the knowledge of fundamentals of Semiconductor physics, Lasers and fiber optics enable the students to apply to various systems like communications, solar cell, photo cells and so on.
3. Design, characterization and study of properties of material help the students to prepare new materials for various engineering applications.
4. Exposed to the phenomena of electromagnetism and also to have exposure on magnetic materials and dielectric materials.
5. Be exposed to the phenomena of opto-electronic materials for better in the scientific world.

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| **I Year - II Semester** | **3** | **1-0-0** | **4** |

**(F120A) MATHEMATICS-II**

**ADVANCED CALCULUS**

(Common to CE, EEE,ME,ECE,CSE,IT, ECM&MIE)

**Course Objectives:** The Student will

1. Geometrical approach to the mean value theorems and their application to the mathematical problems &Evaluation of improper integrals using Beta and Gamma functions
2. Finding maxima and minima of function of two and three variables
3. Evaluation of multiple integrals and their applications
4. The physical quantities involved in engineering field related to vector valued functions
5. The basic properties of vector valued functions and their applications to line, surface and volume integrals

**UNIT-I: Calculus**

Mean value theorems: Rolle's theorem, Lagrange's Mean value theorem with their Geometrical Interpretation and applications, Cauchy's Mean Value Theorem. Taylor's Series.

Applications of definite integrals to evaluate surface areas and volumes of revolutions of curves (Only in Cartesian coordinates), Definition of Improper Integral: Beta and Gamma functions and their applications.

**UNIT-II: Multivariable Calculus (Partial Differentiation and Applications**)

Definitions of Limit and continuity. Partial Differentiation; Euler's Theorem; Total derivative;

Jacobian; Functional dependence & independence, Maxima and minima of functions of two variables and three variables using method of Lagrange multipliers

**UNIT-III: Multivariable Calculus (Integration)**

Evaluation of Double Integrals (Cartesian and polar coordinates); change of order of integration (only Cartesian form);

Evaluation of Triple Integrals: Change of variables (Cartesian to polar) for double and (Cartesian to Spherical and Cylindrical polar coordinates) for triple integrals.

Applications: Areas (by double integrals) and volumes (by double integrals and triple integrals), Centre of mass and Gravity (constant and variable densities) by double and triple integrals (applications involving cubes, sphere and rectangular parallelopiped).

**UNIT-IV: Vector Differentiation**

Vector point functions and scalar point functions. Gradient, Divergence and Curl.
Directional derivatives, Tangent plane and normal line. Vector Identities. Scalar potential functions. Solenoidal and ir-rotational vectors.

**UNIT-V: Vector Integration**

Line, Surface and Volume Integrals.
Theorems of Green, Gauss and Stokes (without proofs) and their applications.

**TEXT BOOKS**:


1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
3. R. K. Jain& S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 4th Edition, 2014


**REFERENCES:**


1. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
2. G. B. Thomas and R. L. Finney, Calculus and Analytic Geometry, 9th Edition, Pearson, Reprint, 2010.


**Course outcomes:** The student will be able to

1. Solve the applications on the mean value theorems.
2. Evaluate the improper integrals using Beta and Gamma functions.
3. Find the extreme values of functions of two variables with/ without constraints.
4. Evaluate the multiple integrals and apply the concept to find areas, volumes, centre of mass and Gravity for cubes, sphere and rectangular parallelepiped.
5. Evaluate the line, surface and volume integrals and converting them from one to another

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**(F120B) ENGLISH**

(Common to EEE, ME, ECE, CSE,IT&MIE)

**Course Objectives:** The students will

1. Understand the concept of Raman Effect and concept in LSRW skills.
2. Acquire the knowledge in ancient architecture in India and Vocabulary
3. Learn how denim jeans were manufactured.
4. Know practice of healthy eating.
5. Know how to change their fortune

**UNIT-I: 'The Raman Effect' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.**

**Vocabulary Building**: The Concept of Word Formation --The Use of Prefixes and Suffixes. **Grammar:** Identifying Common Errors in Writing with Reference to Articles and Prepositions. **Reading:** Reading and Its Importance- Techniques for Effective Reading.

**Basic Writing Skills:** Sentence Structures -Use of Phrases and Clauses in Sentences- Importance of Proper Punctuation- Techniques for writing precisely –

**Paragraph writing** – Types, Structures and Features of a Paragraph - Creating Coherence- Organizing Principles of Paragraphs in Documents.

**UNIT-II: 'Ancient Architecture in India' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.**

**Vocabulary:** Synonyms and Antonyms, Homophones, Homonyms, and Homographs. **Grammar:** Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb Agreement.

**Reading:** Improving Comprehension Skills – Techniques for Good Comprehension.

**Writing:** Format of a Formal Letter-

**Writing Formal Letters** E.g.., Letter of Complaint, Letter of Requisition, and Job Application with Resume.

**UNIT-III: 'Blue Jeans' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.**

**Vocabulary:** Acquaintance with Prefixes and Suffixes from Foreign Languages in English to form Derivatives-Words from Foreign Languages and their Use in English.

**Grammar:** Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses. Reading: Sub-skills of Reading- Skimming and Scanning

**Writing:** Nature and Style of Sensible Writing- Defining- Describing Objects, Places and Events – Classifying- Providing Examples or Evidence and Essay Writing

**UNIT-IV: 'What Should You Be Eating' from the prescribed textbook 'English for**

**Engineers' published by Cambridge University Press.**
**Vocabulary:** Standard Abbreviations in English.
**Grammar:** Redundancies and Clichés in Oral and Written Communication.
**Reading:** Comprehension- Intensive Reading and Extensive Reading.
**Writing:** Writing Practices--Writing Introduction and Conclusion -Précis Writing.

**UNIT-V: 'How a Chinese Billionaire Built Her Fortune' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.**
**Vocabulary:** Technical Vocabulary and their usage.
**Grammar:** Common Errors in English.
**Reading:** Reading Comprehension-Exercises for Practice.
**Writing:** Technical Reports- Introduction – Characteristics of a Report – Categories of Reports

**TEXT BOOKS**:

1. Sudarshana, N.P. and Savitha, C. (2018). English for Engineers. Cambridge University Press.

**REFERENCES:**

1. Swan, M. (2016). Practical English Usage. Oxford University Press.
2. Kumar, S and Lata, P.(2018). Communication Skills. Oxford University Press.
3. Wood, F.T. (2007).Remedial English Grammar. Macmillan.
4. Zinsser, William. (2001). On Writing Well. Harper Resource Book.
5. Hamp-Lyons, L. (2006).Study Writing. Cambridge University Press.
6. Exercises in Spoken English. Parts I –III. CIEFL, Hyderabad. Oxford University Press

**Course outcomes:** The student will be able to

1. Find the nature of diffraction and use LSRW skills in his day to day life conversations.
2. Implement in the construction field.
3. Design different models in manufacturing jeans.
4. Discuss balanced eating habits with everyone.
5. Implement in their own life.

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| **B. Tech. ME** | **L** | **T-P-D** | **C** |
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| **I Year - II Semester** | **3** | **0-0-0** | **3** |

**(F125A) PROGRAMMING FOR PROBLEM SOLVING**

(Common to CE,ME,CSE,IT& MIE)

**Course Objectives:** The Student will

1. Learn the fundamentals of computers.
2. Understand the various steps in program development.
3. Understand the syntax and semantics of C programming language.
4. Learn the usage of structured programming approach in solving problems.
5. Gain the knowledge on searching and sorting methods.

**UNIT – I : Introduction to Programming**

**Introduction to components of a computer system:** disks, primary and secondary Memory, processor, operating system, compilers, creating, compiling and executing a program etc., Number systems. Introduction to Algorithms: steps to solve logical and numerical problems. Representation of Algorithm, Flowchart/Pseudo code with examples, Program design and structured programming. Introduction to C Programming Language: variables (with data types and space requirements), Syntax and Logical Errors in compilation, object and executable code, Operators, expressions and precedence, Expression evaluation, Storage classes (auto, extern, static and register), type conversion, The main method and command line arguments

**Bitwise operations:** Bitwise AND, OR, XOR and NOT operators Conditional Branching and Loops: Writing and evaluation of conditionals and consequent branching with if, if-else, switch-case, ternary operator, goto, Iteration with for, while, do- while loops.I/O: Simple input and output with scanf and printf, formatted I/O, Introduction to stdin, stdout and stderr.

**UNIT – II : Arrays, Strings, Structures and Preprocessor**

**Arrays:** one and two dimensional arrays, creating, accessing and manipulating elements of arrays.

**Strings:** Introduction to strings, handling strings as array of characters, basic string functions available in C (strlen, strcat, strcpy, strstr etc.), arrays of strings

**Structures:** Defining structures, initializing structures, unions, Array of structures

**Preprocessor:** Commonly used Preprocessor commands like include, define, undef, if, ifdef, ifndef

**UNIT – III : Pointers and File Handling in C**

**Pointers:** Idea of pointers, Defining pointers, Pointers to Arrays and Structures, Use of Pointers in self-referential structures, usage of self-referential structures in linked list (no implementation) Enumeration data type.

**Files:** Text and Binary files, Creating and Reading and writing text and binary files, Appending data to existing files, Writing and reading structures using binary files, Random access using fseek, ftell and rewind functions.

**UNIT – IV : Function and Dynamic Memory Allocation**

**Functions:** Designing structured programs, declaring a function, Signature of a function, Parameters and return type of a function, passing parameters to functions, call by value, passing arrays to functions, passing pointers to functions, idea of call by reference, Some C standard functions and libraries.

**Recursion:** Simple programs, such as Finding Factorial, Fibonacci series etc., Limitations of Recursive functions.

**Dynamic memory allocation:** Allocating and freeing memory, Allocating memory for arrays of different data types.

**UNIT – V : Introduction to Algorithms**

Basic searching algorithms (linear and binary search techniques),

Basic sorting algorithms (Bubble, Insertion, Quick, Merge and Selection sort algorithms)

Basic concept of order of complexity through the example programs

**TEXT BOOKS**:

1. Reema Thareja, Programming in C, Oxford university press.
2. B.A. Forouzan and R.F. Gilberg, C Programming and Data Structures, Cengage Learning, (3rdEdition)

**REFERENCES:**

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. R.G. Dromey, How to solve it by Computer, Pearson (16$^{th}$Impression)
3. Stephen G. Kochan, Programming in C, Fourth Edition, Pearson Education.
4. Herbert Schildt, C: The Complete Reference, McGraw Hill, 4thEdition
5. Byron Gottfried, Schaum's Outline of Programming with C, McGraw Hill

**Course outcomes:** The student will be able to

1. Convert the algorithms/flowcharts to C programs.
2. Code and test a given logic in C programming language.
3. Decompose a problem into functions and to develop modular reusable code.
4. Use arrays, pointers, strings and structures to write C programs.
5. Implement Searching and sorting problems.

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| **I Year - II Semester** | **3** | **1-0-0** | **4** |

**(F120D) ENGINEERING CHEMISTRY**

(Common to CE, ME, CSE, IT & MIE)

**Course Objectives:** The Student will

1. know the suitability of water for domestic and industrial purposes
2. bring adaptability to new developments in Engineering Chemistry and to acquire the skills required to become a perfect engineer.
3. understand the principles of electrochemistry and corrosion
4. acquire knowledge of chemical reactions those are used in the synthesis of molecules.
5. include the importance of spectroscopic techniques and molecular energy levels

**UNIT – I : Atomic Structure and Theories of Bonding**

Atomic and Molecular orbitals. Linear Combination of Atomic Orbitals (LCAO), molecular orbitals of diatomic molecules, molecular orbital energy level diagrams of $N_2$, $O_2$, $F_2$, CO and NO.

**Crystal Field Theory (CFT):** Salient Features of CFT – Crystal Field Splitting of transition metal ion d- orbitals in Tetrahedral, Octahedral and square planar geometries. Band structure of solids and effect of doping on conductance.

**UNIT – II : Water and Its Treatment**

Introduction – hardness of water – Causes of hardness - Types of hardness: temporary and permanent – expression and units of hardness – Estimation of hardness of water by complexometric method. Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization.

Boiler feed water and its treatment – Calgon conditioning, Phosphate conditioning and Colloidal conditioning. External treatment of water – Ion exchange process. Desalination of water – Reverse osmosis. Numerical problems

**UNIT – III : Electrochemistry and Corrosion**

Electro chemical cells – electrode potential, standard electrode potential, types of electrodes – calomel, Quinhydrone and glass electrode. Nernst equation, determination of pH of a solution by using quinhydrone and glass electrode. Electrochemical series and its applications. Numerical problems. Batteries – Primary (Lithium cell) and secondary batteries (Lead – acid storage battery).

**Corrosion:** Causes and effects of corrosion – theories of chemical and electrochemical corrosion – mechanism of electrochemical corrosion, Types of corrosion: Galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion, Corrosion control methods-Cathodic protection – Sacrificial anode and impressed current cathodic methods. Surface

coatings – metallic coatings – techniques of coating-hot dipping, cementation and electroplating of Copper.

**UNIT – IV : Spectroscopic Techniques and Applications**

Principles of spectroscopy, selection rules and applications of electronic spectroscopy. Vibrational and rotational spectroscopy.

Basic concepts of Nuclear magnetic resonance Spectroscopy, chemical shift. Introduction to Magnetic resonance imaging.

**UNIT – V : Reaction Mechanism and Synthesis of Drug Molecules**

**Substitution reactions:** Nucleophilic substitution reactions: Mechanism of $S_N1$, $S_N2$ reactions. Electrophilic and nucleophilic addition reactions: Addition of HBr to propene. Markownikoff and anti Markownikoff's additions. Grignard additions on carbonyl compounds. Elimination reactions: Dehydro halogenation of alkylhalides. Saytzeff rule.

**Oxidation reactions:** Oxidation of alcohols using KMnO4 and chromic acid. Reduction reactions: reduction of carbonyl compounds using $LiAlH_4$& $NaBH_4$. Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.

**TEXT BOOKS**:


1. P. C. Jain & M. Jain; Dhanpat Rai, Engineering Chemistry,Publishing Company (P) Ltd., New Delhi.
2. C.N. Banwell, Fundamentals of Molecular Spectroscopy
3. K.P.C. Volhardt and N. E. Schore, Organic Chemistry: Structure and Function ,5th Edition.
4. B.M. Mahan, University Chemistry, Pearson IV Edition.
5. P.W. Atkins,Physical Chemistry,
6. B.L. Tembe, Kamaluddin and M.S. Krishnan, Engineering Chemistry (NPTEL Web-book)


**REFERENCES:**


1. B. L. Tembe, Kamaluddin and M. S.Krishnan, Engineering Chemistry(NPTEL web book)
2. D. Narsipuri, Stereochemistry of organic compounds ,published by New age international publishers


**Course outcomes:** The student will be able to

1. analyze microscopic chemistry in terms of atomic and molecular orbitals
2. understand the suitability of water for domestic and industrial purposes
3. apply their knowledge in solving related engineering problems.
4. synthesize drug molecules
5. distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques

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**(F1201) ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB**

(Common to EEE,ME,ECE,CSE,IT & MIE)

**Course Objectives:** The Student will

1. Recognize sounds of English
2. Apply stress and intonation while speaking
3. Develop Listening skills.
4. Develop introducing himself and others.
5. Understand how to describe, debate and knows the types of presentations.

The following course content is prescribed for the English for the English Language and Communication Skills Lab based on Unit -6 of AICTE Model Curriculum 2018 for B. Tech First English. As the syllabus is very limited, it is required to prepare teaching/learning materials by the teachers collectively in the form of handouts based on the needs of the students in their respective colleges for effective teaching/learning and timesaving in the lab.

**SYLABUS:**

English Language and Communication Sills Lab (ELCS) will have two parts:

**a)** Computer Assisted Language Learning (CALL) Lab

**b)** Interactive Communication Skills (ICS) Lab

**Exercise – I:**

**CALL Lab**:

***Understand:*** Listening Skill- Its importance – Purpose- Process- Types- Barriers of Listening. ***Practice*****:** Introduction to Phonetics – Speech Sounds – Vowels and Consonants.

**ICS Lab**: *Understand:* Communication at Work Place- Spoken vs. Written language. *Practice:* Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing Oneself and Others.

**Exercise – II:**

**CALL Lab**:

***Understand:*** Structure of Syllables – Word Stress and Rhythm– Weak Forms and Strong Forms in Context.

***Practice:*** Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms in Context.

**ICS Lab**:

***Understand:*** Features of Good Conversation – Non-verbal Communication.

***Practice:*** Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette

**Exercise – III:**

**CALL Lab**:

***Understand:*** Intonation-Errors in Pronunciation-the Influence of Mother Tongue (MTI).

***Practice:*** Common Indian Variants in Pronunciation – Differences in British and American Pronunciation.

**ICS Lab**:

***Understand:*** How to make Formal Presentations.

***Practice:*** Formal Presentations.

**Exercise – IV:**

**CALL Lab**:

***Understand:*** Listening for General Details.

***Practice:*** Listening Comprehension Tests.

**ICS Lab**:

***Understand:*** Public Speaking – Exposure to Structured Talks.

***Practice:*** Making a Short Speech – Extempore

**Exercise – V:**

**CALL Lab**:

***Understand:*** Listening for Specific Details.

***Practice:*** Listening Comprehension Tests.

**ICS Lab**:

***Understand:*** Interview Skills.

***Practice:*** Mock Interviews.

**Computer Assisted Language Learning (CALL) Lab:**

**The Computer Assisted Language Learning Lab** has to accommodate 40 students with 40 systems, with one Master Console, LAN facility and English language learning software for self- study by students. **System Requirement (Hardware component):** *Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications:*

i) Computers with Suitable Configuration

ii) High Fidelity Headphones

**Interactive Communication Skills (ICS) Lab:**

**The Interactive Communication Skills Lab:** A Spacious room with movable chairs and audio-visual aids with a Public-Address System, a LCD and a projector etc.

**Course outcomes:** The student will be able to

1. Analyze and use correct pronunciation.
2. Make use of stress and intonation properly while speaking and writing.
3. Tell the answers effectively after listening
4. Describe him and others in day to day life situations.
5. Improve in handling debates and oral presentation.

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**(F1206) PROGRAMMING FOR PROBLEM SOLVING LAB**

(Common to CE,ME,CSE,IT& MIE)

**Course Objectives:** The Student will

1. To work with an IDE to create, edit, compile, run and debug programs
2. To analyze the various steps in program development.
3. To develop programs to solve basic problems by understanding basic concepts in C like operators, control statements etc
4. To develop modular, reusable and readable C Programs using the concepts like functions, arrays etc.
5. To write programs using the Dynamic Memory Allocation concept, files

**1. SIMPLE NUMERIC PROBLEMS:**

a) Write a program for find the max and min from the three numbers.
b) Write the program for the simple, compound interest.
c) Write program that declares Class awarded for a given percentage of marks, where mark <40%= Failed, 40% to <60% = Second class, 60% to <70%=First class, >=70% = Distinction. Read percentage from standard input

**2. EXPRESSION EVALUATION:**

a) Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)
b) Write a program that finds if a given number is a prime number
c) A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of these quence.
d) Write a C program to find the roots of a Quadratic equation.

**3. ARRAYS AND POINTERS AND FUNCTIONS:**

a) Write a C program to find the minimum, maximum and average in an array of integers
b) Write a C program to find Addition of Two Matrices
c) Write a C program to find Multiplication of Two Matrices
d) Write C programs that use both recursive and non-recursive functions
e) Write a program for reading elements using pointer into array and display the values using array.

**4. Files:**

a) Write a C program to display the contents of a file to standard output device.
b) Write a C program which copies one file to another, replacing all lowercase characters with their uppercase equivalents.
c) Write a C program to count the number of times a character occurs in a text file. The file name and the character are supplied as command line arguments.

**5. Strings:**

a) Write a C program to determine if the given string is a palindrome or not (Spelled same in both directions with or without a meaning like madam, civic, noon, abcba, etc.)
**b)** Write a C program to count the lines, words and characters in a given text.

**6. Sorting and Searching:**

a) Write a C program for using binary search method.
b) Write a C program for linear search.
c) Write a C program that implements the Bubble sort method.
d) Write a C program that implements the Insertion sort method.
e) Write a C program that implements the Quick sort method.
f) Write a C program that implements the Merge sort method.

**ADDITIONAL PROGRAMS (Given to Students as Assignment):**

1) Write a program that prints a multiplication table for a given number and the number of rows in the table. For example, for a number 5 and rows = 3, the output should be:
   **a.** 5 x 1 = 5, **b**. 5 x 2 =10, **c**. 5 x 3 =15
2) Write a program that shows the binary equivalent of a given positive number between 0 to 255
3) Write a C program to find the sum of individual digits of a positive integer and test given number is palindrome.
4) Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
5) Write a C program to calculate the following, where x is a fractional value. 1-x/2+x^2/4-x^3/6.
6) Write a C program to read in two numbers, x and n, and then compute the sum of this geometric progression: 1+x+x^2+x^3+x^n. For example: if n is3 and x is 5, then the program computes 1+5+25+125.
7) Write a C program to find the minimum, maximum and average in an array of integers.
8) Write a functions to compute mean, variance, Standard Deviation, sorting of n elements in single dimension array.
9) Write a C program that uses functions to perform the following:

(a) Transpose of a matrix with memory dynamically allocated for the new matrix as row and column counts may not be same.
(b) To find the factorial of a given integer.
(c) To find the GCD (greatest common divisor) of two given integers.

10) Write a C program that does the following:
(a) It should first create a binary file and store 10 integers, where the file name and 10 values are given in the command line. (hint: convert the strings using atoi function) Now the program asks for an index and a value from the user and the value at that index should be changed to the new value in the file. (hint: use fseek function). The program should then read all 10 values and print them back.
(b) Write a C program to merge two files into a third file (i.e., the contents of the first file followed by those of the second are put in the third file).

11) Write a C program to convert a Roman numeral ranging from I to L to its decimal equivalent.

12) Write a C program that converts a number ranging from 1 to 50 to Roman equivalent

13) Write a C program that uses functions to perform the following operations:
(a)To insert a sub-string in to a given main string from a given position.
(b) To delete n Characters from a given position in a given string.

14) Write a C program to construct a pyramid of numbers as follows:

```
1          *          1          1          *
1 2        * *        2 3        2 2        * *
1 2 3      * * *      4 5 6      3 3 3      * * *
                                 4 4 4 4    * *
                                            *
```

15) Write a C program that sorts a given array of names

**Course outcomes:** The student will be able to

1. Formulate the algorithms for simple problems
2. Correct syntax errors as reported by the compilers
3. Represent and manipulate data with arrays, strings and structures
4. Use pointers of different types, functions
5. Create, read and write to and from simple text and binary files

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**(F1205) WORKSHOP AND MANUFACTURING PRACTICES**

(Common to CE,ME,ECE, ECM & MIE)

**Course Objectives:** The Student will

1. Acquire basic skills in machining operations on lathe, milling and drilling machines
2. Learn about the tools used in Fitting shop, and perform the basic operations such as square-cutting, V-fitting, etc.,
3. Learn about the various tools used in Carpentry, and how to make joints such as dovetail lap joint, cross half lap joint, etc.,
4. Get to know about the Elements of Electrical house wiring, and do certain basic exercises like One lamp controlled by one switch, stair case wiring, etc.,
5. Learn how to use the tools of Arc welding and Gas Welding, and do simple exercises like
6. Learn the various types of Patterns and Molding sands, know how to use the different tools in Foundry practice
7. Understand the various hand Forging tools and Forging operations and perform simple exercises such as To make a Square rod from a given round rod, To make an S-hook from a given round rod, etc.,
8. Understand the basic tools used in Sheet metal work, and learn to produce simple shapes like a Rectangular Tray, a cylindrical pipe, etc., as per required dimensions.

**(I) WORKSHOP AND MANUFACTURING PRACTICES – 10 Lecture hours**

1. Brief introduction to Manufacturing processes: –
   a. machining on lathe, milling and drilling machines,
   b. basic process involved in the casting,
   c. brief process of forging, forming,
   d. metal joining, brief process of gas welding **(3 hours )**
2. Demo of working of CNC machine **(2 hours)**
3. Fitting operations & power tools **(1 hour)**
4. Electric house wiring **(1 hour)**
5. Carpentry **(1 hour)**
6. Metal casting **(1 hour)**
7. Welding (arc welding & gas welding), brazing **(1 hour)**

**(II) WORKSHOP PRACTICE: 60 hours**

1. Machine shop - on Lathe, Milling and drilling **(12 hours)**
2. Fitting shop **(8 hours)**
3. Carpentry **(8 hours)**

4. Electrical house wiring **(8 hours)**
5. Welding shop (Arc welding 4 hrs + gas welding 4 hrs) **(8 hours)**
6. Foundry practices – mould preparation **(8 hours)**
7. Smithy – Black smithy and Tin smithy **(8 hours)**

**Course outcomes:** The student will be able to

1. Follow the general safety precautions while doing the exercises in the workshop.
2. Gain complete knowledge of the tools and equipments used in foundry, fitting, carpentry, House-wiring, machine shop, welding and black smithy, etc.,
3. Fabricate various models, using the above tools, in these trades such as Carpentry, Fitting, Tin smithy, etc.,
4. Understand the basics of metal removal from Workpiece surface to attain specific shape.
5. Prepare a concise report on each exercise.
6. Be ready to get further training in Machine Tools Laboratory, CAD/CAM Laboratory, etc.,

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| **I Year - II Semester** | **0** | **0-3-0** | **1.5** |

**(F1203) CHEMISTRY LABORATORY**
(Common to CE, ME,CSE,IT &MIE)

**Course Objectives:** The Student will

1. Estimate the hardness & chloride content in water to check its suitability for drinking purpose.
2. Determine the rate constant of reactions from concentrations as a function of time.
3. Gain the knowledge about measurement of physical properties like adsorption and viscosity.
4. Synthesize the drug molecules and check the purity of organic molecules by thin layer chromatographic (TLC) technique.
5. To measure the conductance and EMF values of solutions

**EXPERIMENT 1**: Determination of total hardness of water by complexometric method using EDTA

**EXPERIMENT 2**: Determination of chloride content of water by Argentometry

**EXPERIMENT 3**: Estimation of an HCl by Conductometric titrations

**EXPERIMENT 4**: Estimation of Acetic acid by Conductometric titrations

**EXPERIMENT 5**: Estimation of HCl by Potentiometric titrations

**EXPERIMENT 6**: Estimation of $Fe^{2+}$ by Potentiometry using KMnO4

**EXPERIMENT 7**: Estimation of amount of $Cu^{+2}$ by Colorimetry

**EXPERIMENT 8**: Estimation of amount of $KMnO_4$ by Colorimetry

**EXPERIMENT 9**: Synthesis of Aspirin and Paracetamol

**EXPERIMENT 10**: Determination of acid value of coconut oil

**EXPERIMENT 11**: Thin layer chromatography calculation of $R_f$ values. egortho and para nitro phenols

**EXPERIMENT 12**: Determination of viscosity of castor oil and ground nut oil by using Ostwald's viscometer.

**EXPERIMENT 13**: Determination of partition coefficient of acetic acid between n-butanol and water.

**EXPERIMENT 14**: Determination of surface tension of a give liquid using stalagmometer.

**Course outcomes:** The student will be able to

1. Determine the parameters like hardness and chloride content in water.
2. Estimate the rate constant of a reaction from concentration – time relationships.
3. Determine the physical properties like adsorption and viscosity.
4. Calculate Rf values of some organic molecules by TLC technique.
5. Students can be able to determine the partition coefficient of a organic compound in two immissible liquids

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| **II Year - I Semester** | **2** | **0-0-0** | **2** |

**(F210B) BIOLOGICAL SCIENCES**

(Common to ME&CE )

**Course Objectives:** The Student will

1. Understand the basics of biology such as cell structure and functions
2. Gain the knowledge on inheritance & evolution, systems of human life
3. Understand the role nutrition on the biological system
4. Learn basic concepts of microbiology
5. Learn basic concepts of genetics

**UNIT – I : Basic Biology**

Introduction, Living organisms, Cell structure and Organelles, Organogenesis.

**UNIT – II : Human Anatomy**

Systems of Life-Digestion, Respiration, Circulation, Excretion, Reproduction, and Nervous system.

**UNIT – III : Biochemistry**

Diet and Nutrition- Macro (Carbohydrates, proteins, lipids) - and Micronutrients (vitamins), Essential minerals and their role; deficiency symptoms; and their role; deficiency symptoms.

**UNIT – IV : Microbiology**

Microorganisms -Classification of Microorganisms, beneficial and harmful effects of Bacteria, Fungi and Viruses

**UNIT – V : Genetics**

Basic principles of Mendel, molecular genetics, structure and function of genes and chromosomes, Transcription and Translation, gene expression and regulation

**TEXT BOOKS**:

1. P K Gupta, “Elements of Biotechnology”, RASTOGI Publications
2. Dr RC Dubey, “Advanced Biotechnology”, S Chand Publications.

**REFERENCES:**

1. “Cell biology”, Rastogi Publications
2. Biotechnology, U. sathyanarayana

**Course outcomes:** The student will be able to

1. Acquire the Knowledge of basic biology
2. Acquire the Knowledge of Human Biological Systems
3. Acquire the knowledge of Nutrients
4. Acquire Knowledge on Microorganisms
5. Acquire the knowledge genetics

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| **II Year - I Semester** | **3** | **0-0-0** | **3** |

**(F213A) INSTRUMENTATION AND METROLOGY**

**Course Objectives:** The Student will

1. Gain knowledge of basic principles of Measurement and Measurement systems, and the sources of error, their classification and elimination
2. Understand and perform measurement of different parameters, such as Temperature, Pressure, Flow, Speed, Force, Torque, Power, and Strain Measurement
3. Understand the concept of Limits, fits and tolerances, and learn to use the Limit Gauges, Sine bar, etc.,
4. Learn the methods of Measurement of flat surfaces, and Surface Roughness Measurement.
5. Understand the principle of operation of Coordinate Measuring Machines, their types and applications.

**UNIT – I :**

**Definition** – Basic principles of measurement – Measurement systems, generalized configuration and functional descriptions of measuring instruments – examples. 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, Calibration procedures

**UNIT – II :**

**Measurement of Temperature:** Classification – Various Principles of measurement – Expansion, Electrical Resistance – Thermistor – Thermocouple – Pyrometers – Temperature Indicators.

**Measurement of Pressure:** Classification – different principles used. Manometers, Bourdon pressure gauges, Bellows – Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges – ionization pressure gauges, Mcleod pressure gauge.

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

**UNIT – III :**

**Measurement of Speed:** Mechanical Tachometers – Electrical tachometers – Stroboscope, Non- contact type of tachometer.

**Strain Measurements:** Strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending, Strain gauge Rosettes.

**Measurement of Force, Torque and Power:** Elastic force meters, load cells, Torsion meters, Dynamometers

**UNIT – IV :**

**Limits, fits and tolerances:** Unilateral and bilateral tolerance system, hole and shaft basis system. Interchangeability and selective assembly. FD and IT grades and fit designations **Limit Gauges**: Taylor's principle, Design of GO and NO GO gauges Measurement of angles, Bevel protractor, and Sine bar. Measurement of flat surfaces, straight edges, surface plates, optical flat and auto collimator, precision polygon

**UNIT – V :**

**Surface Roughness Measurement**: Roughness, Waviness. Surface roughness parameter symbols, Roughness measurement by Taylor Hobson. Methods of measurement of surface finish, Talysurf. Screw thread measurement, Gear measurement; Machine Tool Alignment Tests on lathe, milling and drilling machines

**Coordinate Measuring Machines:** Types and Applications of CMM.

**TEXT BOOKS**:

1. Measurement Systems: Applications and Design: D.S. Kumar, Anuradha Agencies.
2. Instrumentation, Measurement and Analysis: B.C. Nakra & K.K. Choudhary, TMH.
3. Engineering Metrology / IC Gupta / Danpath Rai
4. Engineering Metrology / R/K / Jain / KhannaPublishers

**REFERENCES:**

1. Instrumentation and Control Systems: S. Bhaskar, Newage Publications, 1998.
2. BIS Standards on Limits & Fits, Surface Finish, Machine Tool Alignment etc.
3. Fundamentals of Dimensional Metrology 4e / Connie Dotson /Thomson.

**Course outcomes:** The student will be able to

1. Understand the basics of Instrumentation systems and Metrology measurements and Identify the sources of error, their classification and elimination
2. Use the various transducers to measure displacement, such as Piezo-electric, Inductive, Capacitance, etc., and know their Calibration procedures
3. Perform measurement of Temperature, Pressure, Speed, Flow, Torque, etc., using the relevant instruments
4. Understand the significance of Limits, fits and tolerances, and will be able to use the Limit Gauges, Bevel protractor, and Sine bar, etc.,
5. Perform the measurement of Surface Roughness, Screw thread measurement, Gear measurement; and Machine Tool Alignment Tests and Apply the Coordinate Measuring Machine to measure the height, width, and depth of the target.

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| **II Year - I Semester** | **2** | **1-0-0** | **3** |

**(F213B) THERMODYNAMICS**

**Course Objectives:**

The Student will

1. Understand the Basic Concepts of Thermodynamics, Heat and Work Transfer, Zeroth Law and First Law of Thermodynamics.
2. Learn the Limitations of the First Law of Thermodynamics, Concept of the Second Law of Thermodynamics and Entropy, Elementary Treatment of the Third Law of Thermodynamics
3. Study the Perfect Gas Laws, Concepts of Internal Energy, enthalpy, and entropy, Vander Waals Equation of State, Phase Transformations, and Mollier charts, etc.,
4. Study of the Mixtures of perfect Gases, Gravimetric and volumetric Analysis, Avogadro's Laws of additive volumes, etc.
5. Learn the Thermodynamic Cycles like the Otto, Diesel, Dual Combustion cycles, etc., and study the Comparison of air standard cycles and actual cycles.

**UNIT – I : Introduction**

Basic Concepts: System, Control Volume, Surrounding, Boundaries and Universe, Types of Systems, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle – Reversibility – Quasi – static Process – various Non - flow processes, properties, end states, Heat and Work Transfer, , Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Types, Displacement & Other forms of Work, Heat, Point and Path functions, Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points

– Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale-Joule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system – Steady Flow Energy Equation - Throttling and Free Expansion Processes – Flow processes.

**UNIT – II :**

Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump , Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics

**UNIT – III :**

Perfect Gas Laws – Equation of State, specific and Universal Gas, changes in Internal Energy, enthalpy, entropy and specific heats, various non flow processes. Deviations from perfect Gas Model – Vander Waals Equation of State – Compressibility charts – variable specific Heats – Gas Tables-

Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction, Mollier charts – Various Thermodynamic processes and energy Transfer Steam Calorimetry.

**UNIT – IV :**

Mixtures of perfect Gases – Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction, Volume fraction and partial pressure, Equivalent Gas const. And Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour.

**UNIT – V :**

Thermodynamic Cycles: Power cycles: Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles. Comparison of air standard cycles and actual cycles.

**TEXT BOOKS**:

1. Engineering Thermodynamics: PK Nag /TMH, 5th Edition
2. Engineering Thermodynamics/E Rathakrishnan, PHI, second Edition,2013

**REFERENCES:**

1. Engineering Thermodynamics/DP Mishra/ Cengage Learning, Second impression2012
2. Thermodynamics – An Engineering Approach – Yunus Cengel & Boles, TMH
3. Thermodynamics – J. P. Holman, McGraw Hill

**Course outcomes:**

The student will be able to

1. Basic concepts of thermodynamic such as System, Control Volume, Continuum, Thermodynamic Equilibrium, Point and Path functions, Steady Flow Energy Equation, etc.,
2. Limitations of the First Law & Second Law of Thermodynamics, Clausius Inequality, Entropy, and Elementary understanding of the Third Law of Thermodynamics
3. Perfect Gas Laws, Deviations from perfect Gas Model, Gas Tables, Phase Transformations, and Steam Calorimetry
4. Mixtures of perfect Gases – Mole Fraction, Mass friction, Dalton's Law of partial pressure, and Entropy of Mixture of perfect Gases and Vapour.
5. Thermodynamic Cycles such as Otto, Diesel, Sterling, and Atkinson Cycles, Thermal Efficiency and Mean Effective Pressures on Air standard basis, and Comparison of Cycles.

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| **II Year - I Semester** | **3** | **0-0-0** | **3** |

**(F214E) BASIC ELECTRONICS ENGINEERING**

**Course Objectives:** The student will

1. Be introduced with basic knowledge in the analysis of Electric Circuits.
2. Learn to solve the given circuit with various theorems and methods.
3. Learn in recognizing of basic electronic devices such as Diodes, Transistors, to build circuits like amplifiers and oscillators etc.
4. Given thorough knowledge on the various parameters useful for designing electronic system.
5. Acquire the knowledge of various configurations, characteristics and applications

**UNIT – I :**

Semiconductors, Energy levels, PN- Junction diode, VI- characteristics of PN- Junction, Diode as a switch, Rectifiers and Filters, Zener diode, Zener diode characteristics, Voltage regulator.

**UNIT – II :**

Transistor, CB-Configuration, CE-configuration, CC- Configuration, current gains α, β, γ, Relation between current gains, Q-point.

**UNIT – III :**

Digital Circuits: Number Systems, Binary, Octal, Hexadecimal System, Binary - Decimal, Decimal - Binary Conversions. BCD Code. Logic Gates: AND, OR, NAND, NOR. Boolean Theorems, De- Morgan's Theorem, Universal Gates. Sum of products form. Algebraic simplification.

**UNIT – IV :**

Designing Combinational Logic Circuits, and Adder and Subtractor. Flip-flops - RS, D, JK

**UNIT – V :**

Definition of Modulation and Demodulation, Principles of Amplitude and Frequency Modulation, Block Diagram of AM and FM receivers and transmitters. Introduction to basic communication system.

**TEXT BOOKS**:

1. Electronic Devices And Millman & Halkias McGraw Hill

**REFERENCES:**

1. Electronic Devices and Circuits BOYLESTAD
2. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7$^{th}$edition, Pearson, 2014.

3. D. Neamen , D. Biswas "Semiconductor Physics and Devices," McGraw-Hill Education

**Course Outcomes:** The student will be able to

1 Demonstrate strong fundamental back ground in Electronic Engineering.
2 Analyze and solve problems of ac and dc circuits.
3 Find out the value of different resistors.
4 Analyze and design various electronic circuits through various numerous practical circuit
5 Design examples using currently-available devices and standard-value components

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| **II Year - I Semester** | **3** | **0-0-0** | **3** |

**(F213C) MATERIALS ENGINEERING**

**Course Objectives:** The Student will

1. Understand the concepts of composites, their properties, applications, and testing methods.
2. Learn about the manufacturing processes for Thermosetting matrix composites and Thermoplastic matrix composites
3. Gain knowledge of various methods of processing the Metal Matrix Composites.
4. Learn about the Ceramic Matrix Composites, Nano-composites, and Carbon-Carbon Composites, their properties, Fabrication methods, and Applications
5. Learn various methods of Repair and Non-destructive testing for composite materials

**UNIT – I :**

**Engineering Materials and their properties:** Grains and Grain Boundaries. Effect of grain size on the properties. Determination of grain size by different methods.

**Testing of material and their properties:** Tensile, compression and torsion tests; Young's modulus; stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, Hardness , resilience, toughness and elastic recovery

**UNIT – II :**

**Constitution of Alloys:** Necessity of alloying, Types of solid solutions, Hume - Rothery rules, Intermediate alloy phases.

**Phase Diagrams:** Construction and interpretation of phase diagrams, Phase rule and Lever rule. Binary phase Diagrams: Iso-morphous, Eutectic, Eutectoid and Peritectic transformations with examples

**Engineering Materials** –I STEELS:

Iron-Carbon Phase Diagram and Heat Treatment: Study of Fe-Fe3C phase diagram. Construction of

TTT diagrams. Annealing, Normalizing, Hardening and Tempering of steels, Hardenability, Alloy steels. BIS designation of steels

**UNIT – III :**

**Engineering Materials –II**: CAST IRONS: Structure and properties of White Cast iron, Malleable Cast iron, Grey cast iron and Nodular Cast Iron.

**Engineering Materials-III**: Non-ferrous Metals and Alloys: Structure and properties of copper and its alloys, Aluminium and its alloys, Titanium and its alloys.

**UNIT – IV : Engineering Materials–IV**

Ceramics, Polymers and Composites: Crystalline ceramics, glasses, cermets: structure, properties and applications. Classification, properties and applications of composites. Classification, Properties and applications of Polymers.

**UNIT – V :**

**Static failure theories**: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb;

**Fracture mechanics:** Introduction to Stress-intensity factor approach and Griffith criterion.

**Fatigue failure:** High cycle fatigue, Stress-life approach, SN curve, endurance and fatigue limits, effects of mean stress using the Modified Goodman diagram; Fracture with fatigue.

**TEXT BOOKS**:


1. Introduction to Physical Metallurgy: Sidney H. Avner, S Chand Publications, 2nd Edition, 1997.
2. Material Science and Metallurgy for Engineers: Kodgire, Everest Publications, 14th Edition, 2003.
3. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
4. W. D. Callister, 2006, “Materials Science and Engineering-An Introduction”, 6th Edition, Wiley India.


**REFERENCES:**


1. Materials Science and engineering: William and callister.
2. Engineering Material and Metallurgy: Er Amandeep Singh Wadhva
3. Materials Science for Engineering Students: Traugott Fischer 2009Edition.


**Course outcomes:** The student will be able to

1. Describe the important properties of composites, their applications, and testing methods.
2. Identify the manufacturing methods of Polymer Matrix Composites
3. Apply the knowledge acquired in the manufacturing of Metal Matrix Composites, Ceramic Matrix Composites, and Nano-composites to practical situations
4. Identify and assess the damage in Composites by Non-destructive testing methods, and repair the same
5. Apply the knowledge of various methods for Repair and Non-destructive testing for composite materials

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| **II Year - I Semester** | **2** | **1-0-0** | **3** |

**(F213D) ENGINEERING MECHANICS**

**Course Objectives:** The Student will

1. Understand the Concept of Systems of forces, Moment of Force, Couples, and their applications
   and Equilibrium of Planar Spatial force systems
2. Gain knowledge to determine the Centroid, Centre of gravity, and Moment of Inertia of Simple and Composite Figures
3. Learn Analysis of Perfect truss and Imperfect truss by the Method of joints and Method of sections
4. Learn Concepts of : Kinematics – Analysis of Rectilinear and Curvilinear motion of a Rigid Body in Planar Motion
5. Understand Concepts of : Kinematics – Equations of Plane Motion, Fixed Axis Rotation, etc.,

**UNIT – I : Introduction to Engineering Mechanics**

Basic Concepts. Systems of Forces: Coplanar Concurrent Forces–Forces in Space–Moment of Force (scaler and Vector methods) and its Application–Couples and Resultant of Force Systems.

**Equilibrium of Force Systems:** Free Body Diagrams, Equations of Equilibrium - Equilibrium of planar Systems -Equilibrium of Spatial Systems.

**UNIT – II : Centroid**: Centroids of simple figures (from basic principles) – Centroids of Composite Figures

**Centre of Gravity**: Centre of gravity of simple body (from basic principles), centre of gravity of composite bodies, Pappus theorem.

**Area moment of Inertia :** Definition–Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia.

**UNIT – III : Analysis of structures**

Introduction- Types of trusses- Analysis of Perfect Truss-Imperfect truss.

**Analysis of trusses**: Method of joints-Method of sections.

**UNIT – IV : Kinematics**

Rectilinear and Curvilinear motions–Velocity and Acceleration–Motion of Rigid Body Types and their Analysis in Planar Motion

**UNIT – V : Kinetics**

Analysis as a Particle and Analysis as a Rigid Body in Translation–Central Force Motion

Equations of Plane Motion–Fixed Axis Rotation–Rolling Bodies

**TEXT BOOKS**:

1. Engineering. Mechanics / Timoshenko &Young.
2. Engineering Mechanics, Basudev Bhattacharya, Oxford Univ. Press, New Delhi, Second Edition, 2014.

**REFERENCES:**

1. Engineering Mechanics / Fedinand. L. Singer /Harper–Collins
2. Engineering Mechanics / S.S. Bhavikatti & J. G. Rajasekharappa
3. Engineering Mechanics / Irving. H. Shames, Prentice–Hall.

**Course outcomes:** The student will be able to

1. Apply Systems of Forces, Moments, Couples, Resultant of Force Systems, and Equilibrium of Force Systems
2. Determine the location of Cenroid, Centre of Mass and Centre of Gravity for different shapes, Moments of Inertia of Composite Figures, and Products of Inertia.
3. Analyze of structures – their types, Perfect trusses, Imperfect trusses, and their application in engineering problems.
4. Analyze the Rectilinear and Curvilinear motions of a Rigid bodyin Planar Motion, Equations of Plane Motion, and Fixed Axis Rotation of Rolling Bodies and Solving practical problems based on the above concepts.
5. Analyze Particals and rigid bodies under kinetic motion. Be in a position to study the subjects like Theory of Machines, Strength of Materials, Design of machine elements, etc.,

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| **II Year - I Semester** | **0** | **0-0-6** | **3** |

## (F2131) MACHINE DRAWING PRACTICE

**Course Objectives:** The Student will

1. understand the fundamental concepts of machine drawing, and develop the capacity to represent any machine part.
2. develop knowledge of SI Conventions for working drawings of Machine Parts.
3. draw the views of different machine elements and parts, such as Cotter Joints, Shaft couplings, Bearings, etc., with correct drawing proportions.
4. develop skill to draw the Assembled Views for the part drawings of I C engine components, Valves, etc.

**Machine Drawing Conventions:**

Need for Machine Drawings – Introduction to SI Conventions – Introduction to types of Drawings and working Drawings for Machine Parts.

a) Conventional representation of Materials, Common Machine Elements and Parts such as Screws, Nuts, Bolts, Keys, Gears, Bearings, Springs, etc.

b) Types of Sections – Selection of sectional planes and drawing of sections and auxiliary sectional views. Parts not usually sectioned.

c) Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centre lines, curved and tapered features.

d) Title boxes - size, location and details - common abbreviations in general usage

**I. Drawing of Machine Elements and Simple Parts**

Selection of Views, additional views for the following machine elements and parts with easy drawing proportions.

a. **Screw Threads and Fasteners** - Popular forms of Screw Threads, Bolts, Nuts, Stud Bolts, Tap Bolts, Set Screws.
b. **Keys** – Saddle Keys, Sunk Keys, Feather Keys, Woodruff Keys, Splines
c. **Cotter Joints** – with Sleeves, with Socket and Spigot ends, with Gibs
d. **Pin Joints** – Knuckle Joint.
e. **Riveted Joints**: Various types of Riveted Joints for plates.
f. **Welded Joints:** Various types of Welded Joints and Symbols.
g. **Shaft coupling** – Sleeve or Muff Couplings, Flanged Couplings, Universal Couplings, Oldham Coupling.
h. **Pipe Joints**: Cast Iron Pipe Joints, Joints for Hydraulic Pipes, Pipe Fittings
i. **Pulleys**: Flat Belt Pulleys, 'V' – Belt Pulleys, Rope Pulleys.

j. **Bearings:** Journal Bearings – Solid, Bushed and Collared Journal Bearings, Pivot or Foot-Step Bearings.

**II. Assembly Drawings:**

Drawings of Assembled Views for the part drawings of the following using conventions and easy drawing proportions.

a) **Engine Parts:** Steam Engines: Stuffing Box, Cross Head, Eccentric. Petrol Engine: Connecting Rod, Piston Assembly.
b) **Other Machine Parts:** Screws Jack, Plain Machine Vice, Plummer Block, Tail-stock.
c) **Valves**: Gate Valve, Screw-down Stop Valve, Spring Loaded Safety / Relief Valve, Feed Check Valve and aircock.

**NOTE:** First angle projection to be adopted.

**TEXT BOOKS**:


1. Machine Drawing: K. L. Narayana, P. Kannaiah & K. Venkata Reddy; New Age Publishers, 5th Edition, 2016.
2. Machine Drawing: N.D. Bhatt; Charotar Publications, 47th Edition,2012


**REFERENCES:**


1. Machine Drawing: Ajeet Singh; TMH Publications, 4th Edition,2010
2. Machine Drawing: P. S. Gill; Kataria Publications, 16th Edition,1996
3. Machine Drawing: Junarkar. N. D; Pearson Publication, 2009


**Course outcomes:** The student will be able to

1. gain thorough knowledge of the conventional representation of common Machine Elements and Parts such as Screws, Nuts, Keys, Bearings, Springs, etc.
2. acquire Very good skills in drawing of joints used in engineering practice, such as Cotter and Knuckle Joints, Riveted Joints, Welded Joints, etc.,
3. draw the assembly drawings of Machine Parts such as Stuffing Box, Eccentric, Connecting Rod, Screw Jack, Valves, etc.,
4. interpret the machine drawings that in turn help the students in the preparation of the production drawings.

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| **II Year - I Semester** | **0** | **0-2-0** | **1** |

## (F2143) BASIC ELECTRONICS ENGINEERING LAB

**Course Objectives:** The student will

1. be introduced the basic knowledge in the analysis of electric circuits
2. learn to solve the given circuit with various theorems and methods
3. learn in recognizing of basic electronic devices such as diode, transistors, to builds circuits like amplifiers, oscillators etc …
4. gain thorough knowledge on the various parameters useful for designing electronic systems
5. acquire the knowledge of the various configurations, characteristics and applications

**Experiment-1:** Forward & Reverse Bias Characteristics of a PN Junction Diode

**Experiment-2:** Zener diode Characteristics

**Experiment-3:** Zener diode as a voltage Regulator

**Experiment-4:** Input & Output Characteristics of Transistor in CB Configuration

**Experiment-5:** Input & Output Characteristics of Transistor in CE Configuration

**Experiment-6:** Half Wave Rectifier with & without filters

**Experiment-7:** Full Wave Rectifier with & without filters

**Experiment-8:** Bridge Rectifier with & without filters

**Experiment-9:** Verification of logic gates

**Experiment-10:** Verification of Universal gates

**Experiment-11:** Design and Verification of Half adder

**Experiment-12:** Design and Verification of Full adder

**Experiment-13:** Amplitude Modulation and Demodulation

**Experiment-14:** Frequency Modulation and Demodulation

**Course Outcomes:** The student will be able to

1. demonstrate strong fundamental background in electrical engineering
2. analyze and solve problems of AC and DC circuits
3. find out the value of different resistors
4. analyze and design electronic circuits through various numerous practical circuit
5. design examples using currently available devices and standard value components

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| **II Year - I Semester** | **2** | **0-0-0** | **0** |

**(F210D) ENVIRONMENTAL SCIENCE**

(Common to ME&CE )

**Course Objectives:** The Student will

1. know the importance of Environment is a key to the future of mankind.
2. understand global warming, the depletion of ozone layer and loss of biodiversity have made everyone aware of environmental issues
3. understand the social, aesthetic, ethical, scientific, and technical aspects of environmental issues.
4. apply modeling to understand the behavior make predictions for future and plan management in view of changing environmental conditions

**UNIT-I: Ecosystems & Natural Resources**, **Biodiversity**

Concept, Classification of Resources: Water resources, Land resources, land degradation, Forest resources, Mineral resources, Energy resources. Concept of ecosystem, Classification of ecosystem, Functions of ecosystem. Biodiversity, Level, values, hotspots of biodiversity, Threats To Biodiversity, Conservation of Biodiversity.

**UNIT-II: Global Environmental Problems and Global Efforts**:

Deforestation, Greenhouse effect, Global Warming, Sea level rise, Ozone depletion. International conventions/protocols: green-belt- development, Concept of Green Building, Clean Development Mechanism (CDM).

**Environmental Impact Assessment (EIA) and Environmental Management Plan:** Definition of Impact, classification of impacts, methods of baseline data acquisition. Impacts on different components: such as human health resources, air, water, flora, fauna and society, impact assessment methodologies. Environmental management plan (EMP)

**UNIT-III: Environmental Policy, Legislation, Rules and Regulations:** Environmental Protection Act: Air (Prevention and control of pollution) Act-1981, Water (Prevention and control of pollution) Act-1974, Forest Conservation Act

**Towards Sustainable Future**: Concept of Sustainable Development, Threats to Sustainability, Strategies for achieving Sustainable development, Environmental Ethics, Environmental Economics, Concept of Green Computing.

**TEXT BOOKS**:


1. Text book of Environmental Science and Technology by M. Anji Reddy2007
2. Principles of Environmental Science and Engineering by P. Venugopal Rao.
3. Introduction to Environmental Studies by K. Mukkanti
4. Text book of Environmental studies by Kaushik & Anubhakaushik

**REFERENCES:**


1. Tata McGraw Hill: Introduction to Environmental Studies by BennyJoseph
2. Environmental Studies by Erach Bharucha 2005, University Grants Commission, University Press.


**Course outcomes:** The student will be able to

1. understand the importance of natural resources and use them efficiently and knowing how to conserve the biodiversity.
2. apply environmental plan in developing any sort of environmental projects.
3. apply the environmental legislation in every walk of life.
4. analyze reserve the natural resources for future generations in sustainable manner

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**(F220A) PROBABILITY AND PARTIAL DIFFERENTIAL EQUATIONS**

(Common to ME & CE)

**Course Objectives:** The Student will

1. learn basic properties of probability and random variables
2. understand different types of hypothesis and hypothesis testing
3. learn the T-distribution-distribution and chi-square distribution
4. learn different numerical techniques used for solving algebraic and transcendental equations
5. perform formation and solution of first order PDE

**UNIT-I: Probability and Distributions**

Random variables-Definitions of Random variables (Discrete and continuous). Distributions- Binomial-Poisson and normal distributions-related properties

**UNIT-II: Sampling Theory**

Sampling distributions –Sampling distribution of means (known and Unknown)-Estimation- Point estimation-interval estimation-confidence interval estimates of parameters

**UNIT-III: Testing of Hypothesis**

Tests of hypothesis -Large samples- Null hypothesis – Alternate hypothesis type I, & type II errors – critical region, confidence interval for mean testing of single variance, Difference between the means.

**UNIT-IV: Partial Differential Equations of First Order**

Introduction-Formation of partial equation by elimination of arbitrary constants-arbitrary functions-solutions of first order linear (Lagrange) equation and nonlinear (Standard type)

**UNIT-V: Partial Differential Equations Second Order**

Introduction- Classification of linear PDEs-Method of separation of variables to solve IBVP like 1-D heat, 1-D wave and BVP like 2-D Laplace's equations

**TEXT BOOKS**:


1. Introduction- Classification of linear PDEs-Method of separation of variables to solve IBVP like 1-D heat, 1-D wave and BVP like 2-D Laplace's equations Grewal B.S, "Higher Engineering Mathematics", Khanna publications, 42nd edition 2012
2. Advanced Engineering Mathematics by Jain and S.R.K. Iyangar, Narosa Publications
3. Numerical Methods by T.K.V. Iyengar & B. Krishna Gandhi & Others, S. Chand

**REFERENCES:**


1. Engineering Mathematics by G. Shankar Rao, I.K. International Publications
2. KREYSZIG. E, “Advanced Engineering Mathematics” John Wiley& Sons Singapore, 10th edition, 2012
3. Veerarajan. T “Engineering Mathematics-I”, Tata McGraw hill Publishing Co. New Delhi, 5th edition,2006.
4. Engineering Mathematics by B. V. Ramana, Tata McGraw hill Publishing Company Ltd. New Delhi, 5th edition,2011


**Course outcomes:** The student will be able to

1. classify the types of random variables and calculate mean and variance
2. recognize where the binomial distribution could be appropriate model and find mean and variance
3. understand the foundation for classical inference involving confidence interval and hypothesis testing
4. calculate the solution of algebraic and transcendental equations
5. form first order PDE and solution of PDE

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| **II Year - II Semester** | **3** | **1-0-0** | **4** |

**(F223A) THEORY OF MACHINES –I**

**Course Objectives:** The Student will

1. learn the concept of machines, mechanisms and related terminologies such as Kinematic link, Kinematic pair, Kinematic chains and their Inversions.
2. understand the Concepts of Relative Velocity, Instantaneous center of rotation, Coriolis acceleration, and Determination of Velocity and Acceleration of any point in a mechanism by graphical methods.
3. learn Construction and Operation of Steering mechanisms, Hooke's Joint, and Straight Line Motion Mechanisms, their applications.
4. study Cams and Followers, their Classification, Drawing of Cam Profile for different combinations of cams, followers, and follower motions, and Analysis of Cams with special profiles.
5. learn Different types of Gears, Gear Terminology, Gear teeth profiles, Interference in gears, types of Gear Trains, their applications, Finding Train Value, Analysis of Epicyclic gear Train, and Differential gear for an automobile.

**UNIT-I:**

**Mechanisms:** Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained.

**Machines:** Mechanism and machines – classification of machines – kinematic chain – inversion of mechanism – inversions of quadric cycle chain – single and double slider crank chains. Mechanical Advantage –Grubler's criterion.

**UNIT-II:**

**Kinematics:** Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration diagrams – Graphical method – Application of relative velocity method four bar chain.

**Analysis of Mechanisms:** Analysis of slider crank chain for displacement, velocity and acceleration of slider – Acceleration diagram for a given mechanism, Kleins construction, Coriolis acceleration, determination of Coriolis component of acceleration.

**Plane motion of body:** Instantaneous center of rotation, centrodes and axodes – relative motion between two bodies – Three centres in line theorem – Graphical determination of instantaneous centre, Velocity diagrams for simple mechanisms and determination of angular velocity of points and links.

**UNIT-III:**

**Steering Mechanisms:** Conditions for correct steering – Davis Steering gear, Ackermans steering gear – velocity ratio.

**Hooke's Joint:** Single and double Hooke's joint – Universal coupling – application – problems. **Straight Line Motion Mechanisms:** Exact and approximate copied and generated types – Peaucellier, Hart and Scott Russul – Grasshopper – Watt, T. Chebicheff and Robert Mechanisms, Pantograph

**UNIT-IV:**

**Cams:** Definitions of cam and followers – their uses – Types of followers and cams – Terminology – Types of follower Motion - Uniform Velocity – Simple Harmonic Motion and Uniform Acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases.

**Analysis of motion of followers:** Roller follower – circular cam with straight- Tangent cam with roller follower.

**UNIT-V:**

Higher pairs, friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion, Form of teeth: cycloidal and involute profiles. Velocity of sliding – phenomenon of interference – Methods of reducing interference. Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact – Introduction to Helical, Bevel and worm gearing.

**Gear Trains:** Introduction – Train value – Types – Simple and reverted gear train – Epicyclic gear Train. Methods of finding train value or velocity ratio – Compound Epicyclic gear trains. Selection of gear box-Differential gear for an automobile.

**TEXT BOOKS**:

1. Theory of Machines: Thomas Bevan, Pearson Publications, 3rd Edition,2011.
2. Theory of Machines: S. S. Ratan, Tata McGrill,2015

**REFERENCES:**

1. Theory of Machines: R. K. Bansal, S. Chand, 5th Edition,2010
2. Theory of Machines: P L. Ballaney, Khanna publishers.
3. Mechanism and Machine Theory: J S Rao and RV Dukkipati, NewAge international publications

**Course outcomes:** The student will be able to

1. understand the basic principles of mechanisms and machines, their analysis and applications.
2. apply the knowledge of Velocity and Acceleration Analysis to practical problems.

3. have a thorough understanding of various Mechanisms such as Steering Mechanisms, Hooke's Joint etc., so as to apply these concepts in real world problems.
4. have a thorough understanding of various Mechanical Elements such as cam & Follower and their follower profiles.
5. apply various concepts related to gear drive, able to learn & implement in practical way.

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| **II Year - II Semester** | **3** | **0-0-0** | **3** |

**(F223B) MANUFACTURING TECHNOLOGY**

**Course Objectives:** The Student will

1. learn about the Sand Casting process, Patterns and Pattern making, Special casting processes, and Methods of Melting
2. understand the basics of Welding, Types of welding, and different methods for Cutting of Metals
3. have detailed understanding of various welding processes like TIG and MIG welding, Friction welding, Induction welding, Explosive welding, etc., and their applications and learn about the welding defects, their causes and remedies, Destructive and non-destructive testing of welds
4. gain knowledge of the process and application of Fabrication methods, such as Rolling, Extrusion of metals, Forging processes, Drawing and its types, Presses and Press tools, etc.,
5. learn the basics of Metal Cutting theory, Mechanics of orthogonal cutting, and Cutting Tool materials.

**UNIT-I: CASTING**

Steps involved in making a casting – Advantage of casting and its applications. – Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Principles of Gating, Gating ratio and design of Gating systems. Solidification of casting – Concept – Solidification of pure metal and alloys, short and long freezing range alloys. Risers – Types, function and design, casting design considerations, special casting processes, Centrifugal casting, Die casting, Investment casting.

**Methods of Melting:** Crucible melting and cupola operation, steel making processes.

**UNIT-II: Welding**

Classification of welding process types of welds and welded joints and their characteristics, design of welded joints, Gas welding, Arc welding, Forge welding, resistance welding, Thermit welding and Plasma (Air and water) welding.

**Cutting of Metals:** Oxy Acetylene Gas cutting, water plasma cutting and Cutting of ferrous, non-ferrous metals

**UNIT-III:**

Inert Gas welding, TIG and MIG, welding, Friction welding, Induction welding, Explosive welding, Laser welding, Soldering and Brazing. Heat affected zones in welding; welding defects – causes and remedies – destructive nondestructive testing of welds

**UNIT-IV:**

Hot working, cold working, strain hardening, recovery, re-crystallization and grain growth, Comparison of properties of Cold and Hot worked parts, Rolling fundamentals – theory of rolling, types of Rolling mills and products. Forces in rolling and power requirements.

**Extrusion of metals:** Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion Hydrostatic extrusion. **Forging processes:** Principles of forging – Tools and dies – Types Forging – Smith forging, Drop Forging – Roll forging – Forging hammers: Rotary forging – forging defects.

Stamping, forming and other cold working processes: Blanking and piercing – Bending and forming – Drawing and its types – wire drawing and Tube drawing – coining – Hot and cold spinning – Types of presses and press tools. Forces and power requirement in the above operations

**UNIT-V:**

Elementary treatment of metal cutting theory – Basics of cutting process – Geometry of single point tool - angles chip formation and types of chips – built up edge and its effects, chip breakers - Mechanics of orthogonal cutting –Merchant's diagram, cutting forces – cutting speeds, feed, depth of cut, tool life, coolants, machinability – Tool materials.

**TEXT BOOKS**:


1. Manufacturing Technology: P.N. Rao, TMH, 2nd Edition, 2000.
2. Manufacturing Processes for Engineering Materials: Serope Kalpakjian and Steven R Schmid, Pearson Pubishers.
3. Machine Tools: C. Elanchezhian and M. Vijayan, Anuradha Agencies Publishers, 2nd Edition, 2012


**REFERENCES:**


1. Production Technology: Sharma P C, S. Chand Publications, 6th Edition, 2006.
2. Production Technology: R.K. Jain, Khanna Publications, 2005.
3. Production Engineering : Suresh Dalela& Ravi Shankar, Galgotia Publications Pvt. Ltd.


**Course Outcomes:** The student will be able to

1. make the pattern , mould and casting
2. prepare metal joints by Gas welding, Arc the welding, TIG / MIG welding etc. and different methods for cutting metals.
3. apply the knowledge of advanced welding techniques of TIG, MIG , Friction welding, explosive welding.
4. Well-versed with the principles of Hot / Cold working, Rolling, Extrusion, Forging, etc.
5. apply the concepts of Mechanics of orthogonal cutting, Chip formation, Cutting forces, etc., in further study of Metal Cutting and Machine Tools

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| **II Year - II Semester** | **3** | **1-0-0** | **4** |

**(F223C) MECHANICS OF SOLIDS**

**Course Objectives:** The Student will

1. Understand basic concepts of stress, strain, their relations, and study the Stresses in axially loaded members, and Composite bars
2. Learn about the Shear Force and Bending Moment in beams, how to draw S.F and B.M diagrams for cantilever, simply supported, and overhanging beams subjected to different types of loads and study the Deflection and Slope of a beam subjected to different types of loading
3. Acquire sufficient knowledge about Flexural Stresses, Theory of simple bending, Determination bending stresses and section modulus, and Design of simple beam sections. and learn about the Shear Stresses and Shear stress distribution across various beams sections like rectangular, circular, triangular, etc.,
4. Understand the concepts of Principal Stresses and Strains, Compound stresses, Normal and Tangential stresses, – Analytical and Graphical solutions.
5. Study in detail about Pure torsion of Circular Shafts, Torsional moment of resistance, and Design of shafts according to various theories of failure and understand the topics of Thin seamless cylindrical shells, longitudinal and circumferential stresses and strains, Thin spherical shells, Thick Cylinders, and Compound cylinders.

**UNIT-I:** Stresses in axially loaded members, Bars of uniform & varying section – composite bars – Temperature stresses

**UNIT-II: Shear Force and Bending Moment:** Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, U.D.L., uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of abeam.

**Deflection of Beams:** Deflection of Beams: Introduction- Relation between slope, deflection and radius of curvature- Deflection and slope of a beam subjected to uniform bending moment, Deflection of a simply supported beam carrying a point load at the centre, eccentric point load, and a uniformly distributed load. Deflection by using Double integration method, Macauly's method, moment area method and strain energy method.

**UNIT-III: Flexural Stresses:** Theory of simple bending – Assumptions – Derivation of bending equation: M/I = f/y = E/R Neutral axis – Determination bending stresses –

section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.

**Shear Stresses:** Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

**UNIT-IV: Principal Stresses and Strains**

Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for biaxial stresses – Two perpendicular normal stresses accompanied by a state of simple shear – Mohr's circle of stresses – Principal stresses and strains – Analytical and graphical solutions.

**UNIT-V: Torsion of Circular Shafts:** Theory of pure torsion – Derivation of Torsion equations: $T/J = q/r = N\theta/L$ – Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts – Combined bending and torsion and end thrust – Design of shafts according to theories of failure.

**Thin and Thick Cylinders:** Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in diameter, and volume of thin cylinders– Thin spherical shells. Thick Cylinders-Lami's equations, Compound cylinders.

**TEXT BOOKS**:

1. Strength of materials – R.S. Kurmi and Gupta.
2. Solid Mechanics, by Popov
3. Strength of Materials – Ryder. G.H.; Macmillan Long Man Pub.
4. Strength of Materials – W.A. Nash,TMH

**REFERENCES:**

1. Strength of Materials -By Jindal, Umesh Publications.
2. Analysis of structures by Vazirani and Ratwani.
3. Mechanics of Structures Vol –I by H. J. Shah and S. B. Junnarkar, Charotar Publishing House Pvt. Ltd.
4. Strength of Materials by D.S Prakash Rao, Universities Press Pvt. Ltd.
5. Strength of Materials by S. S. Rattan, Tata McGraw Hill Education Pvt. Ltd.

**Course outcomes:** The student will be able to

1. predict mechanical behavior of the member by determining the stresses, strains and deflections produced by the various loads
2. draw shear force and bending moment diagrams for statically determinate beam due to various types of loads and evaluate slope and deflection of statically determinate beams by the various loads
3. apply the concept of theory of bending and solve numerical problems across various beam sections like rectangular, circular, triangular etc.
4. apply the concepts of different types of stresses and strains in the design of simple beam sections, shafts,
5. solve numerical problems to determine the torsional moments in shaft and to design shafts according to various theories of failure, and apply the concept of thick and thin cylinders

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**(F220B) MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS**

(Common to ME,ECE & ECM)

**Course Objectives:** The student will

1. know the basics of management's concepts,
2. understand production and cost analysis concepts,
3. know trends in economic environment and
4. understand financial accounting topics.
5. gain knowledge on marketing management, and Logistics

**UNIT-I: Introduction to Managerial Economics & Demand Analysis**

Definition, Nature and Scope of Managerial Economics

Demand Analysis: Demand Determinants, Law of Demand and its exceptions. Elasticity of Demand: Definition, Types, Measurement and Significance of Elasticity of Demand. Demand Forecasting, Factors governing demand forecasting, methods of demand forecasting.

**UNIT-II: Production & Cost Analysis**

Production Function - Isoquants and Isocosts, MRTS, Least Cost Combination of Inputs, Cobb- Douglas Production function, Laws of Returns, Internal and External Economies of Scale.

Cost Analysis: Cost concepts. Break-even Analysis (BEA)-Determination of Break-Even Point (simple problems) - Managerial Significance.

**UNIT-III: Types of Markets & Economic Environment**

Types of competition and Markets, Features of Perfect competition, Monopoly and Monopolistic Competition.

Price-Output Determination in case of Perfect Competition and Monopoly. Pricing - Objectives and Policies of Pricing. Methods of Pricing. Trends in economic Environment: Inflation, GDP, Introduction to GST, Interest rates

**UNIT-IV: Introduction to Financial Accounting**

Accounting concepts and Conventions - Introduction IFRS - Double - Entry Book Keeping, Journal, Ledger, Trial Balance - Final Accounts (Trading Account, Profit and Loss Account and Balance Sheet with simple adjustments)

**UNIT-V: FINANCIAL ANALYSIS**

Analysis and Interpretation of Liquidity Ratios, Activity Ratios, and Capital structure Ratios and Profitability ratios. Du Pont Chart analysis. Theoretical concept of Funds Flow Statements.

**TEXT BOOKS**:

1. Ambrish Gupta, Financial Accounting for Management, Pearson Education, New Delhi, 2012.
2. H. Craig Peterson & W. Cris Lewis, Managerial Economics, Pearson, 2012. Lipsey & Chrystel, Economics, Oxford University Press,2012.

**REFERENCES:**

1. Varshney & Maheswari: Managerial Economics, Sultan Chand, 2014
2. S.A. Siddiqui & A.S. Siddiqui, Managerial Economics and Financial Analysis, New Age international Publishers, Hyderabad 2014.

**Course outcomes:** The student will be able to

1. Know the Importance of management and contributions of management thinkers
2. Know prominent importance of planning, vision & mission, types of organizational structures.
3. apply fundamentals of operations management & project management
4. apply basic concepts of Human resource management, Job Evolution, Leadership and Motivation.
5. familiar to marketing management, Marketing mix, PLC, rural marketing, Logistics & SCM

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**(F2231) MATERIALS ENGINEERING LABORATORY**

**Course Objectives:** The Student will

1. Get familiarized with the tools used in various shops, such as Foundry, Welding, Press- working, and Processing of Plastics
2. Gain hands-on training in the production of sand castings, fabrication of welded joints, and Processing methods of Plastics such as Injection Molding and Blow Molding.
3. Be able to understand the principle and application of different welding processes, such as Arc welding, Gas welding, Brazing, etc., and their related equipment / tools Learn to carry out the Blanking and Piercing operations, and Press-working operations
4. Be able to correlate the theoretical concepts of the above processes to the real world situations in practice
5. Learn to appreciate the limitations in applying the theoretical concepts to practical problems.

**EXPERIMENT 1**: Preparation and study of the Micro Structure of pure metals such as Fe, Cu and Al.

**EXPERIMENT 2**: Preparation and study of the Microstructure of Plain Carbon Steels such as Mild steels, Low carbon Steels and High carbon Steels.

**EXPERIMENT 3**: Study of the Micro Structures of Cast Irons.

**EXPERIMENT 4**: Study of the Micro Structures of Copper Alloys.

**EXPERIMENT 5**: Study of the Micro Structures of Aluminum Alloys.

**EXPERIMENT 6**: Tensile test on UTM.

**EXPERIMENT 7**: Impact test.

**EXPERIMENT 8**: Hardness test.

**EXPERIMENT 9**: Torsion test.

**EXPERIMENT 10**: Determination of Young's modulus using beams such as Cantilever beam and simply supported beam

**Course outcomes:** The student will be able to

1. Prepare different types of patterns, and use the pattern to prepare a sand mold with Runner, Riser, Gating, Pouring basin, etc.,
2. Get the training for Melting the metal and pouring it into the mold to produce the casting
3. Understand the principle and application of different welding processes, such as Arc welding, Gas welding, Brazing, etc., and their related equipment / tools and fabricate metal joints by Arc welding, Gas welding, Spot welding, Plasma welding, etc.,
4. Use the Press tools for Blanking and Piercing operation
5. Carry out exercises in : Injection Molding and Blow Molding
6. Interpret the results of experiments, understand the limitations of the practical processes and draw correct inferences.

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## (F2232) INSTRUMENTATION AND METROLOGY LABORATORY

**Course Objectives:** The Student will

1. Understand the usage of common measurement equipment, and learn the basic concepts of Accuracy, Precision, Uncertainty, Error, etc.,
2. Gain basic knowledge of measuring linear displacement, Temperature, flow, speed and strain measurements, and Calibration of the measuring systems used.
3. Learn the use of Vernier calipers, Micrometers, Dial bore indicators, etc., to measure Lengths, Heights and Diameters
4. Learn to use the Bevel Protractor, Tool Maker's Microscope, Sine bars for Angle and Taper measurements.
5. Understand how to carry out the measurement of Spur Gear elements, Thread measurement by Three Wire Method, and measurement of Surface roughness using Talysurf.

**EXPERIMENT 1:** Calibration of LVDT for the measurement of linear displacement.
**EXPERIMENT 2:** Calibration of Thermocouple, Thermistor, RTD for temperature measurement.
**EXPERIMENT 3:** Study and calibration of Photo and Magnetic speed pickups for the speed measurement.
**EXPERIMENT 4:** Calibration of strain gauge for cantilever beam**.**
**EXPERIMENT 5:** Study and calibration of Rotameter for flow measurement**.**
**EXPERIMENT 6:** Measurement of a lengths, Heights and diameters by Vernier calipers and micrometers.
**EXPERIMENT 7:** Measurement of bores by internal micrometer and dial bore indicators
**EXPERIMENT 8:** Measurement of Spur Gear elements
**EXPERIMENT 9:** Angle and Taper measurements by Bevel Protractor and Sine bars.
**EXPERIMENT 10:** Thread measurement by Three Wire Method.
**EXPERIMENT 11:** Surface roughness measurement using Talysurf
**EXPERIMENT 12:** Tool Makers Microscope and its Applications

**Course outcomes:**

The student will be able to

1. Calibrate the measuring instruments, and conduct the experiments with minimum error in measurements
2. Apply the basic knowledge of Linear Displacement, Temperature, flow, speed and strain measurements, with good accuracy and precision, in practical situations

3. Have good knowledge of using various Metrological instruments like Vernier calipers, Micrometers, Bevel Protractor, Talysurf, and Tool Maker's Microscope
4. Have good knowledge to use Bevel Protractor, Tool Maker's Microscope, Sine bars for Angle and Taper measurements.
5. Interpret the results of experiments and draw correct inferences.

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| **II Year - II Semester** | **0** | **0-2-0** | **1** |

## (F2233) MANUFACTURING TECHNOLOGY LABORATORY

**Course Objectives:** The Student will

1. Understand the principles of metal casting processes with detailed design of gating, riser, pattern, sprue system.
2. Acquire basic operational skills on various advanced welding processes and identify safety measures in using welding machine.
3. Summarize the theory of press working operations used in the fabrication of sheet metal components.
4. Learn the basic processing techniques of thermoplastics by injection and blow moulding.

***1. METAL CASTING***

**EXPERIMENT 1:** Pattern Design and making - for one casting drawing**.**

**EXPERIMENT 2:** Moulding Melting and Casting - 1 Exercise

***2. WELDING:***

**EXPERIMENT 1:** ARC Welding Lap & Butt Joint - 2 Exercises

**EXPERIMENT 2:** Spot Welding - 1 Exercise

**EXPERIMENT 3:** TIG welding

**EXPERIMENT 4:** Gas Welding-1 Exercise

**EXPERIMENT 5:** Brazing-1 Exercise

**EXPERIMENT 6:** Plasma Welding

3. ***MECHANICAL PRESS WORKING*:**

**EXPERIMENT 1:** Blanking and piercing operations, study of simple, compound and progressive press tools

4. ***PROCESSING OF PLASTICS***

**EXPERIMENT 1:** Injection Moulding

**EXPERIMENT 2:** Blow Moulding

**Course outcomes:** The student will be able to

1. Prepare mould cavities using different types of patterns, get the training for melting and pouring the molten metal into mould cavity.
2. Explain the welding symbols, types of joints, defects in weld joints and the applications of arc welding, spot welding,TIG welding, brazing and plasma welding.
3. Identify sheet metal cutting operations.
4. Classify the processed plastics by injection, blow moulding and describe the process of manufacturing.

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**(F220E) GENDER SENSITIZATION**

(Common to CE & ME)

**Course Objectives:** The students will

1. Understand caste system
2. Learn women's work its politics and economics aware rebuilding lives.
3. Understand about relationships, responsibilities and gender identities

**UNIT-I: Gender: Why should we study it?**

Socialization: Making women, Making Men, Introduction, Preparing For Womanhood, Growing up male, First lessons in caste, Different masculinities.

**UNIT-II: Women's Work: Its Politics and Economics**

Fact and fiction, Unrecognized and unaccounted work, Further reading: Wages and conditions of work, Domestic Violence: Speaking Out, Is home a safe place?, When women unite [Film], Rebuilding lives, Further reading: New forums for justice.

**UNIT-III: Just Relationships: Being Together as Equals**

Marykom and Onler, Love and acid just do not mix, Love letters, Mothers and fathers, Further Reading: Rosa Parks – The brave heart

**TEXT BOOKS**:

1. Towards a world of equals by A. Suneetha Susic Tharu publication Telugu academy Hyderabad

**Course outcomes:** The student will be able to

1. Describes the basic structure of caste system in India and the major four categories to which all castes could be come out of ignorance and archaic indoctrination to make the world a better place for both men and women
2. Have learnt to keep them safe and alive in the face of domestic violence
3. Learnt to maintain equality in gender, the student should have understood the responsibility of being good citizens overcoming social evils

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## (F313A) MECHANICS OF FLUIDS AND HYDRAULIC MACHINES

**Course Objectives:** The Student will

1. Understand the physical properties fluids and their influence on fluid motion and learn the difference between Atmospheric, gauge and vacuum pressures, and about measurement of pressure using Piezometer, U-tube, etc.,
2. Understand the Kinematics and Dynamics of fluids, different types of flows, Equation of Continuity, Euler's and Bernoulli's equations, Momentum equation and its application
3. Study the Concept of Boundary Layer, laminar and turbulent boundary layers, Closed conduit flow, pipes in series and pipes in parallel, and Measurement of flow using Pitot tube, Venturimeter, etc.,
4. Learn about the basics of turbo machinery, Hydrodynamic force of jets on stationary and moving vanes, and Velocity diagrams and Study Hydraulic Turbines, impulse and reaction turbines, hydraulic design of turbines, and assess the Performance of hydraulic turbines
5. Acquire sufficient knowledge about the working and performance characteristics of Centrifugal pumps and Reciprocating pumps

**UNIT-I Fluid Statics**

Dimensions and units: physical properties of fluids- specific gravity, viscosity, and surface tension vapour pressure and their influence on fluid motion, buoyancy.

**Pressure Measurement:** Atmospheric, gauge and vacuum pressures – measurement of pressure- Piezometer, U-tube and differential manometers.

**UNIT-II: Fluid Kinematics:**

Stream line, path line and streak lines and stream tube, classification of flows- steady and unsteady, uniform and non-uniform, laminar and turbulent, rotational and irrotational flows-equation of continuity for one dimensional flow and three dimensional flows.

**Fluid Dynamics:** Surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend.

**UNIT-III: Closed conduit flow:**

Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line. Measurement of flow: pitot tube, venturimeter, and orifice meter, Flow nozzle.

**Boundary Layer Concepts:** Definition, thicknesses, characteristics along thin plate,

laminar and turbulent boundary layers (No derivation) boundary layer in transition, separation of boundary layer, submerged objects – drag and lift.

**UNIT-IV: Basics of turbo machinery:**

Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

**Hydraulic Turbines:** Classification of turbines, Heads and efficiencies, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design –draft tube theory- functions and efficiency.

**Performance of hydraulic turbines:** Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

**UNIT-V: Centrifugal pumps**:

Classification, working, workdone – barometric head- losses and efficiencies specific speed- performance characteristic curves, NPSH.

**Reciprocating pumps:** Working, Discharge, slip, indicator diagrams.

**TEXT BOOKS**:


1. Modi and Seth, "*Hydraulics, Fluid Mechanics and Hydraulic Machinery*", Standard Book House, 20th Edition, 2015.
2. R. K. Rajput, "*Fluid Mechanics and Hydraulic Machines"*, S. Chand Publications, 6th Edtn


**REFERENCES:**


1. Dr. D.S. Kumar, "*Fluid Mechanics and Fluid Power Engineering*", KATSON Publications, 2012
2. D. Rama Durgaiah, "*Fluid Mechanics and Machinery"*, New Age International (P) Ltd, Publishers, Reprint 2004.
3. Banga & Sharma, "*Hydraulic Machines"*, Khanna Publishers, 16th Edition, 2016


**Course outcomes:** The student will be able to

1. Gain thorough knowledge about measurement of pressure using Piezometer, U-tube, etc and solve numerical problems concerning the measurement of pressure.
2. Apply the various equations such as the Continuity equation, Euler's and Bernoulli's equations, Momentum equation, etc., to analyze the Kinematics and Dynamics of fluids and solve concern numerical problems
3. Apply the concepts of laminar and turbulent boundary layers in closed conduit flow and solve concern numerical problems.
4. Analyze the working of Hydraulic Turbines; solve the numerical problems concerning the hydraulic Turbine.
5. Analyze the working of Centrifugal pumps, Reciprocating pumps and Solve numerical problems concerning the pumps.

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## (F313B) METAL CUTTING AND MACHINE TOOLS

**Course Objectives:** The Student will

1. Learn the fundamental principles of metal removal processes performed on machine tools and get to know about the elements of cutting process, and the various cutting tools used for metal removal on different machine tools
2. Learn the constructional and working features of machine tools such as Lathe, Drilling, Boring, Milling, Shaping and Grinding machines, etc.,
3. Study the different types of metal cutting operations done on the above machines
4. Understand the Non-Traditional machining methods, their working principles and applications
5. Get basic idea of Numerical Control (NC) machining, NC and CNC machine tools, and Fundamentals of CNC Part Programming.

**UNIT-I: Metal cutting**

Introduction, elements of cutting process – Geometry of single point tools. Chip formation and types of chips. Cutting tool materials

**Engine lathe:** Principle of working, types of lathe, specifications. Taper turning – Lathe attachments. Capstan and Turret lathe – Single spindle and multi-spindle automatic lathes – tool layouts.

**UNIT-II: Drilling Machine**

Principles of working, specifications, types, and operations performed; twist drill.

**Boring Machine:** Types of Boring machines and applications. Shaping, slotting and planning machines - Principles of working – machining time calculations.

**UNIT-III: Milling Machines**

Principles of working– Types of milling machines – Geometry of milling cutters – Methods of indexing

**Grinding Machines:** Theory of grinding – classification of grinding machines. Types of abrasives, bonds. Selection of grinding wheel. Lapping, honing and broaching machines. Introduction to jigs & Fixtures.

**UNIT-IV: Non - Traditional Machining**

Need for non-traditional machining methods–Classification of modern machining processes–considerations in process selection. Materials. Applications

**Basic working principle and applications:** Abrasive Water Jet Machining Process, Electro Chemical Machining Process, Electric Discharge Machining Process and Laser Beam Machining.

**UNIT-V: Numerical Control**

NC, NC modes, NC elements, NC machine tools, structure of CNC machine tools, features of Machining center, turning center.

**CNC Part Programming:** Fundamentals, manual part programming methods, Computer Aided Part Programming.

**TEXT BOOKS**:


1. P. N. Rao, "*Manufacturing Technology: Metal cutting and Machine Tools",*Tata McGraw-Hill Publications, 3rd Edition, Volume 2, 2013.
2. HMT Bangalore, "*Production Technology",* Tata McGraw-Hill Publishing Company Limited, 28th Edition, 2008
3. C. Elanchezhian, B. Vijaya Ramnath and M Vijayan, *"Unconventional Machining Processes*", Anuradha Publications, 1st Edition. 2005
4. B. L. Juneja, "*Fundamentals of Metal Cutting and Machine Tools"*, New Age International Publishers. 2ndEdition, 2005.


**REFERENCES:**


1. Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J. White. *"Machine Tool Practices"*, Prentice Hall of India, 2009
2. Yoram and Koren, "*Computer Control of Manufacturing Systems"*, Tata McGraw-Hill International Book Company, 2nd Edition, 2006.
3. V.K Jain, "*Advanced Machining Processes",* Allied publishers, 5th Edition. 2010.


**Course outcomes:** The student will be able to

1. Gain thorough knowledge about Metal Cutting process, the parameters involved, – Geometry of single point tools, Cutting tool materials, etc.,
2. Select the cutting tool materials, tool geometry, and appropriate machining processes for different combinations of tool and work materials.
3. Know completely about the different Machine Tools such as Lathe, Milling, Boring, etc., their constructional and working features, and applications
4. Have good understanding of Non-Traditional machining operations, their suitability, and applications
5. Write simple CNC programs and perform machining operations on NC / CNC machine tools.

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**(F313C) MACHINE DESIGN**

**Note:** Design Data Book permitted

**Course Objectives:** The Student will

1. Learn basics of design considerations of machine elements, selection of materials for their design, Procedure of Design of Axially Loaded Joints and Shaft Couplings
2. Gain knowledge about the design of temporary and permanent joints such as bolted, riveted and welded joints, and their applications
3. Acquire the information on design of mechanical springs and power screws, and their applications
4. Learn the construction and design of sliding and rolling contact bearings, and applications.
5. Get complete knowledge of the design methodology of different types of gears, such as Spur gears, Helical, Bevel and Worm Gears. Know how to use the Design Data book to design any of these machine elements

**UNIT-I: Introduction:**

Factors to be consider for the selection of materials for the design of machine elements, Static theories of failures. Basic Procedures and General Design considerations in Machine Design

**Design of Axially Loaded Joints:** Design of Cotter Joint with Socket and Spigot Ends & Knuckle Joint

**Design of Shaft Couplings:** Design of Rigid Couplings – Muff and Flange Couplings; Flexible Couplings- Pin Bush Coupling.

**UNIT-II: Design of Riveted Joints & Welded Joints:**

Modes of failure of Riveted Joints; Strength Equations; Efficiency of Riveted Joints. Design of Fillet Welds - Axial Loads; Circular Fillet Welds - Bending and Torsion

**Design of Bolted Joints:** Design of Bolts with Pre-Stresses; Design of Bolt Joints under Eccentric loading acting parallel to the axis of Bolts; Bolts of Uniform Strength; Cylinder Cover Joints.

**UNIT-III: Design of Mechanical Springs:**

Stresses and Deflections of Helical Springs; Design of Helical Extension -Compression Springs against Static and Fatigue Loading, Principles of Helical Torsion Springs and Leaf Springs. **(Theory only)**

**Design of Power Screws:** Terminology of Power Screws; Torque requirement for Lifting and Lowering Loads; Self Locking Screws; Efficiency of Power Screws.

**UNIT-IV: Design of Sliding Contact Bearings:**

Types of Journal Bearings; Bearing Construction - Bearing Design; Bearing Materials and Lubrication.

**Design of Rolling Contact Bearings:** Types of Rolling Contact Bearings; Selection of Bearing Type; Selection of Bearing Life; Design for Cyclic Loads and Speeds; Static and Dynamic Loading of Ball and Roller Bearings.

**UNIT-V: Design of Spur Gear:**

Design of Spur Gears - Load Concentration Factor – Dynamic Load Factor - Surface Compressive Strength – Bending Strength - Estimation of Module and Face Width based on Beam Strength and Wear Strength.

**Design of Helical, Bevel and Worm Gears:** Principles of Helical and Bevel Gears (Theory only). Design of Worm Gears; Strength and Wear Rating of Worm Gears; Force Analysis.

**TEXT BOOKS**:


1. V. Bhandari, *"Design of Machine Elements"*, Tata McGraw Hill Publications, 3rd Edition, 2010
2. Dr. N. C. Pandya & Dr. C. S. Shah, "*Machine Design*", Charotar Publishing House Pvt. Ltd, 17th Edition, 2006
3. R. C. Bahl & V. K. Goel, "*Mechanical Machine Design*", Standard Publishers, 2002 .


**REFERENCES:**


1. P. Kannaiah, "*Machine Design*", Scitech Publications, 2nd Edition, 2010.
2. S. Md. Jalaludeen, "*Machine Design"* Volume- II, 2016.
3. PV Ramana Murti & M. Vidyasagar, "*Design Data Book",* BS Publications, 2015
4. K. Mahadevan, "*Design Data Hand Book",* CBS Publishers, 4th Edition, 2016.


**Course outcomes:** The student will be able to

1. Select suitable materials for the design of various machine elements, and develop the design procedure in accordance with the General Design considerations. Design Cotter Joint, Knuckle joint, and different types of Shaft Couplings
2. Carry out the design of temporary / permanent joints such as Riveted Joints, Welded Joints, and Bolted Joints under different types of loading
3. Develop suitable procedures for design of Compression Springs against Static and Fatigue Loading, design of Power Screws,
4. Design independently Sliding and Rolling Contact Bearings.
5. Design independently different types of gears such as Spur Gears, Helical, Bevel and Worm Gears. Make use of the Design Data book for designing any of the above machine elements.

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| **III Year - I Semester** | **2** | **1-0-0** | **3** |

## (F313D) DYNAMICS OF MACHINERY

**Course Objectives:** The Student will

1. The concepts of Friction, and the areas of its applications such as Friction Clutches, Brakes and Dynamometers and their Dynamic analysis.
2. Basics of Power Transmission Systems such as Belt and Rope drives, Chain drives and Sprockets, their types, and materials used for these elements.
3. The Principles of operation of Governors, Drawing of Turning Moment Diagram of I C engine
4. The need for Balancing of masses in rotating machinery, Balancing methods for Rotating masses, Primary and Secondary balancing of reciprocating masses, etc.,
5. Concept of Precessional Motion, and its effect on the stability of moving vehicles. And Principles of Vibratory motion, Free Vibration of single degree of freedom systems, Critical Speeds of Shafts, etc.

**UNIT-I: Friction and Friction Clutches:**

Introduction to Sliding and Rolling Friction. Dynamic analysis of Friction Clutches- Single Disc and Multiple Disc Clutch. Principles of Cone Clutch, Centrifugal Clutch. **(Theory only)**

**Brakes and Dynamometers:** Dynamic analysis of Simple Block Brakes and Band Brakes of vehicle. General description and methods of operations – Absorption and Transmission types.**(Theory only)**

**UNIT-II Power Transmission Systems:**

Transmission of power by Belt and Rope drives, Belts: Flat and V types. Transmission Efficiencies.

**Pulleys and Sprockets:** Pulleys for Belt and Rope Drives and Materials, Chain drives and Sprockets.

**UNIT-III: Turning Moment Diagram:**

Turning Moment Diagrams – Inertia Torque - Connecting rod angular velocity and acceleration, Crank Effort – Fluctuation of Energy.

**Governors:** Dynamic Analysis of Watt, Porter and Proell Governors. Principles of Sensitiveness, Iso – chronism & Hunting in Governors **(Theory only).**

**UNIT-IV: Balancing of Rotating masses:**

Balancing of Rotating Masses, Single and Multiple Masses in Single and Different Planes.

**Balancing of Primary and Secondary Reciprocating Masses:** Primary and Secondary balancing of reciprocating masses, Analytical and Graphical methods –Balancing of

Unbalanced Forces and Couples in Single Cylinder Engines.

**UNIT-V: Precession Motion:**

Principles of Gyroscopes - Effect of Precession Motion on the stability of moving vehicles such as Motor Car, Motor Cycle, Aero-Planes and Ships.

**Vibrations:** Principles of Free Vibration of single degree of freedom systems. Simple problems on free damped vibrations. Critical Speeds of Shafts.

**TEXT BOOKS**:

1. T. Bevan, "*Theory of Machines",* S. Chand Publications, 3rd Edition.
2. S. S. Ratan, "*Theory of Machines*", Tata Mc Graw Hill, 2007 reprint.

**REFERENCES:**

1. R. K. Bansal, "*Theory of Machines",* S. Chand Publications, 5th Edition, 2010.
2. Prof. P. L. Ballaney, "*Theory of Machines and Mechanisms",* Khanna Publishers, Delhi.
3. J.S. Rao and R.V. Dukkipati, *"Mechanism and Machine Theory*", New Age. 1992.

**Course outcomes:** The student will be able to

1. Understand the principles and types of friction, and apply the knowledge acquired for design of friction clutches, brakes, dynamometers, etc.,
2. Apply the knowledge of various power transmission systems, such as Belt drives, Rope drives, Chains drives, etc., in practical design problems
3. Demonstrate the working principle and operation of different types of governors. Draw the Turning Moment Diagrams for I C engines.
4. Apply the basic concepts of balancing of forces and couples for rotating and reciprocating parts.
5. Apply the principles of precessional motion and gyroscopic effects in the design of moving vehicles. Analyze the vibration response of mechanical elements / systems

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| **III Year - I Semester** | **3** | **1-0-0** | **4** |

## (F313E) APPLIED THERMODYNAMICS

**Course Objectives:** The Student will

1. Get to understand the basics of Actual Fuel-Air Cycles of CI Engines and their Analysis, Working principles and Classification of I.C. Engines
2. Learn about the Combustion process in S.I. Engines and C I Engines, Types of Combustion, Types and requirements of Combustion chambers, Testing the I C Engine Performance, and Preparation of Heat balance sheet.
3. Gain the basic knowledge about Rotary and Reciprocating Compressors, their Classification and Principles of operation, stage compression, etc.,
4. Understand the basic concepts of Rankine cycle, fuels and combustion, stoichiometry, flue gas analysis, Flow through Steam Nozzles, their functions, types, and applications
5. Learn the Principle of working of Steam Turbines, Impulse and Reaction turbines, and Gas turbine plant.

**UNIT-I: Actual Cycles and Their Analysis:**

Introduction, Time Loss Factor, Heat Loss Factor, Exhaust Blow down-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines

**I.C. Engines:** Classification - Working principles, Valve and Port Timing Diagrams, Air – Standard, air-fuel and actual cycles.

**UNIT-II: Combustion in S.I. Engines:**

Normal Combustion and abnormal combustion – Importance of flame speed and effect of engine variables – Type of Abnormal combustion, pre-ignition and knocking (explanation of) – Fuel requirements and fuel rating, anti-knock additives – combustion chamber – requirements, types.

**Combustion in C.I. Engines:** Four stages of combustion – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence – open and divided combustion chambers and nozzles used – fuel requirements and fuel rating.

**Testing and Performance:** Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart.

**UNIT-III: Compressors**:

Classification –positive displacement and roto dynamic machinery – Power producing and power absorbing machines, fan, blower and compressor – positive displacement and dynamic types.

**Reciprocating:** Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance, stage compression, under cooling, saving of work, minimum work condition for stage compression.

**UNIT-IV : Basic Concepts:**

Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration and reheating

**Combustion:** fuels and combustion, concepts of heat of reaction, adiabatic flame temperature, stoichiometry, and flue gas analysis

**Steam Nozzles:** Functions- types – applications; Flow through nozzles, thermodynamic analysis – assumptions -velocity of nozzle at exit, Ideal and actual expansion in nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio, criteria to decide nozzle shape: Super saturated flow, effects, degree of super saturation and degree of under cooling - Wilson line.

**UNIT-V: Steam Turbines:**

Classification – Impulse turbine - Mechanical details – Velocity diagram – effect of friction – power developed, axial thrust, and blade or diagram efficiency – condition for maximum efficiency.

**De-Laval Turbine** - features. Methods to reduce rotor speed, Velocity compounding and pressure compounding, Velocity and Pressure variation along the flow – combined velocity diagram for a velocity compounded impulse turbine

**Reaction Turbine:** Mechanical details – principle of operation, thermodynamic analysis of a stage, degree of reaction –velocity diagram – Parson's reaction turbine – condition for maximum efficiency.

**Gas Turbines:** Simple gas turbine plant – Ideal cycle, essential components.

**TEXT BOOKS**:


1. V.Ganesan, "*Internal combustion Engines*", Tata McGraw Hill Companies, 4th Edition, 2012.
2. R.K. Rajput "*Thermal Engineering*", Laxmi Publications, 10th Edition, 2018.
3. V.Ganesan "*Gas Turbines*", Tata McGraw-Hill Education Pvt. Ltd., 3rd Edition, 2010.


**REFERENCES:**


1. Dr. K. K. Ramalinga*, "Internal combustion Engines*", Scietech Publishers, 3rd Edition, 2011.
2. R. Yadav, "*Thermodynamics and Heat Engines",* Central Publishing House, 6th Edition, 2012.

3. P. Khajuria & S. P. Dubey "*Gas Turbines and Propulsive Systems*", Dhanpatrai Publications, 2012.

**Course outcomes:** The student will be able to

1. Gain knowledge about the Standard, air-fuel and actual cycles and their Analysis, Working principle of I.C. Engines, and to obtain the Valve and Port Timing Diagrams
2. Analyze the combustion process in SI engines and CI engines, and Test the Performance characteristics of the engines
3. Distinguish between Rotary and Reciprocating Compressors, the performance features and applications
4. Apply the basic concepts of Rankine cycle, Thermodynamic Analysis, concepts of heat of reaction, and stoichiometry in practical problems and Gain the required expertise in the study of Flow through steam nozzles, Super saturated flow, Wilson line,
5. Apply the knowledge of Impulse and Reaction steam turbines, their working principles and operation of simple Gas turbine plant, etc, to practical situations.

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## (F3131) MECHANICS OF FLUIDS & HYDRAULIC MACHINES LAB

**Course Objectives:** The student will

1. Gain practical knowledge in verification of the characteristics of fluid flow.
2. Get practical training in the calibration of fluid flow instruments.
3. Understand how to determine the major and minor losses in fluid flow.
4. Acquire practical knowledge in evaluating performance of hydraulic turbines and hydraulic pumps.

**EXPERIMENT – I :** Impact of jets on Vanes.
**EXPERIMENT – II :** Performance Test on Pelton Wheel.
**EXPERIMENT – III :** Performance Test on Single Stage Centrifugal Pump.
**EXPERIMENT – IV :** Performance Test on Multi Stage Centrifugal Pump.
**EXPERIMENT – V :** Performance Test on Reciprocating Pump.
**EXPERIMENT – VI :** Calibration of Venturimeter
**EXPERIMENT - VII :** Calibration of Orifice meter.
**EXPERIMENT – VIII :** Determination of friction factor for a given pipe line.
**EXPERIMENT - IX :** Determination of loss of head due to sudden contraction in a pipeline
**EXPERIMENT - X :** Verification of Bernoulli's Theorems.
**EXPERIMENT - XI :** Performance test on Francis Turbine.
**EXPERIMENT - XII :** Calibration of Mouth piece / Orifice apparatus.

**Course Outcomes:** The student will be able to

1. Demonstrate skills in calibration of instruments such as Venturimeter, Orifice meter, etc.
2. Evaluate the minor and major losses in fluid flow.
3. Analyze the performance of hydraulic turbines and pumps used in power plants.
4. Carry out trouble shooting in hydraulic power plants.

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| **III Year - I Semester** | **0** | **0-2-0** | **1** |

## (F3132) MACHINE TOOLS LAB

**Course Objectives:** The student will

1. Get hands-on experience to operate general purpose Machine Tools like Lathe Machine, Drilling, Milling, and Shaping Machines etc.,
2. Get trained to produce simple jobs on all the above machines, using the suitable cutting tools, and work-holding devices
3. Understand the work on special purpose machines like surface grinding machine, cylindrical grinding machine, tool and cutter grinding machine, etc.,
4. Gain knowledge to study and operate CNC machine tools, write and execute part programmes to make simple jobs
5. 5. Acquire the necessary knowledge of the safety precautions to be followed while working on the machines

**EXPERIMENT-I :** Taper turning on lathe machine
**EXPERIMENT- II :** Thread cutting and knurling on -lathe machine.
**EXPERIMENT- III :** Drilling and Tapping
**EXPERIMENT-IV :** Shaping
**EXPERIMENT-V :** Slotting
**EXPERIMENT-VI :** Milling
**EXPERIMENT-VII :** Surface Grinding
**EXPERIMENT-VIII :** Cylindrical grinder
**EXPERIMENT-IX :** Tool and cutter grinder
**EXPERIMENT-X :** Machining of simple components on CNC machine tool.

**Course Outcomes:** The students will be able to

1. Learn how to use various measuring instruments, work-holding fixtures, cutting tools, and coolants while doing the machining operations.
2. Understand how to produce various objects from the given workpiece by using general purpose machines and/or special purpose machines
3. Learn how to cut the tool angles accurately on single point cutting tools using Tool and cutter grinder
4. Analyze how to operate CNC machine, write part programs for simple jobs, and execute the jobs to the required accuracy.
5. Gain knowledge on how to maintain safety precautions while operating on the general purpose and special purpose machines

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**(F3133)THERMAL ENGINEERING LAB**

**Course Objectives:** The student will

1. Get to know to determine the properties of fuels (such as Flash Point, Fire point, Viscosity, Carbon residue, Calorific Value, etc.,) which are to be used in engineering practice, Get hands-on experience to use the apparatus like Pensky Marten Apparatus / Abel's Apparatus, Redwood Viscometer, Calorimeter, etc.,
2. Learn the importance of Valve Timing Diagram and Port Timing Diagram in I C engines, and how to draw these diagrams
3. Understand to carry out the Performance Test on four-stroke diesel engine and two-stroke petrol engine, and interpret the results
4. Conducts Heat Balance Sheet on IC Engine.
5. Be taught how disassemble the parts of I C engine and assembling again and to evaluate the Engine friction by conducting Morse test on four-stroke multi cylinder Petrol Engine, conducts Heat Balance Sheet on IC Engine, and get experience in disassembling and assembling the parts of four-stroke Petrol Engine.
6. Understand the procedure of Performance Test on Reciprocating Air – Compressor Test Rig.

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| **EXPERIMENT- I:** | To determine Flash and Fire point for a given liquid fuel- Pensky Marten Apparatus / Abel's Apparatus |
| **EXPERIMENT -II:** | To determine viscosity of given oil by Redwood Viscometer -I |
| **EXPERIMENT- III:** | To determine Carbon Residue of given fuel |
| **EXPERIMENT- IV:** | To determine Calorific Value of a given fuel/ oil |
| **EXPERIMENT-V:** | I.C. Engines Valve Timing Diagram. |
| **EXPERIMENT-VI:** | I.C. Engines Port Timing Diagram. |
| **EXPERIMENT-VII:** | I.C. Engines Performance Test (4 Stroke Diesel engine) |
| **EXPERIMENT-VIII:** | I.C. Engines Performance Test (2 Stroke Petrol engine) |
| **EXPERIMENT-IX:** | Evaluation of Engine friction by conducting Morse test on 4-sMulti cylinder Petrol Engine |
| **EXPERIMENT-X:** | Heat Balance Sheet on IC Engine |
| **EXPERIMENT-XI:** | 4- Stroke Petrol Engine Assembly and Disassembly |
| **EXPERIMENT-XII:** | Performance Test on Reciprocating Air – Compressor Test Rig. |

**Course Outcomes:** The student will be able to

1. Determine the properties of fuels (Flash Point, Fire point, Viscosity, Calorific Value, etc.,) using Abel's Apparatus, Redwood Viscometer, Calorimeter, etc.,
2. Obtain the Valve Timing Diagram and Port Timing Diagram in I C engines

3. Conduct Performance Tests on four-stroke diesel engine and two-stroke petrol engine, and Morse test on four-stroke Multi cylinder Petrol Engine
4. Determine the Heat Balance of I C Engine
5. Disassemble the parts of I C engine and assembling again, thereby understanding the significance and function of each part
6. Conduct the Performance Test on Reciprocating Air – Compressor, using the test rig

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**(F3134) SUMMER INTERNSHIP**

**Guidelines:**

There is summer internship, in collaboration with an industry of their specialization, to be taken up during the vacation after II year II Semester examination and it will be evaluated in III Year I semester. A report to be submitted in prescribed format on the internship carried out by the student. The report will be evaluated for 100 marks by the committee consisting of head of the department, and internship coordinator and a senior faculty member of the department. There is no semester end examination for the seminar.

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| **III Year -II Semester** | **3** | **1-0-0** | **4** |

**(F323A) HEAT TRANSFER**

**Course Objectives:** The Student will

1. Distinguish among the three modes of Heat Transfer and understand the basic laws of heat transfer.
2. Synthesize a mathematical model of the heat transfer problem with appropriate boundary conditions in both cases of One-Dimensional Steady State Conduction and One-Dimensional Transient Conduction.
3. Learn the basics of Convective heat transfer in free convection and forced convection, and the significance of non-dimensional numbers.
4. Apply the principles of Heat Transfer with Phase Change like Boiling, Film wise and drop wise condensation, etc., and learn the concepts of LMTD and NTU methods, and apply them to solve practical problems.
5. Understand the principles of Radiation Heat Transfer, laws of black body radiation, and Heat exchange between two black bodies.

**UNIT-I: Introduction:**

Modes and mechanisms of heat transfer – Basic laws of heat transfer –General discussion about applications of heat transfer.

**Conduction Heat Transfer:** Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates.

**Simplification and forms of the field equation** – steady, unsteady and periodic heat transfer– initial and boundary conditions.

**UNIT-II: One Dimensional Steady State Conduction Heat Transfer:**

Homogeneous slabs, hollow cylinders and spheres – overall heat transfer coefficient – electrical analogy – Critical radius of insulation.

**One Dimensional Steady State Conduction Heat Transfer:** Variable Thermal conductivity – Systems with heat sources or Heat generation. Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature.

**One Dimensional Transient Conduction Heat Transfer:** Systems with negligible internal resistance – Significance of Biot and Fourier Numbers - Chart solutions of transient conduction systems- Concept of Functional Body.

**UNIT-III: Convective Heat Transfer:**

Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation

– Buckingham Pi Theorem and method, application for developing semi – empirical non-dimensional correlation for convection heat transfer – Significance of non- dimensional numbers – Concepts of Continuity, Momentum and Energy Equations.

**Forced convection: External Flows:** Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer- Flat plates and Cylinders.

**Internal Flows:** Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow based on this – Use of empirical relations for Horizontal pipe flow and annulus flow.

**UNIT-IV : Convection:**

Development of Hydrodynamic and thermal boundary layer along a vertical plate – Use of empirical relations for Vertical plates and pipes.

**Heat Transfer with Phase Change: Boiling:** – Pool boiling – Regimes Calculations on Nucleate boiling, Critical Heat flux and Film boiling. **Condensation:** Film wise and drop wise condensation – Nusselt's Theory of Condensation on a vertical plate – Film condensation on vertical and horizontal cylinders using empirical correlations.

**Heat Exchangers:** Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

**UNIT-V: Radiation Heat Transfer:**

Emission characteristics and laws of black body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchhoff, Lambert, Stefan and Boltzmann.

Heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

**TEXT BOOKS**:


1. J. P. Holman, "*Heat Transfer*", Tata McGraw Hill Publishers, 10th Edition, 2010.
2. P. K. Nag, "*Heat and Mass Transfer",* Tata McGraw Hill Publishers, 3rd Edition, 2011.


**REFERENCES:**


1. R. C. Sachdeva, "*Fundamentals of Engineering Heat and Mass Transfer",* New Age International, 3rd Edition, 2008
2. Ghoshdastidar, "*Heat Transfer",* Oxford University Press, 2nd Edition, 2004.
3. R.K. Rajput, "*Heat and Mass Transfer",* S. Chand & Company Ltd., 1st Edition, 2009.


**Course outcomes:**

The student will be able to

1. Analyze and design various methods of heat transfer for the bodies undergoing

heat exchange, using the fundamental concepts of Conduction, Convection and Radiation.

2. Solve problems in the fields of One-dimensional Steady State Conduction Heat Transfer and One-Dimensional Transient Conduction Heat Transfer.
3. Apply the principles of Forced convection heat transfer for External flows and Internal flows.
4. Comprehend the phenomena of Heat Transfer with Phase Change, such as Boiling and Condensation, their applications in practical situations and Design Heat Exchanger equipment, solve the related problems using LMTD and NTU methods.
5. Apply the principles of radiation heat transfer between two black bodies, and laws of black body radiation, to practical problems.

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**(F323B) OPERATIONS RESEARCH**

**Course Objectives:** The Student will

1. Get the basic knowledge of Linear Programming and its applications to engineering problems and able to formulate a problem in LP model, and solve it using graphical method and Simplex method.
2. Be taught about the variants of the LP problem such as Transportation, Assignment, and Sequencing problems
3. Learn to find the optimal replacement time of equipment, and application of Group Replacement strategy
4. Get to know about solution methods to find the optimal strategy to maximize the outcome and Learn the importance of maintaining optimal inventory in any industry
5. Be exposed to the intricacies of waiting line models faced in real world situations and Solve problems using the Bellman's Principle of Optimality and Understand the concept of Simulation and its application to inventory and queuing problems.

**UNIT-I: Introduction :**

Development – Definition– Characteristics and Phases – Types of models – Operations Research models – applications.

**Allocation:** Linear Programming Problem - Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method; Duality Principle.

**UNIT-II: Transportation problem** :

Formulation – Optimal solution, unbalanced transportation problem – Degeneracy

**Assignment problem** – Formulation – Optimal solution - Variants of Assignment Problem; Traveling Salesman problem.

**UNIT-III: Sequencing:**

Introduction – Flow **–**Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines

**Replacement:** Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely-Group Replacement.

**UNIT-IV :Theory of games:**

Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games –m x 2 & 2 x n games - graphical method – m x n games - dominance

principle.

**Inventory:** Introduction – Single item, Deterministic models – Types - Purchase inventory models with one price break and multiple price breaks – inventory models with and without shortage cost. Stochastic models – demand discrete variable or continuous variable – Single Period model with no setup cost.

**UNIT-V: Waiting lines:**

Introduction – Terminology-Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population.

**Dynamic programming:** Introduction – Terminology- Bellman's Principle of Optimality – Applications of dynamic programming- shortest path problem – linear programming problem

**Simulation:** Definition – types of simulation models- applications, advantages and disadvantage. Brief introduction of simulation languages – inventory and queuing problems using random numbers.

**TEXT BOOKS**:

1. J. K. Sharma, "Operation Research", MacMillan Publishers India Ltd, 4th Edition, 2009.
2. A.C.S Kumar, "Operations Research (Quantitative Analysis for Business decision)", Yesdee Publishers, 1st Edition, 2015.

**REFERENCES:**

1. Maurice Saseini, Arhur Yaspanand and Lawrence Friedman, "*Operations Research: Methods and Problems",* Literary Licensing Publisher, 2013
2. A. M. Natarajan, P. Bala Subramani and A. Tamilarasi "*Operations Research*" Pearson Education, 4th Edition, 2009.
3. Wagner H. M, "*Principles of Operations Research",* PHI Publications, 2nd Edition, 2006.
4. Hillier / Libermann "*Introduction to Operations Research*", MacMillan Publishers, 10th Edition, 2017.

**Course outcomes:** The student will be able to

1. Allocate Optimally the resources in any industry, to maximize the overall gain and Determine the number of each item to be produced / procured, and the optimal product mix, within the framework of constraints in any organization
2. Find the optimal number of units to be transported such that the total transportation cost will be minimum and Assign the required men / machines to perform the given tasks in an optimal way
3. Schedule and sequence production runs by proper allocation of machines and men to get maximum gain or profit and Compute the economic order quantity

4. Understand the competitive situations in business organizations, and how to find the optimal strategies to be adopted according to the given situation
5. Find how to strike a balance between the waiting time cost and service facility cost and apply the Dynamic Programming model to practical problems like finding the shortest path for a salesman, optimal solution to a linear programming problem, etc.

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**(F323C) CAD/CAM**

Professional Elective-I

**Course Objectives:** The Student will

1. Learn about Computer Graphics and their application in computer aided design / drawing and 2D & 3D transformations like transformation of geometry, reflection, rotation etc.,
2. Understand the different geometric modeling techniques like solid modeling, surface modeling, and feature based modeling etc., and to visualize how the components look like before its manufacturing or fabrication.
3. Learn about the Numerical control machining, CNC Part Programming
4. Learn the importance of group technology; computer aided process planning, and computer aided quality control.
5. Understand the overall configuration and elements of computer integrated manufacturing systems.

**UNIT-I**:Computers in Industrial Manufacturing, Product cycle, CAD / CAM Hardware, Basic structure, CPU, Memory types, input devices, display devices, hard copy devices, storage devices.

**Computer Graphics:** Raster scan graphics coordinate system, database structure for graphics modeling, transformation of geometry, 3D transformations, mathematics of projections, clipping, hidden surface removal.

**UNIT-II: Geometric modeling:**

Requirements, geometric models, geometric construction models, curve representation methods, surface representation methods, modeling facilities desired.

**Drafting and Modeling systems:** Basic geometric commands, layers, display control commands, editing, dimensioning, solid modeling.

**UNIT-III: Numerical control:**

NC, NC modes, NC elements, NC machine tools, structure of CNC machine tools, features of Machining center, turning center

**CNC Part Programming:** fundamentals, manual part programming methods, Computer Aided Part Programming.

**UNIT-IV : Group Tech:**

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

**Computer aided Quality Control:** Terminology in quality control, the computer in QC,

contact inspection methods, noncontact inspection methods-optical, noncontact inspection methods, non-optical, computer aided testing, integration of CAQC with CAD/CAM.

**UNIT-V: Computer integrated manufacturing systems:** Types of Manufacturing systems, Machine tools and related equipment, material handling systems, computer control systems, human labor in the manufacturing systems, CIMS benefits.

**TEXT BOOKS**:

1. W. Zimmers & P. Groover, "*CAD / CAM",* PE, PHI, 1st Edition, 2009.
2. Ibrahim Zeid, "*CAD / CAM Theory and Practice",* TMH, 5th Edition, 2010.

**REFERENCES:**

1. Mikell. P. Groover, "*Automation, Production systems & Computer integrated Manufacturing",* Pearson Education, 4th Edition, 2014.
2. Radha krishnan and Subramanian, "*CAD / CAM / CIM*", New Age, 2nd Edition, 2000.
3. Farid Amirouche, *"Principles of Computer Aided Design and Manufacturing*", Pearson Prentice Hall, 2nd Edition, 2004.

**Course outcomes:** The student will be able to

1. Explain the basic structure and components of Computer Hardware used in CAD/CAM, and application of Computer Graphics in CAD for graphics modeling of objects. Carry out 2D and 3D transformations, clipping, and hidden surface removal.
2. Know how to use Drafting and Modeling systems to develop geometric construction models
3. Apply the knowledge of CNC machining and part programming to produce objects of intricate shapes with high level of accuracy
4. Use the principles / methods of GT, CAPP, and Computer aided Quality Control for product development.
5. Get exposure to various elements and their functions in Computer Integrated Manufacturing Systems.

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**(F323D) REFRIGERATION AND AIR CONDITIONING**

Professional Elective-I

**Course Objectives:** The Student will

1. Study the basics of refrigeration and different types of air refrigeration cycles
2. Understand the working principle and essential components of the vapour compression refrigeration plant, and the desirable properties of refrigerants
3. Study the working principle of Evaporators and Expansion devices, understand vapour absorption refrigeration cycle, and Working Principle and Basic Components of Steam Jet Refrigeration System
4. Study the usage of psychometric chart in different types of Psychometric processes
5. Understand the working principle of different components used in Air conditioning system, and requirements of Human comfort.

**UNIT-I**: **Introduction to Refrigeration:**

Necessity and applications – Unit of refrigeration and C.O.P. – Mechanical Refrigeration – Types of Ideal cycles of refrigeration.

**Air Refrigeration:** Bell Coleman cycle and Brayton Cycle, Open and Dense air systems – Actual air refrigeration system problems – Refrigeration needs of Aircrafts.

**UNIT-II: Vapour compression refrigeration:**

Working principle and essential components of the plant – simple Vapour compression refrigeration cycle – COP – Representation of cycle on T-S and p-h charts – effect of sub cooling and super heating – cycle analysis – Actual cycle Influence of various parameters on system performance – Use of p-h charts – numerical Problems.

**Refrigerants** – Desirable properties – classification refrigerants used – Nomenclature – Ozone Depletion – Global Warming.

**UNIT-III: Principles of Evaporators:** –

classification – Working Principles Expansion devices – Types – Working Principles

**Vapor Absorption System** – Calculation of max COP – description and working of NH3 – water system and Li Br –water (Two shell & Four shell) System. Principle of operation Three Fluid absorption system, salient features.

**Steam Jet Refrigeration System** – Working Principle and Basic Components. Principle and operation of (i) Thermoelectric refrigerator (ii) Vortex tube or Hilsch tube.

**UNIT-IV : Introduction to Air Conditioning:**

Psychometric Properties & Processes – Characterization of Sensible and latent heat loads

—— Need for Ventilation, Consideration of Infiltration – Load concepts of RSHF, GSHF-Problems, Concept of ESHF and ADP.

**UNIT-V: Requirements of human comfort and concept of effective temperature**:
Comfort chart – Comfort Air conditioning – Requirements of Industrial air conditioning, Air conditioning Load Calculations.
**Air Conditioning systems** - Classification of equipment, cooling, heating humidification and dehumidification, filters, grills and registers fans and blowers. Heat Pump – Heat sources – different heat pump circuits.

**TEXT BOOKS**:

1. CP Arora, "*Refrigeration and Air Conditioning",* Tata McGraw Hill, 17th Edition, 2006.
2. SC Arora & Domkundwar, Dhanpatrai Publishers, "*A Course in Refrigeration and Air conditioning*", 6th Edition, 2006.

**REFERENCES:**

1. Warren Marsh. R, "*Principles of Refrigeration",* Delmar Publications, 2nd Edition, 1979
2. P. L. Bellaney, "*Refrigeration and Air Conditioning",* Khanna Publishers, 7th Edition, 1985.
3. P. N. Anantha Narayanan, "*Basic Refrigeration and Air-Conditioning*", The McGraw Hill, 8th Edition, 2009.

**Course outcomes:** The student will be able to

1. Explain the fundamental properties of Refrigeration system and evaluate COP using air refrigeration cycles
2. Distinguish between the working of vapour compression refrigeration system and vapour absorption refrigeration system
3. Demonstrate the working principles of Evaporators, Expansion devices, and Steam Jet Refrigeration System
4. Illustrate various Refrigeration and Air conditioning processes using Psychometric charts
5. Design Air conditioning system using cooling load calculation and estimate Air conditioning system parameters.

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| **III Year -II Semester** | **3** | **0-0-0** | **3** |

**(F323E) UNCONVENTIONAL MACHINING PROCESSES**

Professional Elective-I

**Course Objectives:** The Student will

1. Understand the need for Non-Traditional Machining Methods, and appreciate their advantages over conventional machining
2. Learn the important NT Machining Methods such as Ultrasonic machining, Abrasive jet machining, Water jet machining, Electro chemical machining, etc., their application, merits and limitations.
3. Gain knowledge about Thermal Metal Removal Processes like Electric Discharge Machining, Electric Discharge Grinding, and Wire-cut EDM, etc., their Principles, Process parameters, and applications
4. Learn the basics of Electron beam machining and Laser beam machining processes
5. Acquire Knowledge of Application of plasma for machining in manufacturing industries, Chemical machining, Electro stream drilling, etc.,

**UNIT-I**: **Introduction:** Need for non-traditional machining Methods-Classification of modern machining processes – considerations in process selection. Materials. Applications

**Ultrasonic machining** – Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent development.

**UNIT-II: Abrasive jet machining, Water jet machining and abrasive water jet machine**: Basic principles, equipments, process variables, mechanics of metal removal, MRR, application and limitations.

**Electro–Chemical Processes:** Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process, metal removal rate in ECM, Tool design, and Surface finish and accuracy economic aspects of ECM – Simple problems for estimation of metal removal rate. Fundamentals of chemical, machining, advantages and applications.

**UNIT-III: Thermal Metal Removal Processes:** General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Power circuits for EDM, Mechanics of metal removal in EDM.

Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.

**UNIT-IV :**

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes.

General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut.

**UNIT-V:**

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

Chemical machining-principle- maskants – etchants- applications. Magnetic abrasive finishing, Abrasive flow finishing, Electro stream drilling, Shaped tube electrolytic machining.

**TEXT BOOKS**:


1. Vijay K. Jain, "*Advanced Machining Processes",* Allied publishers, 12th Reprint, 2010.
2. Serope Kalpakjian and Steven R. Schmid, "*Manufacturing Engineering and Technology",* Pearson Publications, 4th Edition, 2012.


**REFERENCES:**


1. Pandey P.C. and Shah H.S, "Modern Machining Process", Tata McGraw Hill, 33rd Edition, 2008.
2. C. Elanchezhian, B. Vijaya Ramnath and M Vijayan, "*Unconventional Machining Processes"* Anuradha Publications, 2005.


**Course outcomes:**

The student will be able to

1. Use the different Non-Traditional Machining Methods wherever they are more advantageous over conventional machining
2. Analyze the merits and limitations of different Non-Traditional Machining Processes like USM, AJM, ECM, etc., and thereby select the suitable NT machining process
3. Perform the Thermal Metal Removal Processes like EDM, Electric Discharge Grinding, etc., and thereby appreciate their benefits
4. Apply the other NT machining processes like Electron beam machining, Laser beam machining
5. Apply the other NT machining processes like Plasma machining, Chemical machining, etc., wherever suitable

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| **III Year -II Semester** | **3** | **0-0-0** | **3** |

**(F323F) MECHANICAL VIBRATIONS**

Professional Elective – II

**Course Objectives:** The Student will

1. Learn about Un-damped and Damped free vibrations, and Forced vibrations of Single degree of Freedom system and understand the significance of Vibration Isolation and Transmissibility in machine foundations
2. Gain the knowledge of Response to Non Periodic Excitations and Response to Arbitrary Excitations, and Vibration measuring instruments
3. Be able to analyze Two-degree freedom systems.
4. Be able to analyze Multi degree freedom systems, and Free and forced vibration by Modal analysis
5. Learn about the application of Numerical Methods in Vibration analysis problems and to know theory and applications of Continuous systems, and Critical speeds of shafts.

**UNIT-I: Single degree of Freedom systems - I**

Un-damped and damped free vibrations; forced vibrations coulomb damping. Response to excitation; rotating unbalance and support excitation; vibration isolation and transmissibility.

**UNIT-II: Single degree of Freedom systems - II**

Response to Non Periodic Excitations: unit impulse, unit step and unit Ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

**Vibration measuring instruments**: Vibrometers, velocity meters & accelerometers.

**UNIT-III: Two-degree freedom systems**

Principal modes- un-damped and damped free and forced vibrations; un-damped vibration absorbers;

**UNIT-IV : Multi degree freedom systems**

Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties.

Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi- rotor systems and geared systems; Discrete- Time systems.

**UNIT-V: Numerical Methods**

Raleigh’s stodola's, Matrix iteration, Rayleigh- Ritz Method and Holzer's methods.

**Continuous system:** Free vibration of strings – longitudinal oscillations of bars- traverse vibrations of beams- Torsional vibrations of shafts.

**Critical speeds of shafts**: Critical speeds without and with damping, secondary critical speed.

**TEXT BOOKS**:

1. Leonard Meirovitch, "*Elements of Vibration Analysis",* Tata McGraw Hill, 2001
2. G. K. Groover, "*Mechanical Vibrations",* Nem Chand Publications, 4th Edition, 1983

**REFERENCES:**

1. Singiresu S. Rao, "*Mechanical Vibrations*", Pearson Publications, 5th Edition, 2011.
2. Rao V. Dukkipati & J Srinivas, *"Mechanical Vibration*", PHI Publisher, 2nd Edition, 2012.
3. V. Ram Murthy, "Mechanical Vibrations Practice and Basic Theory", Narosa Publishing House, 2000.

**Course outcomes:** The student will be able to

1. Apply the principles of Vibration Isolation and Transmissibility in determining the dynamic stability of machine foundation
2. Analyze the mathematical model of a linear vibratory system to determine its response
3. Apply the knowledge of Vibrations of Single degree of Freedom systems, Two-degree freedom systems in engineering practice
4. Apply the knowledge of Vibrations of Multi degree freedom systems in engineering practice
5. Apply Numerical Methods in solving the problems of Vibration analysis and to gain the knowledge of Critical speed to avoid the resonance problem in the design of shafts.

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| **III Year -II Semester** | **3** | **0-0-0** | **3** |

**(F323G) MACHINE TOOL DESIGN**

Professional Elective – II

**Course Objectives:** The Student will

1. Understand the kinematics involved in machine tool design
2. Understand the motion control mechanisms, Learn about the Regulation of Speeds and Feeds, Design of Speed Box.
3. Understand the Structural design aspects and Functions of machine tools
4. Learn the Design aspects of Guide ways, Power Screws, Spindles, and Spindle Supports
5. Understand the Dynamics of machine tools, Static and Dynamic Stiffness.

**UNIT-I: Introduction to Machine Tool Drives and Mechanisms:** Introduction to the course, Working and Auxiliary Motions in Machine Tools. Kinematics of Machine Tools, Motion Transmission.

**UNIT-II: Regulation of Speeds and Feeds:**

Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors. Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design.

**UNIT-III: Design of Machine Tool Structures:** Functions of Machine Tool Structures and their requirements, Design for Strength, Design for Rigidity, Materials for Machine Tool Structures, Machine Tool Constructional Features, Beds and Housings, Columns and Tables, Saddles and Carriages.

**UNIT-IV : Design of Guide ways, Power Screws and Spindles:**

Functions and Types of Guide ways, Design of Guide ways, Design of Aerostatic Slide ways, Design of Anti-Friction Guide ways, Combination Guide ways, Design of Power Screws.

**Design of Spindles and Spindle Supports:** Functions of Spindles and Requirements, Effect of Machine Tool Compliance on Machining Accuracy, Design of Spindles, antifriction Bearings.

**UNIT-V: Dynamics of Machine Tools:**

Machine Tool Elastic System, Static and Dynamic Stiffness Acceptance Test.

**TEXT BOOKS**:

1. N.K. Mehta, *"Machine Tool Design and Numerical Control"*, Tata McGraw Hill Publisher, 3rd Edition, 2012.
2. G.C. Sen and A. Bhattacharyya, "*Principles of Machine Tools",* New Central Book Agency (P) Ltd, 2nd Edition, 2009.

**REFERENCES:**

1. D. K Pal, S. K. Basu, "*Design of Machine Tools"*, Oxford & Ibh, 6th Edition, 2017
2. N. S. Acherkhan, "*Machine Tool Design",* Vol. I, II, III and IV / / University Press of the Pacific.

**Course outcomes:** The student will be able to

1. Apply the kinematic principles to design Machine Tool Drives and Motion Control Mechanisms
2. Know how to Regulate the Speeds and Feeds, and apply the principles of designing Speed Gear Box and Feed Box
3. Analyze the structural design aspects of machine tools by applying the principles of Design for Strength, Design for Rigidity.
4. Carry out the design of Guide ways, Power Screws, Spindles, and Spindle Supports
5. Determine the Static and Dynamic Stiffness, Rigidity, etc., involved in Machine tool dynamics.

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| **III Year -II Semester** | **3** | **0-0-0** | **3** |

**(F323H) AUTOMOBILE ENGINEERING**

Professional Elective – II

**Course Objectives:** The Student will

1. Learn basics of automobiles, drives, engine lubrication systems, emissions and pollution aspects
2. Know about the fuel injection systems for S.I. Engine and C.I. Engine, fuel pumps and Nozzles, Alternative fuels for Automobiles, and Hybrid vehicles
3. Understand the types and requirements of Cooling system, and Functions and types of Ignition system
4. Understand the functioning of Electrical system components such as current-voltage regulator, bendix drive mechanism, lighting systems, and learn about the Transmission system components and their functions, such as Clutch, Gear box, Differential mechanism, etc.,
5. Understand the construction and operational features of Steering system, Suspension system, and Braking system.

**UNIT-I: Introduction:**

Components of four wheeler automobile – chassis and body – power unit – power transmission – rear wheel drive, front wheel drive, 4-wheel drive – types of automobile engines, engine construction.

**Engine lubrication:** Splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation – engine service, reboring, decarburization, nitriding of crankshaft.

**Emission from Automobiles:** Pollution standards, National and international – Pollution Control – Techniques – Noise Pollution & control.

**UNIT-II: Fuel System:**

S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pumps – carburetor – types – air filters – petrol injection. Electronic injection system

**C.I. Engines:** Requirements of diesel injection systems, types of injection systems, fuel pump, nozzle, Alternative fuels for Automobiles-injection, Classification, Properties, Hybrid vehicles injection timing, testing of fuel, pumps.

**UNIT-III: Cooling System:**

Cooling Requirements, Air Cooling, Liquid Cooling and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporating cooling – pressure sealed cooling – anti freeze solutions.

**Ignition System**: Function of an ignition system, battery ignition system, constructional

features of storage battery, auto transformer, contact breaker points, condenser and spark plug– Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

**UNIT-IV : Electrical System:**

Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

**Transmission System:** Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – Gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. Propeller shaft – Hoatch – Kiss drive, Torque tube drive universal joint, differential rear axles – types – wheels and tyres.

**UNIT-V: Steering System:**

Steering geometry – camber, castor, king pin rake, combined angle toe in, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages

**Suspension System:** Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

**Braking System:** Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes.

**TEXT BOOKS**:


1. Kripal Singh, "*Automobile Engineering",* Standard Publishers Distributors, Vol. 1, & Vol. 2, 2007
2. K.M Gupta, "*Automobile Engineering",* Umesh publication, Vol. 1 & Vol. 2 by, 2012
3. K.K. Ramalingam, "*Automobile Engineering",* Scitech Publications Pvt Ltd, 2nd Edition, 2015.


**REFERENCES:**


1. Jack Erjavec, *"A System approach to Automotive Technology",* YesDee Publishing Pvt Ltd, 5th Edition, 2009.
2. William Crouse, "*Automobile Engineering*", Tata McGraw Hill Publishers, 10th Edition, 2017.
3. Joseph Heitner, "*Automotive Mechanics",* CBS Publishers, 2nd Edition, 2004.


**Course outcomes:** The Student will be able to

1 Identify the basic components automobile like the body, chassis, power transmission system, etc. Gain adequate knowledge of the Engine lubrication system, Crank case ventilation, and Emission controls for Automobiles

2 Analyze the requirements and functioning of the Fuel Injection Systems for SI engines and CI engines and Demonstrate the use of Alternative fuels for Automobiles, and carry out testing of fuel pumps

3 Show reasonable prowess in the understanding of Cooling Systems and Ignition Systems of automobiles

4 Explain the working of various components of the automobile Electrical System, Transmission System,

5 Analyze the working of Steering System, Suspension System, and Braking system.

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| **III Year - II Semester** | **0** | **0-2-0** | **1** |

**(F3231) HEAT TRANSFER LAB**

**Course Objective:** The student will

1. Acquire the necessary skills to conduct various experiments in Heat Transfer Lab which would enable to correlate the theoretical concepts with practical situations
2. Be trained to carry out the experiments of determining the nature of heat transfer in different situations, such as heat transfer through lagged pipe, through a Concentric Sphere etc.,
3. Be able to determine the heat transfer co-efficient. By using the equipments like Composite Slab Apparatus, pin-fin Apparatus, Emissive apparatus, Stefan-Boltzman Apparatus, etc.,
4. Be able to demonstrate the required skills to analyze the nature of heat transfer in natural convection, forced convection, Transient Heat Conduction, etc.,
5. Acquire good knowledge about heat transfer through Parallel and counter flow heat exchanger
6. Be able to demonstrate the principle and operation of heat pipe

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| **EXPERIMENT- I:** | Composite Slab Apparatus – Overall heat transfer co-efficient. |
| **EXPERIMENT- II:** | Heat transfer through lagged pipe. |
| **EXPERIMENT- III:** | Heat Transfer through a Concentric Sphere |
| **EXPERIMENT- IV:** | Thermal Conductivity of given metal rod. |
| **EXPERIMENT- V:** | Heat transfer in pin-fin Apparatus |
| **EXPERIMENT- VI:** | Experiment on Transient Heat Conduction. |
| **EXPERIMENT- VII:** | Heat transfer in forced convection apparatus. |
| **EXPERIMENT- VIII:** | Heat transfer in natural convection |
| **EXPERIMENT- IX:** | Parallel and counter flow heat exchanger. |
| **EXPERIMENT- X:** | Emissive apparatus. |
| **EXPERIMENT- XI:** | Stefan Boltzman Apparatus. |
| **EXPERIMENT- XII:** | Critical Heat flux apparatus |
| **EXPERIMENT- XIII:** | Study of heat pipe and its demonstration. |

**Note:** Minimum 10 experiments must be performed.

**Course Outcomes:**

The student will be able to

1. Apply the concepts of heat transfer to perform experiments related to conduction heat transfer
2. Evaluate nature of heat transfer through lagged pipe, concentric sphere, etc.

3. Evaluate heat transfer coefficient in free and forced convection heat transfer situations
4. Determine the fin efficiency and emissivity by conducting relevant experiments
5. Evaluate the performance of heat exchangers in parallel and counter flow types
6. Explain the principle of working of heat pipe and demonstrate its operation

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| **III Year - II Semester** | **0** | **0-2-0** | **1** |

## (F3232) PRODUCTION DRAWING PRACTICE LAB

**Course objectives:** The student will

1. Understand how to read a production drawing from various perspectives of Manufacturing
2. Understand the conventional representation of materials, manufacturing processes, dimensional tolerances, geometrical dimensions and tolerances
3. Understand in preparing bill of materials and process flow charts for manufacturing a given product
4. Understand in interpreting the notes furnished in the drawing in respect of surface treatment, heat treatment and other special requirements of product under manufacturing

1. Heat treatment and surface treatment symbols used on drawings. Electrical, hydraulic and pneumatic symbols – methods of indicating notes on drawings
2. **Limits and Fits:** Types of fits, exercises involving selection / interpretation of fits and estimation of limits from tables.
3. **Form and Positional Tolerances:** Introduction and indication of the tolerances of form and position on drawings, deformation of run out and total run out and their indication.
4. **Surface roughness and its indication:** Definitions – finishes obtainable from various manufacturing processes, recommended surface roughness on mechanical components.
5. **Detailed and Part drawings:** Drawing of parts from assembly drawings with indications of size, tolerances, roughness, form and position errors etc, preparation of Bill & materials for assembly drawings and process sheet for part- drawings.

**Course outcomes:** The student will be able to

1. Read a production drawing from a holistic manufacturing point of view
2. Understand the conventions of drawing practices associated in manufacturing a product
3. Understand the requirement of material and detail Parts for an assembly of product and its manufacturing process route
4. Read a production drawing comprehensively for obtaining an end product following the instructions given thereof.

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| **III Year - II Semester** | **0** | **0-2-0** | **1** |

## (F3233) COMPUTER AIDED ENGINEERING LAB

**Course Objectives:** The Student will

1. Learn the software's and equipments associated with CAD/CAM
2. Able to build their basic concepts about CAD/CAM
3. Learn the following using different CNC Machine's
   a) & Axis movements
   b) G & M code Development
   c) Programming and Test run of Programmed part

**Brief introduction about CAD/CAE may be discussed for the topics below by taking 10-12 lecture hours**

- Computers in Industrial Manufacturing, Product cycle, CAD / CAM Hardware, Basic structure, CPU, Memory types, input devices, display devices, hard copy devices and storage devices.
- **Drafting and Modeling systems:** Basic geometric commands, layers, display control commands, editing, dimensioning, and solid modeling. (**Lectures: 10)**

**CAD:**

i. 2D Drawing using Sketcher workbench - 3 Drawings (At least)
ii. 3D modeling using 3D features - 3 Models (At least)
iii. Assembly and Drafting - 3 Assemblies (At least)
iv. Surface Modeling - 1 Exercise
v. Sheet Metal Working - 1 Exercise

Software Requirements: **Auto CAD, Solidworks**

**CAE**

i. Determination of deflection and stresses in 2D and 3D trusses and beams
ii. Determination principal/ von-mises stresses and deflections, in plane stress/plane strain/ axi-symmetric models.
iii. Determination of stresses in 3D and shell structures

Software Requirements: **ANSYS**

**Course outcomes:** The student will be able to

1. Design a part or assembly of parts using Computer-Aided Design software.
2. Apply top-down design principles to model a design.
3. Write the program for machining a product using CNC

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| **IV Year - I Semester** | **3** | **0-0-0** | **3** |

**(F413A) FINITE ELEMENT METHODS**

Professional Elective –III

**Course Objectives:** The Student will

1. Learn the basic concepts of FEM and applications, Study the basic equations of elasticity, Stress-Strain relations, and Rayleigh-Ritz method, etc.,
2. Learn about Finite element analysis of One-Dimensional problems using the Potential Energy approach and Virtual energy principle, Quadratic shape functions, and Properties of stiffness matrix, etc.,
3. Perform the Finite Element Analysis of Trusses and Beams, and write the Stiffness matrix equations for truss bar element / beam element
4. Know Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading, Application of Numerical integration methods, and analysis of 3-D problems
5. Learn to apply the finite element method to analyze the Scalar field problems in heat transfer, such as 1-D and 2-D Heat conduction, analysis of thin plates, etc., Understand to derive the dynamic equations for Lumped and consistent mass matrices, and perform modal analysis for bars and beams

**UNIT - I: Introduction to FEM:**

Basic concepts, historical back ground, application of FEM, general description, comparison of FEM with other methods.

Basic equations of elasticity, Stress – Strain and strain - displacement relations. Rayleigh-Ritz method, weighted residual methods.

**UNIT - II: One Dimensional problems**:

Stiffness equations for a axial bar element in local co- ordinates using Potential Energy approach and Virtual energy principle. Finite element analysis of uniform, stepped and tapered bars subjected to mechanical and thermal loads, Assembly of Global stiffness matrix and load Vector-Quadratic shape functions –properties of stiffness matrix.

**UNIT - III:**

Stiffness equations for a truss bar element oriented in 2D plane - Finite Element Analysis of Trusses – Plane Truss and Space Truss elements – methods of assembly.

**Analysis of beams:** Hermite shape functions – Element stiffness matrix – Load vector – Problems.

**UNIT - IV: 2-D problems:**

CST - Stiffness matrix and load vector – Iso-parametric element representation – Shape

functions – convergence requirements – Problems. Two dimensional four nodded iso-parametric elements - Numerical integration - Finite element modelling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements - 3-D problems – Tetrahedran element.

**UNIT - V: Scalar field problems:**

1-D Heat conduction – 1D fin elements – 2D heat conduction - analysis of thin plates – Composite slabs -problems.

**Dynamic Analysis:** Dynamic equations – Lumped and consistent mass matrices – Eigen Values and Eigen Vectors – mode shapes – modal analysis for bars and beams.

**TEXT BOOKS**:

1. S.S. Rao, '*The finite element methods in Engineering",* Elsevier, 4th Edition, 2004
2. Tirupathi R. Chandrupatla and Ashok D. Belagundu, "*Introduction to finite elements in Engineering",* Prentice Hall, 3rd Edition, 2002.
3. G. Ramamurthy, "Applied *Finite Element Analysis"*, I.K. International Publishing house, 2nd Edition, 2010.

**REFERENCES:**

1. Alavala, "*Finite Element Methods",* PHI Publishers, 2nd Edition, 2010.
2. J. N. Reddy, "*An Introduction to Finite Element Methods*", –McGraw Hill Publisher, 3rd Edition, 2006.
3. O.C. Zienkiewicz, "*The Finite Element Method in Engineering Science*", McGraw Hill Publishers, Volume II, 2nd Edition, 2007.

**Course outcomes:**

The student will be able to

1. Apply the basic concepts of FEM in engineering problems, and analyze the equations of elasticity, strain - displacement relations, etc.,
2. Solve structural problems of axially loaded members as 1-D problems.
3. Solve trusses, and beams by using Finite Element Analysis.
4. Formulate 2-D, 3-D and axi-symmetric elements and apply them to 2-D and 3-Dproblemsb of Axi-symmetric solids subjected to Axi-symmetric loading, Heat transfer, and Lumped and consistent mass systems.
5. Solve numerical problems in Structural analysis of trusses and beams, Heat transfer, and vibrational problems using FEM.

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| **IV Year -I Semester** | **3** | **0-0-0** | **3** |

**(F413B) DESIGN FOR MANUFACTURING**

Professional Elective -III

**Course Objectives:** The Student will

1. Obtain the orientation to design a component which will have minimum or nil problems during manufacture, by considering all the necessary aspects in the design stage itself.
2. Get exposure to General Design rules for Manufacturability, Basic principles of designing for economical production, and Selection of Materials for better design
3. Learn to apply Creativity in design, and to use the Process selection charts to find the best match between a set of attributes (of the process) and the design requirements
4. Get to understand the general design guidelines and rules for different manufacturing processes such as Machining, casting, forging, welding, extrusion, etc.
5. Learn to make the design suitable for Assembly, using the Systematic DFA methodology

**UNIT-I: Introduction:**

Design philosophy – Steps in Design process – General Design rules for Manufacturability – Basic principles of designing for economical production – Creativity in design.

**Materials**: Selection of Materials for design – Developments in Material Technology – Criteria for material selection – Material selection interrelationship with process selection – process selection charts.

**UNIT-II: Machining Process:**

Overview of various machining processes – general design rules for machining - Dimensional tolerance and surface roughness –

**Design for Machining ease**–Redesigning of components for machining ease with suitable examples, General design recommendations for machined parts.

**UNIT-III: Metal Casting:**

Appraisal of various casting processes, Selection of casting process, General design considerations for casting – casting tolerances – Use of Solidification Simulation in casting design – Product design rules for sand casting.

**Metal Joining:** Appraisal of various welding processes, Factors in design of weldments – General design guidelines – pre and post treatment of welds – Effects of thermal stresses in weld joints – Design of brazed joints.

**UNIT-IV: Forging:**

Design factors for Forging – Closed die forging design – parting lines of dies – Drop forging die design – General design recommendations

**Extrusion, Sheet Metal Work & Plastics**: Design guidelines for Extruded sections – Design principles for Punching, Blanking, Bending, Deep Drawing – Keeler Goodman Forming Limit Diagram – Component Design for Blanking.

**UNIT-V: Design for Assembly**:

General design guidelines for Manual Assembly- Development of Systematic DFA Methodology- Assembly Efficiency- Classification System for Manual handling- Classification System for Manual Insertion and Fastening- Effect of part symmetry on handling time.

**TEXT BOOKS**:

1. Geoffrey Boothroyd, "*Product design for Manufacture and Assembly",* Inc. NY, 2nd Edition, 2010.
2. Kevin Otto and Kristin Wood, "*Product Design*", Pearson Publications, 1st Edition, 2003.

**REFERENCES:**

1. A.K Chitale and R.C Gupta, "*Product design and Manufacturing",* Prentice – Hall of India, 2nd Edition, 2003.

**Course outcomes:** The student will be able to

1. Incorporate all the necessary features to facilitate ease of manufacture at the design stage of the product by applying the general design rules for Manufacturability
2. Use the Material selection charts and Process selection charts for selecting the suitable material and process at the design stage itself
3. Prepare the design for ease of machining.
4. Prepare better design of the product by applying the design guidelines suitable for the relevant manufacturing process
5. Apply Systematic DFA Methodology principles to produce a design which is best suited for easy assembly

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| **IV Year -I Semester** | **3** | **0-0-0** | **3** |

**(F413C) JET PROPULSION AND ROCKET ENGINEERING**

Professional Elective-III

**Course Objectives:** The Student will

1. Study the elements of Gas Turbine theory and Jet propulsion
2. Learn about the need for Rocket Engines, their principles of operation, and domains of application
3. Learn the principles of Turboprop and Turbojet, plant layout, Thrust Augmentation, Thrust reversal and propellants
4. Study the Ramjet principle of operation, plant lay-out, and performance evaluation
5. Acquire the knowledge of Rocket Technology, Flight mechanics, heat transfer, Testing and Instrumentation

**UNIT-I:**

Elements of Gas Turbine theory-Thermo dynamic Cycles, open closed and semi-closed – Parameters of performances –cycle modifications for improvement of performance.

**UNIT-II: Jet propulsion:**

Historical sketch-reaction principle–essential features of propulsion devices-Thermal Engines, Classification of –Energy flow thrust, thrust power and propulsion efficiency-Need for Thermal Jet Engines and application.

**UNIT-III: Turboprop and Turbojet-1:**

Thermo dynamic cycles, plant layout, essential components, principles of operation – performance evaluation

**Turboprop and Turbojet-II**: Thrust Augmentation and Thrust reversal contrasting with piston Engine Propeller plant.

**UNIT-IV: Ramjet:**

Thermo dynamic Cycle, plant lay-out, essential components–principle of operation-performance evaluation –comparison among atmospheric thermal jet engines- serqujet and pulse jet, elementary treatment.

**Rocket Engines:** Need for, applicat**ions –**Basic principles of operation and parameter s of performance –classification, solid and liquid propellant rocket engines, advantages, domains of application –propellants –comparison of propulsion systems.

**UNIT-V:Rocket Technology-I:**

Flight mechanics, Application Thrust profiles, Acceleration–staging of Rockets, need for – Feed systems, injectors and expansion nozzles –Rocket heat transfer and ablative cooling.

**Rocket Technology- II:** Testing & instrumentation–Need for Cryogenics–Advanced propulsion Systems, elementary treatment of Electrical Nuclear and plasma Arc propulsion.

**TEXT BOOKS**:

1. P. Khajuria & S. P. Dubey, "*Gas Turbines and propulsive systems",* Dhanpatrai Publications, 2003.
2. M. C. Ramaswamy, "*Gas Dynamics & Space Propulsion*", Jaico Publishing House, 2007.

**REFERENCES:**

1. George P. Sutton, "*Rocket Propulsion*", Wiley Publishers; 8th Edition, 2010
2. Cohen, Rogers & Sarvana Muttoo, "*Gas Turbines*", Pearson; 7th Edition, 2017
3. V. Ganesan, "*Gas Turbines*", Tata McGraw Hill, 4th Edition, 1998.

**Course outcomes:** The student will be able to

1. Have sufficient knowledge of Gas Turbines and Jet propulsion
2. Possess knowledge of Jet propulsion, propulsion devices and applications of jet engines
3. Possess knowledge of Turboprop, Turbojet,
4. Have good knowledge of Ramjet, Rocket Engines, Rocket Technology.
5. Possess knowledge of flight mechanics and have the skill to apply the concepts of Jet propulsion and Rocket engineering to problems in practical situations

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| **IV Year -I Semester** | **3** | **0-0-0** | **3** |

**(F413D) ROBOTICS**

Professional Elective – IV

**Course Objectives:** The Student will

1. Be familiar with the features of automation in robotics. Learn about the various components of Industrial Robotics
2. Be taught about the Kinematic Motion Analysis, Homogeneous transformation, Forward and inverse kinematics, and solution of relevant problems.
3. Be able to solve problems involving Differential Kinematics of planar and spherical manipulators, and Jacobians. Be made familiar Dynamic analysis of Robot motion, and solution of problems on planar two link manipulators.
4. Study the features of Trajectory planning for avoidance of obstacles, and solution of problems on different types of motion.
5. Be made to learn about the Robot actuators and Feedback components. Learn the Application of Robots in Manufacturing activities, such as Material handling, Assembly and Inspection.

**UNIT-I: Introduction:**
Automation and Robotics – An over view of Robotics – classification by coordinate system and control systems.
**Components of the Industrial Robotics:** Degrees of freedom–End effectors: Mechanical gripper–Magnetic–Vacuum cup and other types of grippers – General consideration on gripper selection and design.

**UNIT-II: Motion Analysis:**
Basic rotation matrices – Composite rotation matrices – Euler Angles – Equivalent Angle and Axis – Homogeneous transformation – Problems.
**Manipulator Kinematics:** D-H notations - Joint coordinates and world coordinates - Forward and inverse kinematics–problems.

**UNIT-III**: **Differential Kinematics:**
Differential Kinematics of planar and spherical manipulators - Jacobians – problems.
**Robot Dynamics:** Lagrange – Euler formulations – Newton-Euler formulations – Problems on planar two link manipulators.

**UNIT-IV: Trajectory planning**: Joint space scheme – cubic polynomial fit – Avoidance of obstacles. **Types of motion:** Slew motion - joint interpolated motion – straight line motion –problems.

**UNIT-V: Robot actuators and Feedback components:**

Actuators: Pneumatic and Hydraulic actuators. **Electric Actuators:** DC servo motors - stepper motors.

**Feedback components:** position sensors – potentiometers, resolvers and encoders – Velocity sensors – Tactile sensors.

**Robot Application in Manufacturing:** Material handling - Assembly and Inspection.

**TEXT BOOKS**:

1. Groover M P, "*Industrial Robotics",* MCH Publishers, 2010.
2. J.J. Craig, "*Introduction to Robotic: Mechanics and Control*", Pearson, 3rd Edition, 2009.

**REFERENCES:**

1. K. S. Fu, "*Robotics*", Tata McGraw Hill Publishers, Indian Edition, 2017.
2. H. Asada and J. J. E. Slotine, "*Robot Analysis and Intelligence*", Wiley Inter-Science. 1986
3. Mark W. Spong and M. Vidyasagar, "*Robot Dynamics & Control*", John Wiley & Sons Pvt. Ltd, 1989.

**Course outcomes:** The student will be able to

1. Understand the design and working of the various components of Robot such as End effectors, grippers, control systems, etc.,
2. Perform calculations of Robot motion involving forward kinematics, inverse kinematics, Homogeneous transformations, etc.,
3. Apply Differential Kinematics, Jacobian, Lagrange-Euler formulations, etc., to solve problems of planar and spherical manipulators
4. Analyze the various types of motion (slew motion, straight line motion, etc.,) for solving problems in Trajectory planning
5. Apply the knowledge of various types of Robot actuators and Feedback components, and applications of industrial robots in the activities of manufacturing.

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| **IV Year -I Semester** | **3** | **0-0-0** | **3** |

**(F413E) COMPUTATIONAL FLUID DYNAMICS**

Professional Elective – IV

**Course Objectives:** The Student will

1. Understand the basics of numerical techniques like number system and errors, representation of integers, floating point arithmetic, etc.,
2. Get exposure to Applied Numerical Methods and Finite Difference Applications in Heat conduction and Convection
3. Learn to apply finite-difference equations to fluid flow modeling
4. Understand the elements of first order wave equation and its applications, and Review of the equations governing Fluid Flow and Heat Transfer
5. Analyze the Steady flow of fluids, stream function, and Finite volume methods like differentiation, linear interpolation and quadratic interpolation, etc.,

**UNIT-I:** Elementary details in numerical techniques: Number system and errors, representation of integers, fractions, floating point arithmetic, loss of significance and error propagation. Condition for instability, computational methods for error estimation, convergence of sequences.

**UNIT-II:**

Applied Numerical Methods: Solution of a system of simultaneous Linear Algebraic Equations, iterative schemes of Matrix Inversion, Direct Methods for Matrix inversion, and direct methods for banded matrices.

Finite Difference Applications in Heat conduction and Convection – Heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer, closure.

**UNIT-III:**

Finite Differences, discretization, consistency, stability. Fundamentals of fluid flow modeling: Introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods.

**UNIT-IV:**

Introduction to first order wave equation; stability of hyperbolic and elliptic equations, fundamentals of fluid flow modeling, conservative property, the upwind scheme

Review of Equations Governing Fluid Flow and Heat Transfer: Introduction, conservation of mass, Newton's second law of motion, expanded forms of Navier-stokes equations, conservation of energy principle, and special forms of the Navier-stokes equations.

**UNIT-V:**

Steady flow, dimensionless form of Momentum and Energy equations, Stokes equation, conservative body force fields, stream function - Vorticity formulation.

Finite volume method: Approximation of surface integrals, volume integrals, interpolation and differentiation practices, upwind interpolation, linear interpolation and quadratic interpolation.

**TEXT BOOKS**:

1. Suhas V. Patankar, "*Numerical Heat Transfer and fluid flow",* Hemashava Publishers & McGraw Hill, 1980
2. Muralidaran, "*Computational Fluid Flow and Heat Transfer*" Narosa Publications, 1985.

**REFERENCES:**

1. John D. Anderson, "*Computational Fluid Dynamics Basics with applications",* McGraw Hill, 1995.
2. Tapan K. Sengupta, "*Fundamentals of Computational Fluid Dynamics",* Universities Press, Hyderabad, 2004.

**Course outcomes:** The student will be able to

1. Apply various numerical techniques to fluid flow analysis involving Heat conduction and Convection
2. Apply the Finite Difference techniques to fluid flow modeling
3. Apply the equations governing Fluid Flow and Heat Transfer
4. Solve numerical problems using the Navier-stokes equations, Momentum and Energy equations, and Interpolation and Differentiation practices.
5. Apply Finite volume methods and solve dimensionless form of Momentum and Energy equations

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**UGC AUTONOMOUS**

| **B. Tech. ME** | **L** | **T-P-D** | **C** |
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| **IV Year -I Semester** | **3** | **0-0-0** | **3** |

**(F413F) PRODUCTION PLANNING AND CONTROL**

Professional Elective – IV

**Course Objectives:** The Student will

1. Understand the objectives, functions and elements of PPC, types of production and Organization of PPC department
2. Understand the concept and importance of forecasting, types of forecasting techniques, qualitative and quantitative methods
3. Acquire knowledge of Inventory management, the functions of inventory, inventory costs, EOQ models, and inventory control systems (P system, Q system) and Study the methods of ABC analysis and VED analysis, Development of EOQ models, and principles of MRP, ERP, Line of balance and JIT inventory
4. Understand the routing procedures, route sheets, bills of materials, scheduling policies, standard scheduling method (job shop and floor shop)
5. Learn the concepts of Line balancing aggregate planning, Dispatching and Follow up and Study the applications of computers in PPC

**UNIT-I:**

Introduction: Definitions – objectives of production planning and control- functions of production planning and control-elements of production control-

Types of production- organization of production planning and control – internal organization department.

**UNIT-II:**

Forecasting – Importance of forecasting – types of forecasting, their uses. General principles of forecasting techniques- Qualitative methods and quantitative methods.

**UNIT-III**:

Inventory management – Functions inventory- Relevant inventory cost- ABC analysis- VED Analysis- EOQ model – Inventory control systems – P- Systems and Q – Systems

Introduction to MRP and ERP, LOB (Line of balance), JIT inventory, Japanese concepts.

**UNIT-IV: Routing** :

Definition – routing procedure- Route sheets – Bill of material- factors affecting routing procedure

**Schedule** – definition – difference with loading. Scheduling polices – techniques, standard scheduling methods- job shop, flow shop.

**UNIT-V:**

Line balancing, aggregate planning- methods for aggregate planning- Chase planning, expediting, control aspects

Dispatching – Activities of dispatcher- Dispatching procedure - follow up – definition – reasons for existence of functions – types of follow up, applications of computer in production planning control.

**TEXT BOOKS**:

1. M. Mahajan, "*Production Planning and Control",* Dhanpati Rai Publications, 2010.
2. Jain & Jain, "*Production Planning and Control",* Khanna publications, 7th Edition, 2014.

**REFERENCES:**

1. S.K. Mukhopadhyaya, "*Production Planning and Control: Text & cases"*, PHI Publishers. 3rd Edition, 2015
2. R. Panneer Selvam, "*Production and operations Management*", PHI, 3rd Edition, 2014.

**Course outcomes:**

The student will be able to

1. Obtain clear understanding of the various objectives and functions of PPC, and organization of production planning and control to suit different types of production
2. Apply the different methods of sales forecasting optimize the organization's output
3. Develop EOQ models for different inventory situations and optimal Inventory control systems and Apply the concepts of ABC analysis, VED analysis, MRP, ERP, LOB, and JIT for better management of inventory
4. Get thorough knowledge of the Routing procedures, preparation of Route sheets, and Bills of materials and Apply the standard scheduling methods for processing of jobs on the shop floor to achieve optimal utilization of resources
5. Acquire sufficient expertise in the concepts of line balancing, aggregate planning, dispatching, follow-up, and control aspects and incorporate the practice of using computers in the functions of PPC.

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| **B. Tech. ME** | **L** | **T-P-D** | **C** |
| **IV Year - I Semester** | **0** | **0-4-0** | **2** |

**(F4132) INDUSTRY ORIENTED MINI PROJECT**

**Guidelines:**

There is an Industry Oriented Mini Project, in collaboration with an industry of their specialization to be taken up during the vacation after III year II semester examinations. Industry Oriented Mini Project is submitted in a report form and presented before the committee in IV year I semester. It is evaluated for 100 marks by the committee consisting of Head of the Department, supervisor of the Industrial Oriented mini project and a senior faculty member of the department.

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| **B. Tech. ME** | **L** | **T-P-D** | **C** |
| **IV Year – I Semester** | **0** | **0-8-0** | **4** |

## (F4131) PROJECT STAGE – I

**Guidelines:**

UG project work shall be carried out in two stages: Project Stage – I during IV Year I Semester, Project Stage – II during IV Year II Semester. Each stage will be evaluated for 100 marks. Student has to submit project work report at the end of each semester. First report includes project work carried out in IV Year I semester and second report includes project work carried out in IV Year I & II Semesters. SEE (Semester End Examinations) for both project stages shall be completed before the commencement of SEE Theory examinations.

For Project Stage – I, the Project Review committee (PRC) consisting of Head of the Department, project coordinator and two senior faculty members shall evaluate (SEE) the project work for 70 marks and project supervisor (CIE) shall evaluate for 30 marks.

The student is deemed to have failed, if he

(i) Does not submit a report on Project Stage - I or does not make a presentation of the same before the evaluation committee as per schedule, or

(ii) Secures less than 40% marks in the sum total of the CIE and SEE taken together

A student who has failed may reappear once for the above evaluation, when it is scheduled again; if he fails in such „one reappearance" evaluation also, he has to reappear for the same in the next subsequent semester, as and when it is scheduled.

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| **IV Year – II Semester** | **3** | **0-0-0** | **3** |

**(F423A) MANUFACTURING OF COMPOSITES**

Professional Elective – V

**Course Objectives:** The Student will

1. Understand the concepts of composites, their properties, applications, and testing methods.
2. Learn about the manufacturing processes for Thermosetting matrix composites and Thermoplastic matrix composites
3. Gain knowledge of various methods of processing the Metal Matrix Composites.
4. Learn about the Ceramic Matrix Composites, Nano-composites, and Carbon-Carbon Composites, their properties, Fabrication methods, and Applications
5. Learn various methods of Repair and Non-destructive testing for composite materials

**UNIT-I:Introduction to Composites:**

Concept of composites, Classification of composites, Applications of composites, Metals vs Composites. Composites lay-up nomenclature, Laminating stacking, Standard orientation and sequence of ply.

**Properties and testing of composites:** Composite properties, Volume fraction calculations, Elastic behaviour. Composites testing- types of testing- Physical testing, Mechanical testing, chemical testing, Thermal testing, Rheological testing.

**UNIT-II: Manufacturing of Polymer Matrix Composites:**

Processes for Thermosetting matrix composites - Hand layup and spray up techniques, Filament winding, Pultrusion, Resin transfer moulding, Autoclave moulding.

Processes for Thermoplastic matrix composites- Injection moulding, Film stacking, Diaphragm forming. Thermoplastic tape laying. Stacking of reinforcements

Manufacturing Process Selection, Criteria, Product Fabrication Techniques, Mold and Tool Making method.

**UNIT-III: Manufacturing of Metal Matrix Composites (MMC)**

Introduction, Classification, Advantages and disadvantages; Reinforcements and Matrices. Processing of MMC- Processing methods, Liquid state processing, Stir Casting, Infiltration, Gas pressure, Squeeze casting, Pressure die, Solid state fabrication, Diffusion bonding, Sintering, In situ fabrication of MMC, Co-deposition methods, Electrolytic co-deposition, Spray co-deposition, Vapour co-deposition.

**UNIT-IV: Manufacturing of Ceramic Matrix Composites (CMCs) and Nano Composites**

Introduction, Types, Properties, Interfaces, Fabrication methods of CMCs- Polymer

Infiltration and Pyrolysis, Chemical Vapor Infiltration, Liquid Silicon Infiltration, Direct Oxidation Process, Slurry Infiltration, Selective Laser Sintering, Applications of CMCs. Carbon – Carbon Composites - Introduction, Processing of CCC, Advantages, limitations and Applications of CCC.

**Nano Composites-** Nano-composites and fillers, Synthesis of nano-composites, Solution casting, Melt blending, In-situ polymerization, Electro deposition, Advantages, limitations and Applications of nano-composites.

**UNIT-V: Repair and NDT of Composites**

**Repair of Composites**- Damage in Composites, Damage Assessment, Contaminations, Types of repair, Scarfing and Stepping

**Non-destructive testing methods for composite materials-** Ultrasonic Testing (UT), Acoustography, Radiographic Testing (RT), Shearography Testing, Thermography.

**TEXT BOOKS**:


1. Mazumdar, S., 2001. Composites manufacturing: materials, product, and process engineering. CRC press.
2. Balasubramanian, M., 2013. Composite materials and processing. CRC press.
3. Campbell Jr, F.C. ed., 2003. Manufacturing processes for advanced composites. Elsevier.


**REFERENCES:**


1. Analysis and performance of fibre Composites, B. D. Agarwal and L. J. Broutman, Wiley- Inter science, New York, 1980
2. R. M. Jones, “Mechanics of Composite Materials”, Mc Graw Hill Company, New York, 1975.
3. Engineering Mechanics of Composite Materials/Isaac and M Daniel/Oxford University Press, 1994.


**Course outcomes:** The student will be able to

1. Describe the important properties of composites, their applications, and testing methods.
2. Identify the manufacturing methods of Polymer Matrix Composites
3. Apply the knowledge acquired in the manufacturing of Metal Matrix Composites, Ceramic Matrix Composites, and Nano-composites to practical situations
4. Identify and assess the damage in Composites by Non-destructive testing methods, and repair the same
5. Apply the knowledge of various methods for Repair and Non-destructive testing for composite materials

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| **IV Year – II Semester** | **3** | **0-0-0** | **3** |

**(F423B) CNC TECHNOLOGY**

Professional Elective – V

**Course Objectives:** The Student will

1. Understand the fundamentals of numerical control, Features of N/C Machine Tools, and CNC Machine Elements
2. Acquire knowledge of Tooling systems for CNC Machines, and features of NC Part Programming
3. Get exposure to the basics of :Computer-Aided Programming, APT programming problems, and Introduction to CAD/CAM software
4. Get Introduction to DNC systems, advantages and disadvantages of DNC, and different types of Adaptive Control
5. Learn about Micro Controllers, their Hardware components, Selection criteria, Applications and Programming of Micro Controllers, Programming Logic Controllers, their basic structure, principle of operation, and Applications in CNC Machines.

**UNIT-I: Features of NC Machines:**

Fundamentals of numerical control, advantage of NC systems, classification of NC systems, point to point, NC and CNC, incremental and absolute, open and closed loop systems, Features of N/C Machine Tools, design consideration of NC machine tool, methods of improving machine accuracy.

**CNC Machines Elements:** Machine Structure- Guide ways - feed drives-spindles - spindle bearings - measuring Systems-Tool monitoring systems.

**UNIT-II: Tooling for CNC Machines:**

Interchangeable tooling system, preset and qualified tools, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers.

**NC Part Programming:** Manual Programming-Basic concepts, point to point contour programming, canned cycles, parametric programming.

**UNIT-III**: **Computer-Aided Programming:**

General information, APT programming, Examples APT programming problems (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors. Introduction to CAD/CAM software, Automatic Tool Path generation.

**UNIT-IV: DNC Systems and Adaptive Control:**

Introduction, type of DNC systems, advantages and disadvantages of DNC, adaptive control with optimization, Adaptive control with constraints, Adaptive control of

machining processes like turning, grinding.

**UNIT-V: Micro Controllers:**

Introduction, Hardware components, I/O pins, ports, external memory, counters, timers and serial data I/O interrupts. Selection of Micro Controllers, Embedded Controllers, Applications and Programming of Micro Controllers

**Programming Logic Controllers (PLC's):** Introduction, Hardware components of PLC, System, basic structure, principle of operations. Programming mnemonics timers, Internal relays and counters, Applications of PLC's in CNC Machines.

**TEXT BOOKS**:

1. Yoram Koren, "*Computer Control of Manufacturing Systems",* Tata McGraw Hill, 2010.
2. Michel P. Groover, '*CAD/CAM*", Tata McGraw Hill, 1st Edition, 2009.

**REFERENCES:**

1. Manfred Weck, *"Machining Tools Hand Book: Automation & Control"*, John Wiley and Sons Publications, Volume 3, 1984.
2. HMT, "*Mechatronics*", Tata McGraw Hill, 5th Edition, 2005.
3. Kalpak Jain, "*Manufacturing Engineering and Technology",* Pearson Publication, 4th Edition, 2012.

**Course outcomes:**

The student will be able to

1. Appreciate the differences between NC and CNC, get exposure to the design consideration of NC machine tools, and CNC Machine Elements
2. Write Part Programming for simple jobs to be processed on NC machines
3. Acquire knowledge of computer aided programming, APT Programming and CAD/CAM Software.
4. Acquire complete knowledge about DNC Systems and application of Adaptive Control to machining processes like turning, grinding, etc.,
5. Apply the knowledge gained about the features and operating principles of Micro Controllers, Embedded Controllers, and Programming Logic Controllers in CNC Machines.

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| **IV Year – II Semester** | **3** | **0-0-0** | **3** |

**(F423C) PLANT LAYOUT AND MATERIAL HANDLING**

Professional Elective – V

**Course Objectives:** The Student will

1. Understand the significance of Plant Layout, Layout design procedures, and Elements of Process layout and Product layout
2. Learn about the Heuristics for Plant layout, Group Layout, Fixed position layout, and Quadratic assignment model
3. Understand the different types of Material Handling systems, and their relationship to plant layout.
4. Learn about the Selection of material handling methods, methods of job evaluation and merit rating
5. Get exposure to the methods to minimize the cost of material handling, Maintenance and Ergonomics of Material Handling equipment and Know the features of Work Study, Method study, and how to calculate standard time for processing a job

**UNIT-I:** Introduction- Classification of Layout, Advantages and Limitations of different layouts, Layout design procedures.

Overview of the plant layout. Process layout & Product layout: Selection, specification, Implementation and follow up, comparison of product and process layout.

**UNIT-II:** Heuristics for Plant layout — ALDEP, CORELAP, CRAFT, Group Layout
Fixed position layout- Quadratic assignment model, Branch and bound method.

**UNIT-III**: Introduction, Material Handling systems, Material Handling principles
Classification of Material Handling Equipment, Relationship of material handling to plant layout.

**UNIT-IV: Basic material handling system:**

Selection, material handling methods- path, equipment and function oriented systems. Job evaluation – methods of job evaluation – simple routing objective systems – classification methods – benefits of job evaluation and limitations

Merit Rating – job evaluation vs merit rating – objectives of merit rating – method for merit rating – ranking method – paid company method – checklist method.

**UNIT-V:**

Methods to minimize cost of material handling - Maintenance of Material Handling Equipments, Safety in handling Ergonomics of Material Handling equipment

Work Study: Introduction – definition – objectives – steps in work study – Method study – definition – objectives – steps in method study. Work Measurement – purpose – types of study – allowances – standard time calculations.

**TEXT BOOKS**:

1. P. B. Mahapatra, "*Operations Management*", PHI Publishers, Kindle Edition, 2010
2. Dr. KC Arora & Shinde, "*Aspects of Material handling*", Lakshmi Publishers, 1st Edition, 2007.

**REFERENCES:**

1. RL Francis, "*Facility Layout & Location- An Analytical Approach*", PHI Publishers, 2nd Edition, 1998.
2. R Panneerselvam, "*Production and Operations Management*", PHI Publishers, 3rd Edition, 2012
3. RB Chowdary, "*Plant Layout and Material Handling*", Khanna Publishers. 2nd Edition, 1986.

**Course outcomes:** The student will be able to

1. Design Plant Layout by incorporating the knowledge gained about the Heuristics for Plant layout
2. Appreciate the importance and role of Material handling systems and their relationship to plant layout.
3. Apply the principles of Job Evaluation and Merit Rating in the organization
4. Apply suitable methods to minimize the cost and maintenance of material handling, and apply Safety procedures in handling
5. Apply the principles of Work Study, Method Study, and Work Measurement in the working of Plant.

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| **IV Year – II Semester** | **3** | **0-0-0** | **3** |

**(F423D) POWER PLANT ENGINEERING**

Professional Elective – V

**Course Objectives:** The Student will

1. Understand the Functioning of steam power plant, Plant layout, coal storage, Coal and Ash handling systems and learn the Combustion Process, Pulverized fuel burning system and its components, Furnace design and construction, Corrosion and feed water treatment.
2. Study Construction and Operation of Internal Combustion Engine Plant, and Plant layout with auxiliaries and Learn about Gas Turbine Plant, Layout, closed and open cycle gas turbines, and Direct Energy Conversion
3. Study the functioning of Hydroelectric power plant, Hydrographs, Storage and Pondage, Plant layouts, plant auxiliaries and operation and Get the knowledge of generation of power from nonconventional sources like Solar energy, Wind Energy, Tidal Energy, etc.,
4. Understand the functioning of Nuclear power plant, Nuclear reactor operation, Types of Reactors such as boiling water reactor, fast Breeder Reactor, etc., and Radiation hazards
5. Understand the power plant economics and environmental Considerations, general arrangement of power distribution, and Methods of Pollution control.

**UNIT-I:**

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

**Steam Power Plant:** Plant Layout, Working of different Circuits, Fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, and Ash handling systems.

**Steam Power Plant: Combustion Process:** Properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment.

**UNIT-II: Internal Combustion Engine Plant:**

Diesel Power Plant: Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air intake system, lubrication and cooling system – super charging.

**Gas Turbine Plant:** Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants

and comparison

**Direct Energy Conversion:** Solar energy, Fuel cells, Thermo electric and Thermo ionic, MHD generation.

**UNIT-III**: **Hydro Electric Power Plant:**

Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways. Classification of plants – Typical layouts – plant auxiliaries – plant operation pumped storage plants.

**Power from Non-Conventional Sources:** Utilization of Solar- Collectors- Principle of Working, Wind Energy – types – HAWT, VAWT -Tidal Energy.

**UNIT-IV: Nuclear Power Station:**

Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation.

**Types of Reactors:** Pressurized water reactor, boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

**UNIT-V: Power Plant Economics and Environmental Considerations**:

Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises.

Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.

**TEXT BOOKS**:

1. P. C. Sharma, "*Power Plant Engineering*", S. K. Kataria Publications, 2009.
2. Arora and S. Domkundwar, "*A Course in Power Plant Engineering",* Dhanpat Rai Publications, 2016.

**REFERENCES:**

1. R.K. Rajput, "*A Text Book of Power Plant Engineering*", Laxmi Publications, 4th Edition, 2008.
2. K. K. Ramalingam, "*Power Plant Engineering*", Scitech Publishers, 2013.
3. P. K. Nag, "*Power Plant Engineering*", Tata McGraw Hill, 4th Edition, 2014.
4. G. D. Rai, "*An Introduction to Power Plant Technology",* Khanna Publications, 1996.
5. Elanchezhian, "*Power Plant Engineering*", I.K. International Publications, 2007.

**Course outcomes:** The student will be able to

1. Acquire thorough knowledge about the working of various types of power plants such as steam power plant, Diesel Power Plant, Gas Turbine Plant, and Hydroelectric power plant.
2. Exposed to the Layouts, various components and subsystems, and relative merits of these power plants

3. Obtain clear understanding of generation of power from Non-Conventional Sources
4. Demonstrate the construction and operation of Nuclear power plant, Nuclear reactor operation, and radioactive waste disposal, etc.,
5. Apply the knowledge of power plant economics and environmental considerations for economical and environment-friendly operation of the power plants.

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| **IV Year – II Semester** | **3** | **0-0-0** | **3** |

**(F423E) AUTOMATION IN MANUFACTURING**

Professional Elective – VI

**Course Objectives:** The Student will

1. Understand the basic concepts of Automation and Automation strategies in manufacturing systems.
2. Acquire the knowledge of automated flow lines and their analysis.
3. Study the elements of Assembly systems, flexible assembly lines, and line balancing methods
4. Learn about analysis and design of automated material handling systems, automated guided vehicle systems, and automated storage and retrieval systems.
5. Learn the fundamentals of Industrial controls, logic controls, sensors and actuators, concepts of Business process Re-engineering, Concurrent Engineering, and Rapid Proto typing.

**UNIT-I: Introduction:**

Types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools. Mechanical feeding and too changing and machine tool control transfer the automaton.

**Automated flow lines**: Methods or work part transport transfer Mechanical buffer storage control function, design and fabrication consideration.

**UNIT-II: Analysis of Automated flow lines**:

General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

**UNIT-III**: **Assembly system and line balancing:**

Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

**UNIT-IV: Automated material handling:**

Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems

Automated storage systems, automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

**UNIT-V: Fundamentals of Industrial controls**:

Review of control theory, logic controls, sensors and actuators, Data communication and LAN in Manufacturing

**Business process Re-engineering:** Introduction to BPE logistics, ERP, Software

configuration of BPE, concurrent Engineering, Techniques of Rapid Proto typing.

**TEXT BOOKS**:

1. M. P. Groover, "*Automation, Production Systems and Computer Integrated Manufacturing*", PHI Publications, 3rd Edition, 2009.
2. Tien-Chien Chang, Richard A, "*Computer Aided Manufacturing",* Pearson Publishers, 3rd Edition, 2005.

**REFERENCES:**

1. P.Radha Krishnan & S. Subrahmanyam, "*CAD/ CAM/ CIM*", New Age International Publishers, 2003.
2. W. Buekinsham, "*Automation*", PHI Publications, 3rd Edition, 2004.

**Course outcomes:** The student will be able to

1. Demonstrate the basic knowledge of automation in machining
2. Design and analyze the automated flow lines and implement them in manufacturing systems
3. Explain assembly systems and line balancing methods.
4. Describe the importance of automated material handling, Storage and Retrieval systems.
5. Apply the knowledge of control theory, logic controls, Data communication and LAN in Manufacturing, concepts of Business process Re-engineering, including Concurrent Engineering and Rapid Proto typing techniques in manufacturing.

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| **IV Year – II Semester** | **3** | **0-0-0** | **3** |

**(F423F) QUALITY ENGINEERING IN MANUFACTURING**

Professional Elective – VI

**Course Objectives:** The Student will

1. Understand the significance of Quality engineering in the design of production processes, Quality Loss Function, and Evaluations and types of tolerances
2. Learn about Analysis Of Variance (ANOVA), different types of ANOVA, and Critique of F-test
3. Get exposed to the concepts of Orthogonal Arrays, Strategies in Experimentation, Designing, conducting and analyzing an experiment, and Interpolation of experimental results
4. Learn about Tolerance design, Parameter design, Case studies on parameter and tolerance designs.
5. Understand the basic Quality tools such as ISO-9000 Quality System, Business Process Re-engineering, Six-sigma, etc.,

**UNIT-I: QUALITY VALUE AND ENGINEERING:** An overall quality system, Quality engineering in product design, Quality engineering in design of production processes, Quality engineering in production.

**LOSS FUNCTION AND QUALITY LEVEL:** Derivation and use of Quality Loss Function (QLF), Economic consequences of tightening tolerances as a means to improve quality, Evaluations and types tolerances - N-type, S-type and L-type.

**UNIT-II: ANALYSIS OF VARIANCE (ANOVA):** No - way ANOVA, One-way ANOVA, Two-way ANOVA, Critique of F-test, ANOVA for four level factors.

**UNIT-III**: **ORTHOGONAL ARRAYS:** Introduction to OA, Degrees of Freedom, Structure of OA, Linear Graphs & Interaction tables, Strategies in Experimentation - Typical test strategies, Better test strategies & Efficient test strategies, steps in designing, conducting and analyzing an experiment.

**INTERPOLATION OF EXPERIMENTAL RESULTS:** Interpretation methods, Percent contribution, estimating the mean.

**UNIT-IV: TOLERANCE DESIGN AND TOLERANCING:** Functional limits, Tolerance design for N-type, L-type and S-type characteristics, Tolerance allocation for multiple components.

**PARAMETER AND TOLERANCE DESIGN:** Introduction to parameter design, Signal to noise ratios, Parameter design strategy, some of the case studies on parameter and tolerance designs.

**UNIT-V: QUALITY TOOLS:**

ISO-9000 Quality System, Business Process Re-engineering (BPRE), Six-sigma, Bench making, Quality circles, Brain Storming, Fishbone diagram.

**TEXT BOOKS**:

1. Phillip J. Ross, "*Taguchi Techniques for Quality Engineering*", McGraw Hill Publishers, 2nd Edition, 1995.
2. G. Taguchi, A. Elsayed, "*Quality Engineering in Production systems*", Tata McGraw Hill Publishers. 3rd Edition, 1989.

**REFERENCES:**

1. Madhav S. Phadke, "*Quality Engineering using Robust Design*", Pearson Education. 3rd Edition, 2008
2. Poornima M. Charantimath, "*Total Quality Management",* Pearson Publications, 2nd Education, 2006.
3. Tapan P. Bagchi, "*Taguchi Methods Explained: Practical steps to Robust Resign*", Prentice Hall Ind Pvt. Ltd., 1993.

**Course Outcomes:** The student will be able to

1. Know how to implement Quality in the design and manufacturing of products, Use of Quality Loss Function and Evaluation methods of different types of tolerances
2. Apply the methodology of ANOVA for experimental results
3. Use different Strategies in Experimentation and Obtain the necessary expertise for designing, conducting and analyzing an experiment, and apply the methods for Interpretation of experimental results
4. Design various types of Tolerances, and Allocate Tolerance for multiple components
5. Solve the problems concerned with parameter and tolerance designs.

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**(F423G) ADDITIVE MANUFACTURING**

Professional Elective – VI

**Course Objectives:** The student will

1. Understand the need for Additive Manufacturing / Rapid Prototype / 3D Printing Technologies in product development, and the required Tooling and Applications.
2. Learn the Basic Concepts of CAD and Reverse Engineering, CAD model preparation, Tool path Generation, etc., Acquire knowledge of Softwares for Additive Manufacturing Technology
3. Study the principles of Liquid based Additive Manufacturing Systems such as Stereo-lithography Apparatus (SLA)
4. Study the principles of Solid based Additive Manufacturing Systems such as Fused Deposition Modeling and Laminated Object Manufacturing, their advantages and applications
5. Study the principles of Powder based Additive Manufacturing Systems such as Selective Laser Sintering, Three Dimensional Printing, Laser Engineered Net Shaping (LENS), and Electron Beam Melting, their advantages and applications

**UNIT-I: INTRODUCTION:**

Overview – History - Need-Classification -Additive Manufacturing / Rapid Prototype / 3D Printing Technologies in product development- Materials for Additive Manufacturing Technology – Tooling - Applications.

**UNIT-II: CAD & REVERSE ENGINEERING:**

Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – softwares for Additive Manufacturing Technology: MIMICS, MAGICS.

**UNIT-III: LIQUID BASED ADDITIVE MANUFACTURING SYSTEMS:**

Classification – Liquid based system – Stereo-lithography Apparatus (SLA)- Principle, process, advantages and applications.

**UNIT-IV: SOLID BASED ADDITIVE MANUFACTURING SYSTEMS:**

Solid based system –Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing.

**UNIT-V: POWDER BASED ADDITIVE MANUFACTURING SYSTEMS:**

Selective Laser Sintering – Principles of SLS process - Process, advantages and applications, Three Dimensional Printing - Principle, process, advantages and applications-

Laser Engineered Net Shaping (LENS), Electron Beam Melting.

**TEXT BOOKS**:


1. Chua C.K., Leong K.F, "*Rapid prototyping: Principles and applications*", World Scientific Publishers, 3rd Edition, 2010.
2. Gebhardt A., *"Rapid Prototyping*", Hanser Gardener Publications, 2003.


**REFERENCES:**


1. Liou L.W. and Liou F.W., "*Rapid Prototyping and Engineering Applications: A tool box for prototype development"*, CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., "*Rapid Prototyping: Theory and practice*", Springer, 2006.
3. Hilton P.D. and Jacobs P.F., "*Rapid Tooling: Technologies and Industrial Applications*", CRC press, 2000.


**Course outcomes:** The student will be able to

1. Compare and assess different technologies like Additive Manufacturing / Rapid Prototype / 3D Printing, and select the suitable process
2. Apply the principles of CAD and Reverse Engineering in product design and development
3. Use the Liquid based Additive Manufacturing Systems in practice
4. Use the Solid based Additive Manufacturing Systems in practice.
5. Use the Powder based Additive Manufacturing Systems in practice.

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| **IV Year – II Semester** | **3** | **0-0-0** | **3** |

**(F423H) CONTROL SYSTEMS**

Professional Elective – VI

**Course Objectives:** The Student will

1. Study the fundamentals of feedback control system theory and analytical design methods.
2. Understand the concepts of control systems.
3. Comprehend the necessary tools to analyze feedback (linear) controls systems.
4. Understand the negative and positive feedback systems.
5. Understand the frequency compensation and its application to linear and nonlinear control system design.

**UNIT-I:**

Mathematical Modeling of physical systems, 1st, 2nd order and higher order systems, transient, steady state analysis, steady state errors, Performance Indices.

**UNIT-II:**

Poles, zeros, zero and pole placements, Routh‟s criteria, Root locus Technique, Bode plots, Nyquist criterion, Compensation circuits.

**UNIT-III:**

State space method, state transition matrix, canonical forms, Diagonalization, solutions of homogeneous and non-homogenous equations, zero and pole placement using state space techniques, controllability and observability, state controllability matrix, state observability matrix.

**UNIT-IV:**

Non-Linear Systems Phase plane analysis: Phase portraits, Singular points characterization. Analysis of non-linear systems using phase plane techniques, Existence of limit cycles.

**UNIT-V:**

Stability Analysis Concept of stability, Stability in the sense of Lyapunov and absolute stability, UGC AUTONOMOUS systems, the invariance principle, linear systems and linearization, non-UGC AUTONOMOUS systems, linear time varying systems and linearization.

**TEXT BOOKS**:


1. K. Ogata, "*Modern Control Engineering*", Prentice Hall, 2010.
2. Norman Nise, "*Control System Engineering*", John Wiley & Sons, 4th Edition, 2019
3. A. Anand Kumar, "*Control Systems*", Prentice Hall India, 2nd Edition, 2014.

**REFERENCES:**


1. M. Vidyasagar, "*Nonlinear systems analysis*", Prentice Hall, 2nd Edition, 1993
2. H. Khalil, "*Nonlinear Systems*", Prentice Hall Publications, 3rd Edition, 1992.
3. Isidori, "*Nonlinear Control Systems*", Springer Verlag, London, 3rd Edition, 1995.


**Course outcomes:**

The Student will be able to

1. Apply the methods to the design of real-world systems.
2. Formulate the mathematical models and designing feedback control systems.
3. Analyze, design, simulate, and experimentally validate linear and nonlinear control systems while taking into account practical limitations of operations.
4. Apply the concept of negative and positive feedback systems in circuit analysis and control system design
5. Apply frequency compensation concepts in system design.

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**(F4232) PROJECT STAGE –II**

**Guidelines:**

For Project Stage – II, the external examiner shall evaluate the project work for 70 marks and the project supervisor shall evaluate it for 30 marks. The student is deemed to have failed, if he (i) does not submit a report on Project Stage - II, or does not make a presentation of the same before the external examiner as per schedule, or (ii) secures less than 40% marks in the sum total of the CIE and SEE taken together.

For conducting viva-voce of project stage – II, Principal selects an external examiner from the list of experts in the relevant branch submitted by the HODs of the College.

A student who has failed may reappear once for the above evaluation, when it is scheduled again; if student fails in such, one reappearance evaluation also, he has to reappear for the same in the next subsequent semester, as and when it is scheduled.

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| **IV Year - II Semester** | **0** | **0-2-0** | **1** |

**(F4231) SEMINAR**

**Guidelines:**

For the seminar, the student shall collect the information on a specialized topic, prepare a technical report, and submit it to the department. It is evaluated by the departmental committee consisting of Head of the Department, seminar supervisor and a senior faculty member. The seminar report is evaluated for 100 internal marks. There is no semester end examination for the seminar.

# Open Elective – I

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| **III Year - II Semester** | **3** | **0-0-0** | **3** |

**ENERGY AUDIT AND GREEN BUILDING**
**(Open Elective-I)**

**COURSE OBJECTIVES:**

**The Student Will:**

1. Create awareness about the principles of green building technology and to have insight about the criteria for rating systems along with the established Indian codes and guidelines.
2. Establish a clear understanding of various renewable and non-renewable sources of energy along with their carbon footprints and enumerates the process of performance testing including building modeling and energy analysis.
3. Discuss about the energy efficient green building materials and to have understanding on the cost-effective Building Technologies, Strategies for Green Building Systems and Energy Conservation Measures.
4. Give details on the principles of sustainable development in green building design.
5. Describe the best green building practices adopted along with cost/benefit and life-cycle analysis of green buildings.

**UNIT-1**

**Sources of Energy:**

Renewable and Non-renewable sources of energy - Coal, Petroleum, Nuclear, Wind, Solar, Hydro, Geothermal sources, potential of these sources, hazards, pollution with reference to Global scenario, demand and supply in India, Global efforts to reduce carbon emissions, Performance testing. Building modeling- Energy analysis, Metering, Monitoring.

**Carbon emission**: Forecasting, Control of carbon emission, Air quality and its monitoring carbon footprint, Environmental issues, Minimizing carbon emission, Energy retrofits and Green Remodels.

**UNIT-II**

**Green Building Materials**: Sustainable Materials, Depletion of natural resources for preparation of building materials, renewable and recyclable resources, energy efficient materials, Embodied Energy of Materials. Green cement, Biodegradable materials, Smart materials, Manufactured Materials, Volatile Organic Compounds (Voc's), Natural Non-Petroleum Based Materials, Recycled materials, Renewable and Indigenous Building Materials, Engineering evaluation of these materials.

**Green Building Planning and Specifications:** Environment friendly and cost effective Building Technologies, Integrated Life cycle design of Materials and Structures, Green Strategies for Building Systems, Alternative Construction Methods, Energy Conservation Measures in Buildings, Waste and Water management and Recycling by Sustainable Facilities, Heating, Ventilation and Air Conditioning, Passive Solar and Daylight, Plumbing and its Effect on Energy Consumption

**UNIT -III**

**Concept of Green Buildings: G**reen building - Definition, Features, Necessity, Initiatives, Green buildings in India, Green building Assessment – Green Building Rating Systems

(BREEAM, USGBC, LEED, IGBC,TERI-GRIHA, GREEN STAR),Criteria for rating, Energy efficient criteria ,environmental benefits economic benefits, health and social benefits, Major energy efficiency areas for building, Contribution of buildings towards Global Warming. Life cycle cost of buildings, Codes and Certification Programs.

**UNIT-IV**

Design of Green Buildings; Sustainable sites, Impact of construction on environment, Life cycle assessment, Principles of sustainable development in Building Design, Design on Bioclimatic and solar passive architecture, Considerations of energy consumption, water use, and system reliability, indoor air quality, noise level, comfort, cost efficiency in building design, Advanced Green building technologies and innovations

**UNIT-V**

**Construction of Green Buildings**: Energy efficient construction, Practices for thermal efficiency and natural lighting. Ecofriendly water proofing; Energy conservation building codes building rating, Maintenance of green buildings, Cost and Performance Comparisons and Benchmarking, Green Project Management Methods and Best Practices, Cost/benefit analysis of green buildings, Life-cycle analysis of green buildings, Case studies of rated buildings (new and existing)

**TEXT BOOKS**:


1. Alternative Building Materials and Technologies – By K S Jagadeesh, B V Venkata Rama Reddy & K S Nanjunda Rao – New Age International Publishers
2. Integrated Life Cycle Design of Structures – By AskoSarja – SPONPress
3. Non-conventional Energy Resources – By D S Chauhan and S K Sreevasthava – New Age International Publishers
4. Green Buildings (McGraw hill publication): by Gevorkian


**REFERENCES:**


1. Emerald Architecture: case studies in green buildings, The Magazine of Sustainable Design
2. Understanding Green Building Guidelines: For Students and Young Professionals, Traci Rose Rider, W. W. Norton & Company Publisher.
3. Understanding Green Building Materials, Traci Rose Rider, W. W. Norton & Company Publisher.


**Course Outcomes:**

**The student will be able to:**

1. Know the underlying principles, history, environmental and economic impacts of green building technology and to identify the criteria for rating systems along with the established Indian codes and guidelines.
2. Identify various Renewable and Non-renewable sources of energy along with their carbon footprints and comprehend the techniques and benefits of building performance testing such as building modeling and energy analysis, monitoring and metering.
3. Recognize the energy efficient green building materials and explain the cost effective Building Technologies, Strategies for Green Building Systems and Energy Conservation Measures.

4. Explain the application of design guidelines of Green Building considering the Energy Conservation Measures.
5. Summarize on the building codes, relevant legislation governing the consumption of resources and emission of environmental pollutants by buildings and be familiar with IGBC green building certification procedure.

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## ENVIRONMENTAL IMPACT ASSESSMENT
## (Open Elective-I)

**Course Objectives:**

The Students will

1. To impart knowledge on Environmental management and environmental impact assessment.
2. To provide a basic understanding of the EIA process as it is used for research, planning, project or program evaluation, monitoring and regulatory enforcement.
3. To outline the impacts on soil, wetlands, flora, fauna, historical structures and the other socioeconomic environment.
4. To introduce students to the legal, economic, social, administrative and technical process preparing and evaluating environmental impact documents.
5. To assess the air and water quality parameters; predict the impacts and their mitigation measures.

**UNIT - I:**

**Basics concepts of EIA:** Initial environmental examination, elements of EIA, factors affecting EIA, impact evaluation and analysis, preparation of environmental base map, classification of environmental parameters.

**EIA Methodologies**: Introduction, Criteria for the selection of EIA methodology, EIA methods, Ad-hoc methods, matrix methods, network method, Environmental Media Quality Index Method (EMQI), Environmental media quality index method, overlay methods, cost/benefit analysis.

**UNIT - II:**

**Impact of developmental activities and land use:** Introduction and methodology for the assessment of soil and groundwater, delineation of study area, identification of of activities. Assessment of impact of developmental activities on vegetation and wildlife, environmental impact of deforestation- causes and effects of deforestation.

**UNIT - III:**

Procurement of relevant soil quality, impact prediction, assessment of impact significance, identification and incorporation of mitigation measures.

**EIA of surface water, air and biological environment:** Methodology for the assessment of impacts on surface water environment, air pollution sources, generalized approach for assessment of air pollution impact.

**UNIT - IV:**

Environmental audit and environmental legislation, objectives of environmental audit, types of environmental audit, audit protocel, stages of environmental audit onsite activities, evaluation of audit data and preparation of audit report, post audit activities.

**UNIT - V:**

Environmental protection Act, The water Act, The air Act (prevention and control of pollution Act), motor act, wild life act. Case studies of preparation of EIAs for various industries.

**Text Books:**

1. Environmental impact assessment methodologies, by Y.Anjaneyulu, B.S.Publication, Sultan bazaar Hyderabad.
2. Environmental impact assessment, by Alan Gilpin, Cambridge University Press
3. Environmental pollution Control by Dr. H S Bhatia – Galgotia Publications Pvt Ltd, Delhi.
4. Environmental Impact Assessment and Management Publisher, Daya Author: B Hoisetti, A Kumar

**Course Outcomes:**

The Students will be able to

1. Explain different methodologies for environmental impact prediction and assessment.
2. Understand the elements of environmental impact assessments and processes by which they apply.
3. Carry out scoping and screening of developmental projects for environmental and social assessments.
4. Evaluate EIA reports.
5. Plan EIAs and environmental management plans

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| **III Year - II Semester** | **3** | **0-0-0** | **3** |

**ENERGY STORAGE SYSTEMS**
**(OPEN ELECTIVE - I)**

**Course Objectives:**

**The Students will**

1. To enable the student to understand the need for energy storage, devices and technologies.
2. To understand the emerging needs for Electric Energy storage
3. To analyze the features of various Energy storage Systems
4. To integrate the Energy storage systems with batteries.
5. To understand the behavior of different configurations of Energy storage Systems

**UNIT – I: Electrical Energy Storage Technologies**
Characteristics of electricity - The roles of Electric Energy Storage - High generation cost during peak- demand periods - Need for continuous and flexible supply - Long distance between generation and consumption- Congestion in power grids - Transmission by cable

**UNIT – II: Needs For Electrical Energy Storage**
Emerging needs for Electric Energy Storage – Utilization of more renewable energy - less fossil fuel - Smart Grid uses - The roles of electrical energy storage technologies - The roles from the viewpoint of a utility, from the viewpoint of consumers, from the viewpoint of generators of renewable energy.

**UNIT – III: Features of Energy Storage Systems**
Classification of Electric Energy Storage systems - Mechanical storage systems - Pumped hydro storage (PHS) - Compressed air energy storage (CAES) - Flywheel energy storage (FES) - Electrochemical storage systems - Secondary batteries - Flow batteries - Chemical energy storage, -Hydrogen (H2) - Synthetic natural gas (SNG).

**UNIT – IV: Types of Electrical Energy Storage Systems**
Electrical storage systems - Double-layer capacitors (DLC) - Superconducting magnetic energy storage (SMES) - Thermal storage systems - Standards for Electric Energy Storage - Technical comparison of EES technologies.

**UNIT – V: Applications**
Present status of applications - Utility use (conventional power generation, grid operation & service) - Consumer use (uninterruptable power supply for large consumers) - New trends in applications - Renewable energy generation - Smart Grid - Smart Micro grid, Smart House - Electric vehicles - Management and control hierarchy of storage systems - Internal configuration of battery storage systems - External connection of EES systems - Aggregating EES systems and distributed generation (Virtual Power Plant) - Battery SCADA - Aggregation of many dispersed batteries.

**TEXT BOOKS**:

1. Energy Storage Benefits and Market Analysis' by James M. Eyer, Joseph J. Iannucci and Garth P. Corey.
2. The Electrical Energy Storage by IEC Market Strategy Board

**REFERENCE BOOKS:**

1. Jim Eyer, Garth Corey: Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report, Jim Eyer, Garth Corey, Sandia National Laboratories, Feb 2010.

**Course Outcomes:**

The Students will be able to

1. Understand the concepts of energy storage devices
2. Analyze the characteristics of energy from various sources and need for storage
3. Classify various types of energy storage and various devices used for the purpose
4. Apply the same concepts to real time problems.
5. Differentiate the features of Energy Storage Systems.

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| **III Year - II Semester** | **3** | **0-0-0** | **3** |

## ENERGY AUDITING, CONSERVATION AND MANAGEMENT
## (OPEN ELECTIVE - I)

**Course Objectives:**
**The Students will**

1. To understand the need of Energy Audit and Energy Conservation Schemes.
2. To know the necessity of conservation of energy.
3. To generalize the methods of energy management.
4. To illustrate the factors to increase the efficiency of electrical equipment.
5. To detect the benefits of carrying out energy audits.

**UNIT-I:Basic Principles of Energy Audit: Energy Audit**-
Definitions, Concept, Types of audit, Energy index, Cost index, Pie charts, Sankeydiagrams, Load profiles, Energy conservation schemes- Energy audit of industries- Energy savingpotential, Building energy audit

**UNIT-II:Energy Management**
Principles of energy management, Organizing energy management program, Initiating, Planning,Controlling, Promoting, Monitoring, Reporting, Energy manger, Qualities and functions, Language,Questionnaire – Check list for top management.

**UNIT-III:Energy Efficient Motors**
Energy efficient motors, Factors affecting efficiency, Loss distribution, Constructional details, Characteristics - Variable speed, Variable duty cycle systems, RMS HP- Voltage variation-Voltage unbalance- Over motoring- Motor energy audit

**UNIT-IV:Power Factor Improvement, Lighting and Energy Instruments**
Power factor – Methods of improvement, Location of capacitors, Pf with non linear loads, Effect ofharmonics on power factor, Power factor motor controllers - Good lighting system design andpractice, Lighting control , Lighting energy audit - Energy instruments-Wattmeter, Data loggers,Thermocouples, Pyrometers,Lux meters, Tongue testers,Application of PLC's.

**UNIT-V:Economic Aspects and Analysis**
Economics analysis-Depreciation methods, Time value of money, Rate of return, Present worthmethod, Replacement analysis, Life cycle costing analysis- Energy efficient motors-Calculation ofsimple payback method, Net present worth method- Power factor correction, Lighting -Applications of life cycle costing analysis, Return on investment.

**TEXT BOOKS**:


1. W.R. Murphy & G. Mckay, “Energy Management”, Butter worth, Heinemann Publications, Second Edition, 2009.
2. Paul o’ Callaghan, “Energy Management”, Tata Mc-Graw Hill Book Company- First Edition, 1998.
3. W.C.Turner, “Energy Management Hand Book”, CRC Press, First Edition, 2004.


**REFERENCES:**


1. John .C. Andreas, “Energy Efficient Electric Motors”, CRC Press, Third Edition, 1992.
2. Great Britain, “Energy Management and Good Lighting Practice: Fuel Efficiency- Booklet Volume 12-EEO, 1989.


**Course Outcomes**

**The Students will be able to**

1. Analyze energy audit of industries.
2. Predict management of energy systems.
3. Sequence the methods of improving efficiency of electric motor.
4. Analyze the power factor and to design a good illumination system.
5. Determine pay back periods for energy saving equipment.

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**AUTOMOTIVE TECHNOLOGY**

**(OPEN ELECTIVE - I)**

**Course Objectives:**
The Student will

1. Provide an overview on automobile engineering
2. Learn different fuels and advanced control systems
3. Study the concepts and drive train configurations of electric and hybrid electric vehicles
4. Understand use of intelligent vehicle technologies like navigation in automobiles
5. Provide awareness of safety security and regulations

**UNIT-I**

**Structural systems of automobile**– chassis and body, power unit, transmission system, Steering System, Suspension System, Braking System.

**Other systems of automobile**- Ignition systems, Fuel System, Cooling System, Electrical System.

**UNIT –II**

**Fuels**: Types of Fuels-Gasoline fuels, CNG, Biofuels, advantages and limitations.

**Advanced Engine Controls:** Concept of an electronic engine control system, electronic fuel injection - throttle body fuel injection, multi-point fuel injection, gasoline direct injection, common rail direct injection, electronic ignition control.

**UNIT –III**

**Fuel Cell and Solar Vehicles**: Fuel cell vehicle – Operating principle, types of fuel cells, fuel cell options for fuel cell vehicle and fuel cell hybrid vehicle. Solar vehicle - Solar photovoltaic cell, solar array, solar car electrical system and drive train.

**Electric and Hybrid Vehicles**: Electric vehicles - Layout of an electric vehicle, performance, energy consumption, advantage and limitations. Hybrid electric vehicles - Concepts, types of hybrid drive train architecture, merits and demerits.

**UNIT-IV**

**Telematics Systems**: Global positioning system, geographical information systems, navigation system.

**Comfort Systems**: Automotive vision system, adaptive cruise control system, active suspension system, power steering and power windows.

**UNIT-V**

**Safety and Security Systems**: Active and passive safety, airbags, seat belt tightening system, collision warning systems, anti-lock braking systems, traction control system, electronic immobilizers, remote keyless entry, smart card system, number plate coding.

**Emission and noise control regulations**- Pollution standards, National and international – Pollution Control – Techniques – Noise Pollution & control.

**TEXT BOOKS**:


1. William B Riddens, "Understanding Automotive Electronics", 5th edition, Butter worth Heinemann Woburn,1998.
2. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2005.
3. Kripal Singh, "Automobile Engineering", Standard Publishers Distributors, Vol. 1, & Vol. 2, 2007


**REFERENCES:**


1. Automotive Hand Book" Robert Bosch, SAE, 5th edition, 2000.
2. Ljubo Vlacic, Michel Parent and Fumio Harashima, "Intelligent Vehicle Technologies", Butterworth-Heinemann publications, Oxford, 2001.
3. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
4. "Navigation and Intelligent Transportation Systems – Progress in Technology", Ronald K Jurgen, Automotive Electronics Series, SAE, USA, 1998.


**Course outcomes:**

The student will be able to:

1. Outline the overview of automobile engineering
2. Identify the different fuels and advanced control systems
3. Develop the concepts and drive train configurations of electric and hybrid electric vehicles
4. Apply the use of intelligent vehicle technologies like navigation in automobiles
5. Aware of safety security and regulations

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**MATLAB PROGRAMING LANGUAGE**

(Open Elective I)

**Course Objectives:**

**The Student will**

1. understand the basic principles of programming and of implementing mathematical concepts in MATLAB.
2. write numerical algorithms with MATLAB Programming language.
3. evaluate the computational results using graphical representations.
4. gain knowledge about advanced MATLAB Programming methods.
5. gain knowledge on Simulink used in MATLAB.

**Unit-I** : **Introduction To MATLAB**

Historical Background, Applications, Scope of MATLAB, Importance of MATLAB for Engineers, Features, MATLAB Windows (Editor, Work Space, Command History, Command Window).

Operations with Variables, Naming and Checking Existence, Clearing Operations, Commands, Data types, Operators.

**Unit-II**: **Data Flow in MATLAB**

Vectors, Matrix Operations & Operators, Reshaping Matrices, Arrays, Colon Notations, Numbers, Strings, Functions, File Input-Output, Importing and Exporting of data.

**Unit-III: MATLAB Programming**

Conditional Statements, Loops, Writing Script Files, Error Correction, Saving Files, Worked out Examples.

**Unit-IV**: **MATLAB Advanced**

Plotting, Graphics, Creating Plot & Editing Plot, GUI (Graphical User Interface).

Matlab- Algebra, Calculus, Differential, Integration, Polynomials, solving a system of linear equations.

**Unit-V: SIMULINK**

Introduction, Importance, Model Based Design, Tools, Mathematical Modeling, Converting Mathematical Model into Simulink Model, Running Simulink Models, Importing Exporting Data, Solver Configuration, Masking Block/Model.

**TEXT BOOKS:**

1. Getting Started With Matlab: A Quick Introduction For Scientists And Engineers (English) by Rudra Pratap, OXFORD University Press.
2. MATLAB Programming by Y. Kirani Singh, B.B. Chaudhuri, PHI Publication.

**REFERENCE BOOKS:**

1. MATLAB® Programming For Engineers, Fourth edition by Stephen J. Chapman.
2. Applied Numerical Methods Using MATLAB 1st Edition by Won Y. Yang , Wenwu Cao, Tae-Sang Chung, John Morris.

**Course Outcomes:**

The student will be able to

1. translate mathematical methods to MATLAB code.
2. generalize results and represent data visually.
3. apply computer methods for solving a wide range of engineering problems.
4. utilize computer skills to enhance learning and performance in other engineering and science courses.
5. acquire knowledge of Advanced Matlab programming methods and Simulink.

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**PRINCIPLES OF COMMUNICATIONS**

(Open Elective I)

**Course Objectives:**

The Students will

1. provide the basic concepts of communication systems.
2. gain knowledge about Amplitude modulation and Angle Modulation.
3. study sampling and pulse modulation methods.
4. study and compare different binary digital modulation techniques.
5. understand the basic concepts of information theory.

**UNIT – I: Introduction**

Block diagram of Electrical communication system, Radio communication: Types of communications, Analog, pulse and digital types of signals, Noise – Types of noise, sources of noise, calculation of noise in Linear systems and noise figure.

**UNIT – II: Amplitude Modulation**

Need for modulation, Types of Amplitude modulation, AM, DSB SC, SSB SC, Power and BW requirements, generation of AM, DSB SC, SSB SC, Demodulation of AM: Diode detector, Product demodulation for DSB SC & SSB SC. Angle Modulation: Frequency & Phase modulations, advantages of FM over AM, Bandwidth consideration, Narrow band and Wide band FM, Comparison of FM & PM.

**UNIT – III: Pulse Modulations**

Sampling, Nyquist rate of sampling, Sampling theorem for Band limited signals, PAM, regeneration of base band signal, PWM and PPM, Time Divison Multiplexing, Frequency Division Multiplexing, Asynchronous Multiplexing.

**UNIT – IV: Digital Communication**

Advantages, Block diagram of PCM, Quantization, effect of quantization, quantization error, Base band digital signal, DM, ADM, ADPCM and comparison. Digital Modulation: ASK, FSK, PSK, DPSK, QPSK demodulation, coherent and incoherent reception, Modems.

**UNIT – V: Information Theory**

Concept of information, rate of information and entropy, Source coding for optimum rate of information, Coding efficiency, Shanon-Fano and Huffman coding Error control coding: Introduction, Error detection and correction codes, block codes, convolution codes.

**TEXT BOOKS:**

1. Communication Systems Analog and Digital – R.P. Singh and SD Sapre, TMH, 20th reprint, 2004.
2. Principles of Communications – H. Taub and D. Schilling, TMH, 2003.

**REFERENCE BOOKS:**

1. Electronic Communication Systems – Kennedy and Davis, TMH, 4th edition, 2004.
2. Communication Systems Engineering – John. G. Proakis and Masoud Salehi, PHI, 2nd Ed. 2004.

**Course Outcomes:**

The Students will be able to

1. illustrate the main concepts of analogue and digital communication systems.
2. analyze and design an AM and FM modulator/demodulator.
3. explain, discuss, and compare different binary digital modulation techniques.
4. distinguish different types of noise and explain the effects of noise on communication system.
5. use the basic concepts of information theory.

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**DATA BASE MANAGEMENT SYSTEMS**

**(**Open Elective-I**)**

**Course objectives:**

**The Students will:**

1. Understanding of the architecture and functioning of database management systems as well as associated tools and techniques.
2. Understand and apply the principles of data modeling using entity relationship and develop a good database design.
3. Understand the use of structured query language (SQL) and its syntax.
4. Apply normalization techniques to normalize a database.
5. Understand the need of database processing and learn techniques for controlling the Consequences of concurrent data access.

**UNIT - I:**

**Introduction to Data base management systems-** Data base System Applications, data base System VS file System – View of Data – Data Abstraction –Instances and Schemas – data Models – the ER Model – Relational Model – Other Models – Database Languages – DDL – DML – database Access for applications Programs – data base Users and Administrator – Transaction Management – data base System Structure – Storage Manager – the Query Processor

**ER diagrams** - Beyond ER Design Entities, Attributes and Entity sets – Relationships and Relationship sets – Additional features of ER Model – Concept Design with the ER Model

**UNIT - II:**

**Introduction to the Relational Model**- Integrity Constraint Over relations – Enforcing Integrity constraints – Querying relational data – Logical data base Design – Introduction to Views – Destroying /altering Tables and Views.

**Relational Algebra**- Selection and projection set operations – renaming – Joins – Division – Examples of Algebra overviews – Relational calculus – Tuple relational Calculus – Domain relational calculus – Expressive Power of Algebra and calculus.

**UNIT - III:**

**Form of Basic SQL Query**- Examples of Basic SQL Queries – Introduction to Nested Queries – Correlated Nested Queries Set – Comparison Operators – Aggregative Operators – NULL values – Comparison using Null values – Logical connectivity‟s – AND, OR and NOT – Impact on SQL Constructs – Outer Joins – Disallowing NULL values – Complex Integrity Constraints in SQL Triggers and Active Data bases.

**Schema refinement**- Problems Caused by redundancy – Decompositions – Problem related to decomposition – reasoning about FDS – FIRST, SECOND, THIRD Normal forms – BCNF – Lossless join Decomposition – Dependency preserving Decomposition – Schema refinement in Data base Design – Multi valued Dependencies – FORTH Normal Form.

**UNIT - IV:**

**Transaction Concept**- Transaction State- Implementation of Atomicity and Durability – Concurrent – Executions – Serializability- Recoverability– Implementation of Isolation – Testing for serializability- Lock –Based Protocols – Timestamp Based Protocols- Validation- Based Protocols – Multiple Granularity.

**Recovery and Atomicity**- Log – Based Recovery – Recovery with Concurrent Transactions – Buffer Management – Failure with loss of nonvolatile storage-Advance Recovery systems- Remote Backup systems.

**UNIT - V:**

**Data on External Storage**- File Organization and Indexing – Cluster Indexes, Primary and Secondary Indexes – Index data Structures – Hash Based Indexing – Tree base Indexing – Comparison of File Organizations – Indexes and Performance Tuning- Intuitions for tree Indexes – Indexed Sequential Access Methods (ISAM) – B+ Trees: A Dynamic Index Structure.

**Advanced Database Management System-** Introduction to Distributed Database- Reference Architecture, fragmentation, Allocation, Joins

**TEXT BOOKS:**

1. Data Base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGrawHill 3rd Edition
2. Data base System Concepts, Silberschatz, Korth, McGraw hill, V edition.

**REFERENCE BOOKS:**

1. Data base Systems design**,** Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.
2. Fundamentals of Database Systems**,** Elmasri Navrate Pearson Education
3. Introduction to Database Systems**,** C.J.Date Pearson Education

**Course outcomes:**

**The Students will be able to:**

1. Describe basic concepts of database system.
2. Design a data model and schemas in RDBMS.
3. Use RDBMS for developing industry applications.
4. Be competent in use of structured query language sql.
5. Analyze functional dependencies for designing a robust database

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**OPERATING SYSTEMS**

(Open Elective-I)

**Course objectives:**
**The Students will :**

1. Know the purpose and different types of operating systems.
2. Describe process management and CPU scheduling algorithms.
3. Understand file and directory structures.
4. Understand deadlock prevention and avoidance
5. Explain various memory management and page replacement algorithms.

**UNIT - I:**

**Operating System Overview-** Overview of Computer Operating Systems, Operating System Functions, Protection and Security, Distributed Systems, Special Purpose Systems, Operating System Structures, Operating System Services and Systems Calls, Operating Systems Generation.

**Process Management-** Process Concepts, Threads, Scheduling-Criteria, Algorithms Evaluation, Thread Scheduling.

**UNIT - II:**

**Concurrency-** Process Synchronization, Critical-Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization examples, Atomic Transactions.

**Memory Management-** Swapping, Contiguous Memory Allocation, Paging, Page-Table Structure, Segmentation, Virtual Memory, Demand Paging, Page-Replacement Algorithms, Frames Allocation, Thrashing.

**UNIT - III:**

**Principles of Deadlock-** System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery from Deadlock.

**Introduction to File System-** File System Interface, File Concepts, Access Methods and Directory Structure, File System Mounting, File Sharing and Protection.

**UNIT - IV:**

**File System Implementation-** File System Structure, File System Implementation, Directory Implementation, Allocation Methods, Free-Space Management, Efficiency and Performance. Case Studies: UNIX, Linux and Windows.

**Mass Storage Overview-** Mass-Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Swap-Space Management, RAID Structure, Stable-Storage Implementation, Tertiary Storage Structure.

**UNIT - V:**

**Protection and Security-** Goals of Protection, Principles of Protection, Domain of Protection Access Matrix, Implementation of Access Matrix, Access Control, Revocation of Access Rights, Capability-Based Systems, Language-Based Protection. Security Problem, Program Threats, System and Network Threats Cryptography as a Security Tool, User Authentication, Computer-Security Classifications.

**Advanced Operating Systems-** Distributed Operating Systems, Multi-Processor Operating Systems, Real-Time Operating Systems and Mobile Operating Systems.

**TEXT BOOKS:**

1. Operating System Concepts-Abraham Silberchatz, Peter B. Galvin, Greg Gagne, 7th Edition, John Wiley.
2. Operating Systems- a Concept based Approach-D.M.Dhamdhere, 2nd Edition, TMH.

**REFERENCE BOOKS:**

1. Principles of Operating Systems-Naresh Chauhan, Oxford Higher Education.
2. Operating System A Design Approach-Crowley, TMH.
3. Modern Operating Systems-Andrew S Tanenbaum, 2nd Edition Pearson, PHI.

**Course outcomes:**

**The Students will be able to:**

1. Demonstrate the different operating systems.
2. Apply different CPU scheduling algorithms.
3. Analyze different directory structures.
4. Use deadlock prevention and avoidance algorithms
5. Illustrates the behavior of semaphores and monitors.

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**INTRODUCTION TO DATA STRUCTURES**
**(Open Elective-I)**

**Course Objectives:**
The Students will :

1. Describe the appropriate data structure like linked list to solve problems in real world.
2. Explain the implementation of linear and non linear data structure mechanisms.
3. Discuss the various techniques of tree data structure.
4. Describe graph data structure.
5. Explain several searching and sorting Techniques.

**UNIT - I:**
Data Structures-Introduction to Data Structures, abstract data types, Introduction to Linear and Non Linear data structures.Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list. Circular linked list implementation, Doubly linked list implementation, insertion, deletion and searching operations. Applications of linked lists.

**UNIT - II:**
Stacks-Operations, array and linked representations of stacks, stack applications-infix to postfix conversion, postfix expression evaluation. Queues-operations, array and linked representations. Circular Queue operations, Dequeue, applications of queue.

**UNIT - III:**
Trees – Definition, Binary tree representation, Binary search tree, binary Tree traversals.
AVL tree – operations, Red Black tree.

**UNIT - IV**:
Graphs-Terminology, sequential and linked representation.
Graph traversals: Depth First Search & Breadth First Search implementation. Spanning trees, Prims and Kruskals method.

**UNIT - V:**
Searching – Big O Notation, Linear Search and Binary Search.
Sorting-Bubble sort, Insertion Sort, Selection Sort, Merge Sort and Quick sort.

**TEXT BOOKS:**

1. Data Structures Using C, Reema Thareja, Oxford University Press, 2011 Learning.
2. Introduction to Algorithms, TH Cormen, PHI

**REFERENCES BOOKS:**

1. Data Structures & Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education.
2. Design methods and analysis of Algorithms, SK Basu, PHI.
3. Fundamentals of Computer Algorithms, 2nd Edition, Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran, Universities Press.

**Course Outcomes:**

The Students will be able to:

1. Analyze and apply appropriate data structures for solving computing problems.
2. Use linear and non-linear data structures like stacks, queues, trees and graphs.
3. Implement different types of tree data structures.
4. Implement the concepts of graph data structures.
5. Apply the basic searching, sorting Techniques.

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**INTRODUCTION TO WEB DESIGN**
**(Open Elective-I)**

**Course Objectives**

The Students will :

1. Know regarding internet related technologies.
2. Understanding of the current industry support for web technologies.
3. Explain the basic concepts of CSS.
4. Visualize the basic concepts of PHP.
5. Understanding PHP functions and Methods

**UNIT-I**

Basics in Web Design: Brief History of Internet, What is World Wide Web, Why create a web site, Web Standards, Audience requirement.

Web Design Principles: Basic principles involved in developing a web site, Planning process , Five Golden rules of web designing, Designing navigation bar ,Page design, Home Page Layout, Design Concept.

**UNIT-II**

Introduction to HTML: What is HTML, HTML Documents, Basic structure of an HTML document, Creating an HTML document, Mark up Tags, Heading-Paragraphs, Line Breaks, HTML Tags, HTML Tables, HTML Forms.

Elements of HTML: Introduction to elements of HTML, working with Text Working with Lists, Tables and Frames, working with Hyperlinks, Images and Multimedia, Working with Forms and controls.

**UNIT-III**

Introduction to Cascading Style Sheets: Concept of CSS, Creating Style Sheet and types of CSS, CSS Properties, CSS Styling (Background, Text Format, Controlling Fonts), Working with block elements and objects, Working with Lists and Tables, CSS Id and Class, Box Model(Introduction, Border properties, Padding Properties, Margin properties).

CSS Advanced (Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector), CSS Colors, Creating page Layout and Site Designs.

**UNIT-IV**

Introduction to PHP: Downloading, installing, configuring PHP, The anatomy of a PHP Page. Basic Security Guidelines, Variables, Data Types, Operators and Expressions, Constants, Flow Control Functions; Switching Flow, Loops.

Code Blocks and Browser Output, Objects, Strings Processing, Form processing, Connecting to database, using cookies, dynamic contents.

**UNIT-V**

Introduction to Web Publishing or Hosting : Creating the Web Site, Saving the site, Working on the web site. Creating web site structure, Creating Titles for web pages, Themes-Publishing web sites.

**TEXT BOOKS:**

1. Dietel and Dietel : —Internet and World Wide Web - How to Program‖, 5th Edition, PHI/Pearson Education, 2011
2. Web Technologies: HTML,CSS, XML,Php Black Book.

**REFERENCE BOOKS:**

1. Chris Bates, —Web Programming, building internet applications‖, 2ndEdition, WILEY,
   Dreamtech, 2008.
2. HTML 5 in simple steps Kogent Learning Solutions Inc, Dreamtech Press
3. Beginning CSS: Cascading Style Sheets for Web Design Ian Pouncey, ichard York Wiley India

**Course Outcomes:**

The Students will be able to:

1. Develop the application of the HTML for document structure.
2. Develop the skills in analyzing the usable of a website.
3. Create dynamic webpage, using PHP.
4. Using PHP to manipulate Files.
5. Develop the concept of web publishing

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| **III Year - II Semester** | **3** | **0-0-0** | **3** |

**INTERNET OF THINGS**
**(Open Elective – I)**

**Course Objectives:**
**The Students will:**

1. Understand the basic building blocks of IoT
2. Analyze the difference between M2M and IoT
3. Introduction of Basics of IoT System Management
4. Extend the knowledge in WSN an IoT enabling technology.
5. Acquire knowledge about challenges of IoT and Identify the specific application of IoT.

**UNIT–I:**
Introduction to Internet of Things –Definition and Characteristics of IoT, Physical Design of IoT – IoT Protocols, IoT communication models, Iot Communication APIs IoT enabaled Technologies – Wireless Sensor Networks, Cloud Computing, Big data analytics, Communication protocols, Embedded Systems, IoT Levels and Templates.

**UNIT–II:**
**Domain Specific IoTs** – Home, City, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle

**IoT and M2M** –Difference between IoT and M2M, SDN, NFV, Difference between SDN and NFV.

**UNIT–III:**
Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER.

**UNIT–IV:**
**Network & Communication aspects**
Wireless medium access issues, MAC protocol survey, Survey routing protocols, Sensor deployment & Node discovery, Data aggregation & dissemination

**UNIT-V:**
**Challenges in IoT**
Design challenges, Development challenges, Security challenges, other challenges

**Domain specific applications of IoT**
Home automation, Industry applications, Surveillance applications, Other IoT applications

**Text Books:**


1. Internet of Things – A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759


**Course Outcomes:**

**The Students will be able to:**

1. Analyze the physical and logical design of IoT.
2. Understand the characteristic and communication models of IoT and Compare and contrast M2M and IoT, SDN and NFV
3. Understand the Basics IoT management System
4. Understand the wireless medium issues, MAC protocols, routing protocols
5. Comprehend important challenges of IoT related to design, development and security and Learn about specific application of IoT.

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| **III Year II sem** | **3** | **0-0-0** | **3** |

**INTRODUCTION TO MINING TECHNOLOGY**
**(OPEN ELECTIVE - I)**

**COURSE OBJECTIVES:**

**The Student will:**

1. introduce about distribution of mineral deposits in India
2. acquaint with different stages of mining process
3. get idea about Drilling and its machinery
4. get idea about Explosives and blasting in mines
5. know about shaft sinking methods, precaution & lining during shaft sinking

**UNIT-I:**

Introduction: Distribution of mineral deposits in India and other countries, mining contributions to civilization, mining terminology

**UNIT –II:**

Stages in the life of the mine - prospecting, exploration, development, exploitation, and reclamation. Access to mineral deposit- selection, location, size and shape (incline, shaft and Adit), brief overview of underground and surface mining methods.

**UNIT-III:**

Drilling: Types of drills, drilling methods, electric, pneumatic and hydraulic drills, drill steels and bits, drilling rigs, and jumbos.

**UNIT-IV:**

Explosives: Classification, composition, properties and tests, fuses, detonators, blasting devices and accessories, substitutes for explosives, handling and storage, transportation of explosives.; Rock blasting: Mechanism of rock blasting, blasting procedure, and pattern of shot holes.

**UNIT –V:**

Shaft sinking: Ordinary and special methods, problems, and precautions, shaft supports and lining.

**TEXTBOOKS:**

1. R. P. Pal, Rock blasting effect and operation, A. A. Balkema, 1st Ed, 2005.
2. D. J. Deshmukh, Elements of mining technology, Vol. 1, Central techno, 7th Ed, 2001.

**REFERENCE BOOKS:**

1. 1. C. P. Chugh, Drilling technology handbook, Oxford and IBH, 1st Ed, 1977.
2. 2. R. D. Singh, Principles and practices of modern coal mining, New age international, 1st Ed, 1997.

**COURSE OUTCOMES:**

The student will be able to:

1. Learn about distribution of mineral deposits in India
2. Learn about stages on mining process
3. Learn about drilling and its machinery
4. Understand about explosives, blasting and blasting mechanism
5. Understand about shaft sinking methods, precautions and lining of shafts

# Open Elective - II

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| **IV Year - I Semester** | **3** | **0-0-0** | **3** |

## WASTE MANAGEMENT
## (Open Elective-II)

**Course Objectives:**

**The Students will:**

1. provide in depth knowledge about handling of solid waste from cradle to grave.
2. It also provides the knowledge of designing and constructing the solid waste treatment system.
3. Provides the residue disposed of in an environmentally sound way.
4. Provides students depth knowledge in waste minimization.
5. provides knowledge in design and maintenance of different units

**UNIT - I:**

Introduction

Definition of solid waste, garbage, rubbish-Sources and Types of solid wastes Municipal waste, industrial waste, plastic waste, electronic waste, bio-medical waste and hazardous waste - Characteristics of Solid Wastes: Physical, chemical and biological characteristics-Problems due to improper disposal of solid waste.

**UNIT II:**

Functional Elements of Solid Waste Management

Waste generation and handling at source-onsite storage-Collection of solid wastes Collection methods and services-storage of solid waste- guidelines for collection route layout.

**UNIT - III:** Transfer and Transport of Wastes

Transfer station-types of vehicles used for transportation of solid waste-Processing and segregation of the solid waste- various methods of material segregation.

Processing and Transformation of Solid Wastes

Recycling and recovery principles of waste management- Composting: definition methods of composting-advantages of composting- Incineration: definition methods of incineration advantages and disadvantages of incineration.

**UNIT - IV:** Treatment and Disposal of Solid Waste

Volume reduction, Open dumping, land filling techniques, Landfills: classification Design and Operation of landfills, Land Farming, Deep well injection.

**UNIT - V:** Waste Minimization

Introduction to waste minimization, waste minimization techniques-5R (refuse, reduce, reuse, recover, recycle), municipal waste minimization, industrial waste minimization.

**Text Books:**

1. Solid and hazardous waste management by M.N.Rao and Razia sultana, BS publications
2. Environmental Engineering by Howard S.Peavy, Donald R.Rowe and George Tchobanognous

**Reference Books:**

1. Integrated Solid Waste Management by Tchobanognous.
2. Environmental engineering by Y.Anjaneyulu, B.S publication.
3. Environmental Pollution Control Engineering by C.S. Rao; Wiley Eastern Ltd., New Delhi.
4. Environmental engineering by Gerad Kiley, Tata Mc Graw Hill

**Course Outcomes:**

Students will be able to

1. Understand the components of solid waste management and the laws governing it
2. Acquires the knowledge of design, operation and maintenance of landfills, incinerators and composting units.
3. Reducing the amount and toxicity of material entering the waste flow (minimization)
4. Reusing as much material as practicable;
5. Recycling the waste that cannot be used and recovery of resources

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## ESTIMATION, QUANTITY SURVEY & VALUATION
## (Open Elective-II)

**Course Objective**

The Students will:

1. Understand how to estimate the quantities of work, develop the bill of quantities and arrive at the Cost of civil engineering Project
2. Estimate the detailed quantities of various items of work and their rates in building projects.
3. Estimate the quantities of works and evaluate cost of project.
4. Understand and apply the concept of Valuation for Properties
5. Understand, Apply and Create the Tender and Contract document.

**UNIT - I:**

General items of work in Building – Standard Units Principles of working out quantities for detailed and abstract estimates – Approximate method of Estimating

**UNIT II:**

Detailed Estimates of Buildings - Reinforcement bar bending and bar requirement schedules

**UNIT - III:**

Earthwork for roads and canals.

**UNIT - IV:**

Rate Analysis – Working out data for various items of work over head and contigent charges.

**UNIT - V:**

Contracts – Types of contracts – Contract Documents – Conditions of contract, Valuation - Standard specifications for different items of building construction.

**Text Books:**


1. Estimating and Costing by B.N. Dutta, UBS publishers, 2000.
2. Estimating and Costing by G.S. Birdie.


**Reference Books:**


1. Standard Schedule of rates and standard data book by public works department.
2. I. S. 1200 ( Parts I to XXV – 1974/ method of measurement of building and Civil Engineering works – B.I.S.)
3. Estimation, Costing and Specifications by M. Chakraborthi; Laxmi publications.

**Course Outcomes:**

The Students will be able to

1. Prepare detailed and abstract estimates for buildings, roads and canals
2. Prepare valuation of buildings.
3. Interpret Contract document of for civil engineering works
4. To study on Valuation of buildings, Standard specifications for different items building construction
5. Formulate construction scheduling and project Management methods.

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**ELECTRIC AND HYBRID VEHICLES**
**(OPEN ELECTIVE - II)**

**Course Objectives:**
The Student will

1. understand working of different configurations of electric vehicles, and its components
2. understand hybrid vehicle configuration and performance analysis.
3. Introduce the transmission configuration and its analyze the characteristics
4. analyze the different speed control techniques
5. design and evaluate the sizing of components in hybrid vehicles.

**UNIT-I : ELECTRIC VEHICLES**
Introduction to Electric Vehicles – History of Electric and Hybrid Vehicles - Components - vehicle mechanics - Roadway fundamentals - vehicle kinetics - Dynamics of vehicle motion - Propulsion System Design.

**UNIT-II : BATTERIES**
Basics - Types - Parameters - Capacity - Discharge rate - State of charge - state of Discharge - Depth of Discharge - Technical characteristics - Battery pack Design - Properties of Batteries.
Fuel Cells - Types - Fuel Cell Electric Vehicle.

**UNIT-III: DC & AC ELECTRICAL MACHINES**
(Speed control Techniques)
Motor and Engine rating – Requirements – Speed control techniques of DC machines in Electric Vehicles – Speed control techniques of Three phase A/c machines -Induction machines- Permanent Magnet Machines, Switched Reluctance Machines.

**UNIT-IV: ELECTRIC VEHICLE DRIVE TRAIN**
Transmission configuration - Components - gears, differential, clutch, brakes regenerative braking- motor sizing- Gear Ratio – Torque speed characteristics - EV Motor Sizing Initial Acceleration - Rated Vehicle Velocity - Maximum Velocity - Maximum Gradability.

**UNIT-V: HYBRID ELECTRIC VEHICLES**
Types of Hybrid Vehicles - series and parallel Hybrid Electric Vehicles, series- parallel configuration - Internal Combustion Engines - Reciprocating Engines - Practical and Air-Standard Cycles - Air-Standard Otto Cycle - Air-Standard Diesel Cycle - Example IC Engines in HEVs - Design - Drive train - sizing of components.

**TEXT BOOKS**:


1. Iqbal Hussain, “Electric & Hybrid Vehicles - Design Fundamentals”, Second Edition, CRC Press, 2011
2. James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.

**REFERENCES:**


1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.

2. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2001


**Course outcomes:**

The student will be able to:

1. Understand the working of different configurations of electric vehicles, hybrid vehicles and its components.
2. Apply the basic concepts of batteries and Motors in the design of Electric and Hybrid Vehicles.
3. Differentiate the modes of operation of Hybrid Vehicles.
4. Analyze the performance of hybrid vehicles.
5. Design the basic parameters of Electric and Hybrid Electric Vehicles.

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**MATERIALS IN ELECTRICAL SYSTEMS**
**(OPEN ELECTIVE - II)**

**Course Objectives:**
The Student will

1. understand the importance of various materials used in electrical engineering
2. obtain a qualitative analysis of their behavior and applications.
3. analyze the process used in manufacturing of integrated circuits
4. perform the calculations on cables on various aspects
5. evaluate the characteristics of HV and EHV cable.

**UNIT-I : Materials**
Conductors-free electron theory and electron scattering Di electrics Polarization, solid, liquid and gas dielectrics Insulators-Classification, Application in electric devices.

**UNIT-II : Magnetic materials**
Classification based on orientation of magnetic dipoles, Optoelectronic materials, Semiconductors-simple and compound, Refractory Materials. Solders and contacts, Super conductivity and super conducting materials.

**UNIT-III: Components**
Resistors and Capacitors. Display units:-LED, LCD and Monitors. Effect of environment on components.

**UNIT-IV: Processes**
Basic processes used in the manufacture of integrated circuits such as Epitaxy, masking, photolithography, diffusion, oxidation, Etching, metallization, Scribing, wire bonding and Encapsulation. Induction and Dielectric heating. Electron beam welding and cutting..

**UNIT-V: Cables**
Calculations of capacity of cables, charging current, stress, grading, heating of cables, Construction and characteristics of HV & EHV cable

**TEXT BOOKS**:


1. S.O. Kasap, Principles of Electrical Engineering Materials," MGH.
2. Mahajan, Principles of growth and processing of semiconductors," MGH.
3. Decker, Electrical Engineering Materials," PHI.


**REFERENCES:**


1. Dhir, Electronic components and Materials Principles manufacturing and Maintenance," TMH.
2. Allison, „Electronic Engineering Materials and Devices," TMH.
3. Ruska N Scot, Microelectronic processing – an introduction to the manufacture of integrated circuits," MGH.

**Course outcomes:**

The student will be able to:

1. Understand various types of materials and their properties in various conditions.
2. Evaluate magnetic materials and their behavior.
3. Evaluate semiconductor materials and technologies.
4. Acquire Knowledge on Materials used in electrical engineering and applications.
5. Design the components and observe the effect of these components on environment.

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**FUNDAMENTALS OF OPERATIONS RESEARCH**

**Open Elective - II**

**Course Objectives:**
The Student will

1. Get the basic knowledge of formulation, Solve the LPP models using graphical and mathematical applications.
2. Identify the optimal way of developing various transport models, Choose the appropriate assignment of men and machinery to perform various tasks
3. Understand the optimal sequencing for a machine or for a job when there are m machines and n jobs; understand the concept of replacing machine at the appropriate
4. Understand the strategies in the business environment and decide the strategy to get maximum value of the game. Understand the inventory in an industry or business organization and its importance.
5. Define waiting time at any point to get the desired service for a single channel service and multi-channel service.

**UNIT – I Introduction -** Development – Definition– Characteristics and Phases – Types of models – Operations Research models – applications.

**Allocation:** Linear Programming Problem - Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method; Duality Principle.

**UNIT – II**

**Transportation problem** – Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.

**Assignment problem** – Formulation – Optimal solution - Variants of Assignment Problem; Traveling Salesman problem

**UNIT – III**

**Sequencing** – Introduction – Flow **–**Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through 'm' machines

**Replacement:** Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely-Group Replacement.

**UNIT – IV**

**Theory of games:** Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games –m x 2 & 2 x n games - graphical method – m x n games - dominance principle.

**UNIT – V**

**Waiting lines:** Introduction – Terminology-Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population.

**Simulation:** Definition – types of simulation models- applications, advantages and disadvantage. Brief introduction of simulation languages – inventory and queuing problems using random numbers

**TEXT BOOKS**:

1. Operation Research/J. K. Sharma /Mac Milan.
2. Introduction to O.R/Hillier & Libermann (TMH).

**REFERENCES:**

1. Operations Research: Methods and Problems / Maurice Saseini, Arhur Yaspanand Lawrence Friedman
2. Operations Research /A. M. Natarajan, P. Balasubramaniam, A. Tamilarasi / Pearson Education
3. Operations Research / Wagner/ PHI Publications.
4. Operations Research / ACS Kumar/Yesdee

**Course outcomes:**

The student will be able to:

1. Allocate and distribute material, machine, man hour, money and number of men in any service and manufacturing industry.
2. Allot optimum quantities to various destinations from different sources with minimum cost. Assign the required men and machines to perform the given tasks.
3. Determine the number of items to be produced and the product mix. Schedule and sequence production runs by proper allocation of machines and men to get maximum gain or profit.
4. Compute the economic order quantity in different scenario to minimize inventory cost. Determine the quantity to be ordered when there are quantity discounts on the price.
5. Determine the number of service channels required to keep minimum waiting time at optimum service cost. Determine the shortest path for a given route and to solve the inventory and capital management problems.

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**(F41OF) Digital Systems Using VHDL**

(Open Elective -II)

**COURSE OBJECTIVES**

**The Students will:**

1. Learn how a Hardware Description Language (HDL) is used to describe and implement hardware.
2. Learn how to simulate and test that hardware and optimise their designs.
3. Learn in-depth study of combinatorial and sequential hardware systems and the use of finite state machines in the design of sequential systems.
4. To understand concept of Programmable Devices, PLA, PAL, CPLD and FPGA and implement digital system using VHDL.
5. To implement combinational and sequential circuits using VHDL.

**UNIT I**

**Review of Logic Design Fundamentals:** Combinational Logic, Boolean Algebra and Algebraic Simplification, Karnaugh maps, Designing with NAND and NOR Gates, Hazards in Combinational Networks, Flip-flops and latches, Mealy Sequential Network, Equivalent States and reduction of State Tables, Sequential Network Timing, Setup and Hold Times, Synchronous Design, Tristate Logic and Buses.

**UNIT II**

**Introduction to VHDL:** VHDL Description of Combinational Networks, Modeling Flip-flops using VHDL Process, VHDL Models for a Multiplexer, Compilation and Simulation of VHDL Code, Modeling a Sequential Machine, Variables, Signals and Constants, Arrays, operators, Functions, Procedures, Packages and Libraries, VHDL Model for a 74163 Counter.

**UNIT III**

**Designing with Programmable Logic Devices:** Read-Only Memories, Programmable Logic Arrays (PLAs), Programmable Array Logic (PALs) , Other Sequential Programmable Logic devices(PLDs),Design of a Keypad Scanner.

**Design of Networks for Arithmetic Operations:** Design of a Serial Adder with Accumulator, State Graphs for Control Networks, Design of a Binary Multiplier, Multiplication of Signed Binary Numbers, Design of a Binary Divider.

**UNIT IV**

**Digital Design with SM Charts:** State Machine Charts, Derivation of SM Charts, Realization of SM Charts, Implementation of the Dice Game, Alternative Realizations for SM Charts using Microprogramming, Linked State Machine.

**Designing with Programmable gate Arrays and Complex Programmable Logic Devices:** Xilinx 3000 Series FPGAs, Designing with FPGAs, Xilinx 4000 Series FPGAs, Using a One-Hot

State Assignment, Altera Complex Programmable Logic Devices(CPLDs),Altera FLEX 10K Series CPLDs.

**UNIT V**

**Floating-Point Arithmetic:** Representation of Floating-Point Numbers, Floating-point Multiplication, Other Floating-Point Operations.

**Hardware Testing and Design for Testability:** Testing Combinational Logic, Testing Sequential Logic, Scan Testing, Boundary Scan, Build-In Self-Test**.**

**TEXTBOOKS:**

1. Charles H,Roth ,“Digital system design using VHDL” , 2nd Edition, PWS publishing co.
2. Zainalabedin Navabi, “VHDL analysis and modeling of digital systems”,2nd Edition, MGH, 2004.

**REFERENCE BOOKS:**

1. Stphen Brown, "Fundamental of Digital logic with VHDL Design", Tata McGraw Hill, 2008.
2. J.Bhaskar ,“A VHDL primer”,3rd edition 2004, Prentice Hall of India Limited.
3. Michael D.Ciletti, “Advanced Digital design with Verilog HDL”, 2nd Edition, PHI Ltd, 2005.

**COURSE OUTCOMES**

The Students will be able to:

1. develop a digital logic and apply it to solve real life problems.
2. practice combinational and sequential digital circuits using different styles of modeling of VHDL.
3. analyze, design and implement sequential logic circuits.
4. employ digital system design using PLD.
5. simulate and implement combinational and sequential circuits using VHDL systems.

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## (F41OG) IC TECHNOLOGY

(Open Elective -II)

**COURSE OBJECTIVES:**

The Student will

1. understand the basic building blocks of linear and digital integrated circuits.
2. Familiarize with op-amp applications of active filters and oscillators.
3. gain the theory about applications of analog multipliers and PLL.
4. demonstrate the working of ADC and DAC.
5. understand few special functionalities of combinational and sequential integrated circuits.

**UNIT I: INTEGRATED CIRCUITS**

Classification, Chip Size and Circuit Complexity, Ideal and Practical Op-Amp, Op-amp characteristics-DC and AC Characteristics, 741 Op-Amp and its Features, Concept of Virtual Ground ,Modes of operation-inverting, non-inverting, differential.

**UNIT II: OP-AMP APPLICATIONS**

Basic Applications of Op-Amp, Instrumentation Amplifier, AC Amplifier, V to I and I to V Converters, Sample & Hold Circuits, Differentiators and Integrators, Comparators, Schmitt Trigger, Multivibrators.

**UNIT III: ACTIVE FILTERS & OSCILLATORS**

Introduction, First Order and Second Order Low Pass, High Pass and Band Pass Filters, Active Band Reject and All Pass Filters.

Principle of Operation and Types of Oscillators – RC, Wien Bridge and quadrature type. Waveform Generators – Triangular, Saw Tooth, Square Wave.

**UNIT IV: TIMERS & PHASE LOCKED LOOPS**

Introduction to 555 Timer, Functional Diagram, Monostable and Astable Operations and Applications, Schmitt Trigger, PLL - Introduction, Block Schematic, Principles and Description of Individual Blocks of 565, VCO. Introduction to Voltage Regulators, Features of 723 Regulator.

**UNIT V: D-A AND A- D CONVERTERS**

Introduction, Basic DAC Techniques - Weighted Resistor Type, R-2R Ladder Type, Inverted R-2R Type. Different types of ADCs – Parallel Comparator Type, Counter Type, Successive Approximation Register Type and Dual Slope Type. DAC and ADC Specifications.

**TEXT BOOKS:**

1. Linear Integrated Circuits –D. Roy Chowdhury, New Age International (p) Ltd, 3rd Ed., 2008.
2. Op-Amps & Linear ICs – Ramakanth A. Gayakwad, PHI, 1987.

**REFERENCE BOOKS:**


1. Modern Digital Electronics – RP Jain – 4/e – TMH, 2010.
2. Op-Amps and Linear Integrated Circuits – Concepts and Applications by James M.Fiore, Cengage/ Jaico, 2/e, 2009.
3. Operational Amplifiers and Liner Integrated Circuits by K.Lal Kishore – Pearson, 2008.


**COURSE OUTCOMES:**

The Student will be able to:

1. model operational amplifiers with linear and digital integrated circuits.
2. design op amp as active filters and oscillators.
3. reconstruct and relate circuits using operational amplifiers for various applications.
4. examine OP Amp to work as a converter.
5. design special function integrated circuits.

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**COMPUTER NETWORKS**

(Open Elective-II )

**Course objectives:**
**The Students will :**

1. Recognize various layering approaches for networking and understand the functionalities of physical layer.
2. Identify the data link layer protocols, multi access protocols, Ethernet technologies and various internetworking devices.
3. Examine design issues of network layer, services provided to above layer and routing, and congestion control protocols.
4. Examine IP protocol, addressing, various protocols like CIDR, ICMP,ARP and RARP of internet Layer and examination of transport layer services.
5. Examine Transport layer protocols like TCP, UDP, RPC and various congestion controlling mechanisms, including application layer services, protocols like HTTP, FTP, E-Mail etc.

**UNIT - I:**
**Overview of the Internet:** Protocol, Layering Scenario, TCP/IP Protocol Suite: The OSI Model, Internet history standards and administration; Comparison of the OSI and TCP/IP reference model.
**Physical Layer:** Guided transmission media, wireless transmission media.

**UNIT - II:**
**Data Link Layer:** design issues, Framing, Error Detection and Error Correction, Block Coding, Hamming Distance, CRC, Flow control and error Control.
**Protocols:** Noiseless Channels, Noisy Channels, HDLC, Point to Point Protocols..
**Connecting Devices:** Repeaters, Hubs, Switches, Gateways and **Bridges -** Learning and Spanning tree bridges.
**Multi Access protocols-** Random access - . ALOHA, CSMA, CSMA/CD and CSMA/CA, Controlled access, Channelization. Ethernet IEEE 802.3, IEEE 802.5, IEEE 802.11

**UNIT - III:**
**Network Layer**: Network layer design issues, Store and forward packet switching, connection less and connection oriented network services.
**Internetworking:** Protocols-IPV4 and IPV6**,** Logical Addressing-IPV4, IPV6, Tunnelling and Packet Fragmentation.
**Address Mapping**: ARP, RARP, DHCP, ICMP and IGMP.

**Routing Algorithms**: Shortest Path Finding and Distance Vector Routing Algorithms.

**UNIT - IV:**
**Transport Layer:** Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), The TCP Connection Establishment, The TCP Connection Release, Crash recovery, The TCP sliding window, The TCP congestion control, Improving Quality of Service Techniques: Leaky Bucket Algorithm.

**UNIT - V:**

**Application Layer:** Introduction, services, Application layer paradigms.

**Applications:** DNS, WWW, HTTP, FTP, E-MAIL, TELNET, SNMP, SSH.

**TEXT BOOKS:**

1. Data Communications and Networking - Behrouz A. Forouzan, Fifth Edition TMH, 2013.
2. Computer Networks - Andrew S Tanenbaum, 4th Edition, Pearson Education.

**REFERENCES BOOKS:**

1. "Computer Networks", 5E, Peterson, Davie, Elsevier
2. "Introduction to Computer Networks and Cyber Security", Chawan - HwaWu, Irwin, CRC Publications.
3. "Computer Networks and Internets with Internet Applications", Comer .

**Course outcomes:**

**The Students will be able to:**

1. Demonstrate the networking concepts, various Layering approaches and their functionalities.
2. Understand the protocols of Data Link layer, how a medium can be shared among multiple devices, Ethernet technologies and internetworking devices used.
3. Work on fragmentation, assigning of logical address and judge on routing, congestion.
4. Demonstrate the working of IP Protocol, other protocols of internet layer and services of transport layer.
5. Explain the transport layer and application layer protocols, their working.

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**PYTHON PROGRAMMING**

(Open Elective-II)

**Course objectives:**

**The Students will :**

1. Learn how to design and program Python applications.
2. Learn how to use lists, tuples, and dictionaries in Python programs.
3. Learn how to identify Python object types, Components, decision statements, pass arguments in Python.
4. Learn how to build and package Python modules for reusability, design object oriented programs with Python classes, use class inheritance in Python for reusability.
5. Learn how to use exception handling in Python applications for error handling

**UNIT - I:**

Programming paradigms; Structured programming vs object oriented programming, OOPs fundamentals- class, object, abstraction, encapsulation, polymorphism, and inheritance; Introduction to Python Getting started to Python- an interpreted high level language, interactive mode and script mode. Variables, Expressions and Statements Values and types, Variables and keywords, statements, evaluating expressions, operators and operands, order of operations, composition. Functions function calls, type conversion, type coercion, pre-defined functions, composition, user define functions, flow of execution, passing parameters, function parameters and scope. Conditionals and recursion modulus operator, Boolean expression, logical operators, conditional execution, alternative execution, chained and nested conditionals, return statement; Recursion, infinite recursion.

**UNIT - II:**

Python data structures Strings Creating, initializing and accessing the elements; String operators, comparing strings using relational operators; String functions and methods. **Lists:** Concept of mutable lists, creating, initializing and accessing the elements, traversing, appending, updating and deleting elements; List operations; List functions and Methods, list parameters, nested lists, Matrices.

**Dictionaries**

Concept of key-value pair, creating, initializing and accessing the elements in a dictionary, dictionary operations traversing, appending, updating and deleting elements, Dictionary functions and methods.

**Tuples**

Mutability and tuples, Immutable concept, creating, initializing and accessing the elements in a tuple, Tuple functions.

**UNIT - III:**

Object oriented programming using Python: creating python classes, classes and objects: user defined compound types, attributes, instances as arguments, instances as return values, objects are mutable, copying; classes and functions: pure function, modifiers; Exceptions: raising exceptions, handling exceptions, exception hierarchy.

**UNIT - IV:**

Classes and methods: object oriented features, optional arguments, initialization method, operator overloading and polymorphism. Inheritance: Basic Inheritance: extending built-ins, overriding and super; Multiple inheritance: the diamond problem, different sets of arguments.

**UNIT - V:**

Files handling and Exceptions: Text files, writing variables, Directories, Pickling;
Database Programming in Python: Connection module, connect MySQL Data base, perform DDL, DML and DQL operations.

**Text Books:**

1. **Python 3 Object Oriented Programming,** Dusty Phillips, Packet Publishing, 2010.
2. **Programming in Python 3** - A complete Introduction to the Python Language-Second Edition, Mark Summerfiels, Addison-Wesley 2010.

**Reference Books:**

1. **Programming Python- 4th Edition**, Mark Lutz, O'Reilly, 2011.
2. **Object-Oriented Programming in Python**, Michael H, Goldwasser, David Letscher, Pearson Prentice Hall, 2008.

**Course outcomes:**

**The Students will be able to:**

1. Describe to design and program Python applications.
2. Analyse and conversion of to use lists, tuples, and dictionaries in Python programs.
3. Explain the concept to identify Python object types, Components ,decision statements, pass arguments in Python.
4. Apply decision for building and package Python modules for reusability, design object-oriented programs with Python classes, use class inheritance in Python for reusability.
5. Apply file handling and Exception handling Concepts in real world using python

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**COMPUTER ORGANIZATION**
**(Open Elective-II)**

**COURSE OBJECTIVES:**

The Students will :

1. understand the basic operations of the computer system.
2. know the functioning of CPU and the control unit
3. analyze various algorithms for arithmetic operations in the computer.
4. understand different hierarchical memory systems including cache memory and virtual memory.
5. Recognize different ways of communicating with input/output devices and standard I/O interfaces.

**UNIT-I :**

Basic structures of Computers: Computer Types, Functional unit, Basic operational concepts, Bus structures, software, Performance, multiprocessors and multi computers.
Data Representation: Fixed point representation, Floating point representation, Error detection codes.

**UNIT-II:**

Register Transfer and Micro operations: Register transfer language, Register transfer, Bus and memory transfers, Arithmetic micro operations, logic micro operations, shift micro operations, Arithmetic logic shift unit.
Basic computer organization and Design: Instruction codes, computer registers, computer instructions, Timing and control, instruction cycle.

**UNIT-III:**

Computer Arithmetic: Introduction, Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating-point arithmetic operations, Decimal arithmetic unit, Decimal arithmetic operations.

**UNIT-IV:**

The Memory System: Basic concepts, Semiconductor RAM memories, Read-Only memories, speed, Size and Cost, Cache memories, performance considerations, Virtual memories, Secondary storage.

**UNIT-V:**

Input/output Organization: Accessing I/O Devices Interrupts, Interrupt hardware, Enabling and disabling interrupts, Direct memory access, Buses, interface circuits, Standard I/O interfaces.

**TEXT BOOKS:**

1. ComputerOrganization-CarlHamacher,ZvonkoVranesic,SafwatZaky,VthEdition,McGraw Hill.
2. Computer System Architecture-M.Moris Mano, IIIrd Edition, Pearson/PHI

**REFERENCE BOOKS:**

1. Computer organization and architecture-William stallings, Sixth Edition, Pearson/PHI
2. Structures Computer Organization-Andrew S.Tanebaum,4th Edition PHI/Pearson.

**COURSE OUTCOMES:**

The Students will be able to:

1. Illustrate basic operations of the computer system.
2. Apply knowledge of CPU and the control unit.
3. Apply various algorithms for arithmetic operations in the computer.
4. To classify different memory systems.
5. Produce knowledge on input/output organization.

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**HUMAN COMPUTER INTERACTION**
**(Open Elective-II)**

**Course Objectives:**
The Students will :

1. Demonstrate an understanding of guidelines, principles, and theories influencing human computer interaction.
2. Recognize how a computer system may be modified to include human diversity.
3. Select an effective style for a specific application.
4. Design mock ups and carry out user and expert evaluation of interfaces.

**UNIT I**
Introduction: Importance of user Interface – definition, importance of good design. Benefits of good design. A brief history of Screen design, The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.

**UNIT II**
Design process – Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions.

**UNIT III**
Screen Designing:- Design goals – Screen planning and purpose, organizing screen elements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics – Technological consideration in interface design.

**UNIT IV**
Windows – New and Navigation schemes selection of window, selection of devices based and screen based controls Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.

**UNIT V**
Software tools – Specification methods, interface – Building Tools. Interaction Devices – Keyboard and function keys – pointing devices – speech recognition digitization and generation – image and video displays – drivers.

**TEXT BOOKS:**

1. The essential guide to user interface design, Wilbert O Galitz, Wiley DreamTech.
2. Designing the user interface. 3rd Edition Ben Shneidermann , Pearson Education Asia

**REFERENCE BOOKS:**


1. Human – Computer Interaction. Alan Dix, Janet Fincay, Gre Goryd, Abowd, Russell Bealg, Pearson Education
2. Interaction Design Prece, Rogers, Sharps. Wiley Dreamtech.


**Course Outcomes:**

The Students will be able to:

1. Explain the human, Computer components functions regarding interaction with computer
2. Demonstrate Understanding of Interaction between the human and computer components.
3. Use Paradigms, HCI in the software process.
4. Implement Interaction design basics.

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| IV Year - I Semester | 3 | 0-0-0 | 3 |

## INTRODUCTION TO EMBEDDED SYSTEMS

## (OPEN ELECTIVE-II)

**Course Objectives:**

**The Students will:**

1. Understand the basic concepts of embedded systems and 8051 microcontrollers.
2. Compare and contrast the basics of assembly programming language.
3. Identify the unique characteristics of real-time systems
4. Analyze the general structure of a real-time system and define the unique design problems and challenges of real-time systems.
5. Acquaint the embedded software development tools and various advanced architectures.

**UNIT–I:**

**Embedded Computing:** Introduction, complex systems and microprocessor, the embedded system design process, formalisms for system design, design examples.

**UNIT–II:**

**The 8051 Architecture:** Introduction, 8051 micro controller hardware, input/outputports and circuits, external memory, counter and timers, serial data input/output, interrupts.

**Basic Assembly Language Programming Concepts:** The assemblylanguage programming process, programming tools and techniques, programming the 8051. Data transfer and logical instructions, arithmetic operations, decimal arithmetic, jump and call instructions.

**UNIT–III:**

**Introduction to Real-Time Operating Systems:** Tasks and task states, tasks and data, semaphores, and shared data; message queues, mailboxes and pipes, timer functions, events, memory management, interrupt routines in an RTOS environment.

**Basic Design Using a Real-Time Operating System:** Principles, semaphores and queues, hard real-time scheduling considerations, saving memory and power, an example RTOS like uC-OS (open source).

**UNIT–IV:**

**Embedded Software Development Tools**: Host and target machines, linker/locators for embedded software, getting embedded software into the target system

**Debugging Techniques**: Testing on host machine, using laboratory tools, an example system.

**UNIT-V:**

**Introduction to advanced Architectures:** ARM and SHARC, processor and memory organization and instruction level parallelism; networked embedded systems: bus protocols, $I^2C$ bus and CAN bus; internet-enabled systems, design example-elevator controller.

**Text Books:**

1. Wayne Wolf (2008), Computers as Components-principles of embedded computer system design, Elseveir, New Delhi, India.
2. Kenneth J. Ayala (2008), The 8051 Microcontroller, 3rd edition, Cengage Learning, India.

**References:**

1. David E. Simon (1999), An Embedded Software Primer, Pearson Education, India.
2. Jean J. Labrosse (2000), Embedding System Building Blocks, 2nd edition, CMP publishers, USA.
3. Raj Kamal (2004), Embedded Systems, Tata McGraw hill, India.

**Course Outcomes:**

**The Students will be able to:**

1. Program an embedded system
2. Analyze Interfacing with keyboard, A/D & D/A conversions, serial data Communication, LCD and LED display.
3. Illustrate Tasks, Semaphores, Message queues, pipes, Timer functions.
4. Design embedded systems and real-time systems
5. Compare and contrast ARM, SHARC, internet enabled systems.

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**INTRODUCTION TO SURFACE MINING**

**(OPEN ELCTIVE II)**

**COURSE OBJECTIVES:**

1. To introduce surface mining terms and applicable conditions
2. To acquaint with different machinery used in surface mining
3. To get idea about Drilling and blasting of surface ore bodies.
4. To get idea about lighting, dust and slopes in surface mines.
5. To know about ore and waste transportation.

**UNIT-I:** Definition, Terminology, Applicability and limitations of surface mining, Classification, Advantages and dis-advantages of surface mining.

**UNIT-II :** Introduction to surface mining machinery: Equipment selection; Working with rippers, shovels, draglines, shovel-dragline combination; bucket wheel excavator. Disposal of OB/waste material

**UNIT-III:**

Drilling & blasting**:** Drilling mechanism, drilling patters, Drill bits Explosives, Blasting accessories, Bulk explosives, problems in blasting.

**UNIT-IV:** Basics of Mine lighting, Sources of dust in surface mining, dust control, and slope stabilization

**UNIT-V:** Methods of excavation & transportation – shovel-dumper combination, draglines, surface miner, bucket wheel excavator. Impacts on environment due to surface mining

**TEXTBOOKS**:

1. D.J. Deshmukh, Elements of Mining Technology, Vol 1, Central Techno, 7th Edition, 2001.
2. Principles & Practices of Coal Mining, R.D. Singh

**REFERENCE BOOKS**

1. Surface Mining Technology, by Prof S.K.Das, Lovely Prakashan, Dhanbad

**COURSE OUTCOMES:**

The student will be able to:

1. Understand about surface mining terms and conditions of applicability
2. Learn about different machinery used in surface mining
3. Learn drilling and blasting in surface mining
4. Understand mine lighting, dust and slopes in surface mining
5. Understand the transportation of ore and waste in surface mining.

# Open Elective - III

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| B.Tech. | L | T-P-D | C |
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| IV Year - I Semester | 3 | 0-0-0 | 3 |

**ELEMENTS OF CIVIL ENGINEERING**
**(Open Elective-III)**

**Course Objectives:**

**The Students will**

1. understand different methods of surveying for various applications.
2. familiarize with various types of building materials.
3. understand transportation and traffic management.
4. Gain knowledge of water sources, supply& its treatment.
5. Study about Highway development in India, Necessity for Highway planning, different road development plans.

**UNIT - I:**

Introduction, history of the civil engineering, sub – disciplines of civil engineering.

**UNIT II:**

Surveying

Introduction, divisions of surveying, classification of surveying, principles of surveying. Linear measurements and errors–introduction, methods of linear measurements, chaining instruments, types of error and correction. Compass surveying – introduction, angular measurement using compass, whole circle bearing and reduced bearing, fore bearing and back bearing. Traverse surveying –introduction, chain and compass traversing, closing error and adjustments. Levelling– introduction, types of levelling instruments, dumpy level, adjustment of level, levelling staff.

**UNIT - III:**

Building Materials and Construction

Materials: Introduction to construction materials like ferrous and nonferrous metals, alloys, Stones, Bricks, Lime, Cement, Timber, Sand, Aggregates, Mortar, Concrete and bitumen. Construction: Types of building, different loads considered in building design, types of foundation in building, other developments and constructions of buildings.

**UNIT - IV:**

Fire and Earthquake Protection in Building Introduction, fire protection in building, structural and architectural safety requirements of resistive structures, fire resistive properties of building materials, fire exit requirements, force and acceleration on building due to earthquake, building response characteristics, building drift.

**UNIT - V:**

Water Supply, Sanitary and Electrical Works in Building

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

**Highway Engineering:**

Introduction, historical background of road or highway, classification of roads, pavements and roads, traffic control mechanism.

**TEXT BOOKS**:

1. Elements of Civil Engineering Author: Mimi Das Saikia, Bhargab Mohan Das and Madan Mohan Das Publisher: PHI Learning Private Limited New Delhi.
2. Elements of Civil Engineering Author: Dr. R.K. Jain and Dr. P.P. Lodha Publisher: McGraw Hill Education, India Pvt. Ltd.
3. Surveying Vol. I Author: Dr. B. C. Punmia, Ashokkumar Jain, Arunkumar Jain16th Edition Publisher: Laxmi Publication Delhi.
4. Building drawing Author: M.G.Shah, C.M.Kale and S.Y.Patki Publisher: Tata McGraw Hill.

**Reference Books:**

1. Surveying Theory and Practice (7th Edition) Author: James M Anderson and Edward M Mikhail Publisher: McGraw Hill Education, India Pvt. Ltd.
2. Surveying and Leveling Author: R. Subramanian Publisher: Oxford University.
3. Building drawing Author: M.G.Shah, C.M.Kale and S.Y.Patki Publisher: Tata McGraw Hill.
4. Civil Engg. Drawing Author: S. C. Rangwala Publisher: Charotar Pub. House Anand.

**Course Outcomes:**

Students will be able to

1. Carry out simple land survey and prepare maps showing the existing details.
2. Find out area of irregular shaped plane areas.
3. Understand building plan, elevation and section.
4. Get acquainted with construction materials and transportation systems.
5. Understand transportation and traffic problems.

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| **IV Year - I Semester** | **3** | **0-0-0** | **3** |

**DISASTER MANAGEMENT**
**(Open Elective-III)**

**Course Objectives:**

**The Student will:**

1. provide basic conceptual understanding the difference between the hazard and a disaster.
2. gain knowledge about the various disasters and their impacts.
3. provide basic understanding about the hazard and vulnerability profile of India.
4. have conceptual understanding about the disaster management phases.
5. gain approaches of Disaster Risk Reduction (DRR) and the relationship between vulnerability, Disasters, disaster prevention and risk reduction.

**UNIT - I:**

Concept of Disaster, Different approaches ,Concept of Risk, Levels of Disasters ,Disaster Phenomena and Events (Global, national and regional) ,Hazards and Vulnerability, Natural and man-made hazards, response time, frequency and forewarning levels of different hazards, Characteristics and damage potential or natural hazards, hazard assessment ,Dimensions of vulnerability factors, vulnerability assessment Vulnerability and disaster risk ,Vulnerabilities to flood and earthquake hazards.

**UNIT II:**

Disaster Management Mechanism, Concepts of risk management and crisis managements. Disaster Management Cycle, Response and Recovery Development, Prevention, Mitigation and Preparedness ,Planning for Relief.

**UNIT - III:**

Capacity Building: Concept, Structural and Non-structural Measures ,Capacity Assessment; Strengthening Capacity for Risk reduction ,Counter-Disaster Resources and their utility in Disaster Management ,Legislative Support at the state and national levels.

**UNIT - IV**:

Coping with Disaster ,Coping Strategies; alternative adjustment processes, Changing Concepts of disaster management ,Industrial Safety Plan; Safety norms and survival kits, Mass media and disaster management.

**UNIT - V:**

Planning for disaster management, Strategies for disaster management planning, Steps for formulating a disaster risk reduction plan, Disaster management Act and Policy in India. Organizational structure for disaster management in India, Preparation of state and district disaster management plans .

**TEXT BOOKS**:

1. Alexander, D. Natural Disasters, ULC press Ltd, London, 1993.
2. Carter, W.N. Disaster Management: A Disaster Management Handbook, Asian Development Bank, Bangkok, 1991.
3. Manual on Natural Disaster Management in India, NCDM, New Delhi, 2001.

**REFERENCES:**

1. Abarquez I. & Murshed Z. Community Based Disaster Risk Management: Field Practitioner's Handbook, ADPC, Bangkok, 2004.
2. Goudie, A. Geomorphological Techniques, Unwin Hyman, London 1990.
3. Goswami, S.C Remote Sensing Application in North East India, Purbanchal Prakesh, Guwahati, 1997.

**Course Outcomes:**

The Students will be able to

1. Acquired knowledge on various types of disasters and hazards.
2. Distinguish between the hazard and a disaster can be analysed.
3. Acquired knowledge on the various approaches of Disaster Risk Reduction (DRR)
4. Ability to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
5. Develop ability to respond to different disasters.

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| **IV Year - I Semester** | **3** | **0-0-0** | **3** |

**ELECTRIC COSTING AND ESTIMATION**
**(OPEN ELECTIVE - III)**

**Course Objectives:**
The Student will

1. emphasize the estimation and costing aspects of all electrical equipment,
2. design and estimation of wiring
3. design overhead and underground distribution lines,
4. classify types of substations and illumination
5. understand the Installation and costing of Electrical Equipment.

**UNIT-I : Design Considerations of Electrical Installations**
Electric Supply System, Three phase four wire distribution system, Protection of Electric Installation against over load, short circuit and Earth fault, Earthing, General requirements of electrical installations, testing of installations, Neutral and Earth wire, Types of loads, Systems of wiring, Service connections, Service Mains, Sub-Circuits, Location of Outlets, Location of Control Switches, Location of Main Board and Distribution board, Guide lines for Installation of Fittings, Load Assessment, Permissible voltage drops and sizes of wires, estimating and costing of Electric installations.

**UNIT-II : Electrical Installation for Different Types of Buildings and Small Industries**
Electrical installations for residential buildings – estimating and costing of material, Electrical
installations for commercial buildings, Electrical installations for small industries.

**UNIT-III: Overhead and Underground Transmission and Distribution Lines**
Introduction, Supports for transmission lines, Distribution lines – Materials used, Underground cables, Mechanical Design of overhead lines, Design of underground cables.

**UNIT-IV: Substations**
Introduction, Types of substations, Outdoor substation – Pole mounted type, Indoor substations – Floor mounted type.

**UNIT-V: Design of Illumination Schemes**
Introduction, Terminology in illumination, laws of illumination, various types of light sources, Practical lighting schemes LED, CFL and OCFL differences.

**TEXT BOOKS**:


1. "K. B. Raina, S. K. Bhattacharya", "Electrical Design Estimating and Costing", NewAge International Publisher, 2010.
2. "Er. V. K. Jain, Er. Amitabh Bajaj", "Design of Electrical Installations", UniversityScience Press.

**REFERENCES:**


1. Code of practice for Electrical wiring installations,(System voltage not exceeding 650volts), Indian Standard Institution, IS: 732-1983.
2. Guide for Electrical layout in residential buildings, Indian Standard Institution, IS:4648-1968.
3. Electrical Installation buildings Indian Standard Institution, IS: 2032.
4. Code of Practice for selection, Installation of Maintenance of fuse (voltage notexceeding 650 V), Indian Standard Institution, IS: 3106-1966.
5. Code of Practice for earthling, Indian Standard Institution, IS: 3043-1966.
6. Code of Practice for Installation and Maintenance of induction motors, IndianStandard Institution, IS: 900-1965.
7. Code of Practice for electrical wiring, Installations (system voltage not exceeding 650Volts), Indian Standard Institution, IS: 2274-1963.
8. "Gupta J. B., Katson, Ludhiana", "Electrical Installation, estimating and costing", S.K. Kataria and sons, 2013


**Course outcomes:**

The student will be able to:

1. Understand the design considerations of electrical installations.
2. Design electrical installation for buildings and small industries.
3. Analyze the feasibility of type of substation
4. Understand the performance of various materials used for transmission and distribution
5. Identify and design the various types of light sources for different applications.

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**POWER PLANT ENGINEERING**
**(OPEN ELECTIVE - III)**

**Course Objectives:**
The Student will

1. provide the knowledge on principles of solar radiation & solar energy collection & storage and applications.
2. prepare graduates to express the Knowledge on wind energy, geo-thermal energy, and ocean energy plants.
3. understand the behaviour of different power plants.
4. analyse different types of steam cycles and it's efficiencies in a steam power plant.
5. Expose on principle of safety and environmental issues.

**UNIT-I : Thermal Power Plants**
Basic thermodynamic cycles, various components of steam power plant- Layout- Pulverized coal burners- Fluidized bed combustion - Coal Handling systems - Ash handling systems - Forced draft and induced draft fans- Boilers- Feed pumps- Super heater- Regenerator - Condenser- Dearearators - Cooling tower

**UNIT-II Hydro-electric Power Plants**(Elementary Aspects)
Layout- Dams -Selection of water turbines – types - Pumped storage hydel plants

**UNIT-III: Nuclear Power Plants**(Elementary Aspects)
Principles of nuclear energy- Fission reactions - Nuclear reactor-Nuclear power plants

**UNIT-IV: Gas and Diesel Power Plants**(Elementary Aspects)
Types, Open and closed cycle gas turbine, Work output & thermal efficiency, Methods to improve performance-reheating, Inter-coolings, Regeneration-Advantage and disadvantages - Diesel engine power plant, Component and layout.

**UNIT-V: Non-Conventional Power Generation:**(Elementary Aspects)
Solar energy collectors, OTEC, Wind power plants, Tidal power plants and geothermal resources, Fuel cell, Thermoelectric power generation.

**TEXT BOOKS**:


1. Arora and Domkundwar, -"A Course in Power Plant Engineering", Dhanpat Rai and Co.Pvt. Ltd., New Delhi.
2. P.K. Nag,-"Power Plant Engineering", Tata McGraw Hill, Second Edition, Fourth reprint 2003.

**REFERENCES:**


1. Bernhardt G.A. Skrotzki and William A. Vopat, -"Power Station Engineering and Economy", Tata McGraw Hill Publishing Company Ltd., New Delhi, 20th reprint 2002.
2. G.D. Rai, -"An Introduction to Power Plant Technology", Khanna Publishers, Delhi-110 005.
3. M.M. El-Wakil, -"Power Plant Technology", Tata McGraw Hill, New Delhi, 1984.


**Course outcomes:**

The student will be able to:

1. Describe basic working principles of gas turbine and diesel engine power plants.
2. Define the performance characteristics and components of such power plants.
3. List the principal components and types of nuclear reactors.
4. List types, principles of operations, components and applications of steam turbines, steam generators, condensers, feed water and circulating water systems.
5. Estimate different efficiencies associated with power plant systems

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| **IV Year -I Semester** | **3** | **0-0-0** | **3** |

**FUNDAMENTALS OF ROBOTICS**

Open Elective - III

**Course Objectives:** The Student will

1. understand the theoretical aspects of Robotics
2. acquire practical experience in the field of Robotics through design projects and case studies.
3. understand the importance of robots in various fields of engineering.
4. understand trajectory planning and types of motion
5. expose to various robots and their operational details.

**UNIT-I:** Robotics-Introduction-classification with respect to geometrical configuration (Anatomy), Controlled system & chain type: Serial manipulator & Parallel Manipulator.

Components of Industrial robotics-precession of movement-resolution, accuracy & repeatability-Dynamic characteristics- speed of motion, load carrying capacity & speed of response-Sensors-Internal sensors: Position sensors & Velocity sensors, External sensors: Proximity sensors, Tactile Sensors, & Force or Torque sensors.

**UNIT-II:** Grippers - Mechanical Gripper-Grasping force-Engelberger-g-factors-mechanisms for actuation, Magnetic gripper, vaccume cup gripper-considerations in gripper selection & design. Industrial robots specifications. Selection based on the Application.

**UNIT-III**: Kinematics-Manipulators Kinematics, Rotation Matrix, Homogenous Transformation Matrix, D-H transformation matrix, D-H method of assignment of frames. Direct and Inverse Kinematics for industrial robots. Differential Kinematics for planar serial robots

**UNIT-IV: Trajectory planning:** Joint space scheme- Cubic polynomial fit-Obstacle avoidance in

operation space-cubic polynomial fit with via point, bleding scheme. Introduction Cartesian space scheme. Control- Interaction control, Rigid Body mechanics, Control architecture-position, path velocity, and force control systems, computed torque control, adaptive control, and Servo system for robot control.

**UNIT-V:** Programming of Robots and Vision System-Lead through programming methods-Teach pendent- overview of various textual programming languages like VAL etc.

**Introduction to Mobile Robots:** A brief history of mobile robotics, applications and market. Recent advances in the mobile robotics for RISE (Risky Intervention and Surveillance

Environment) applications.

**TEXT BOOKS**:

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Robotics / John J. Craig/ Pearson

**REFERENCES:**

1. Theory of Applied Robotics /Jazar/Springer.H. Asada and J. J. E. Slotine, "*Robot Analysis and Intelligence*", Wiley Inter-Science. 1986
2. Robotics / Ghosal / Oxford

**Course outcomes:** The student will be able to

1. apply the basic components of robots.
2. differentiate types of robots and robot grippers.
3. model forward and inverse kinematics of robot manipulators.
4. analyze forces in links and joints of a robot.
5. programme a robot to perform tasks in differential applications.

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| **IV Year - I Semester** | **3** | **0-0-0** | **3** |

**DIGITAL SYSTEMS USING VERILOG**

(Open Elective -III)

**COURSE OBJECTIVES**

**The Students will**

1. understand the constructs and conventions of the Verilog HDL programming.
2. Industrial-standard design software for coding, synthesis and simulation.
3. Learn in-depth study of combinational and sequential hardware systems and the use of finite state machines in the design of sequential systems.
4. understand concept of Programmable Devices, PLA, PAL, CPLD and FPGA and implement digital system using VHDL.
5. implement combinational and sequential circuits using VHDL.

**UNIT I: Review of Logic Design Fundamentals**

Combinational Logic, Boolean Algebra and Algebraic Simplification, Karnaugh maps, Designing with Nand and Nor Gates, Hazards in Combinational Networks, Flip-flops and latches,Mealy Sequential Network, Equivalent States and reduction of State Tables, Sequential Network Timing, Setup and Hold Times, Synchronous Design, Tristate Logic and Buses.

**UNIT II: Introduction to Verilog**

Computer-Aided Design, Hardware Description Languages, Verilog Description of Combinational Circuits, Verilog Modules, Assignments, Procedural Assignments, Modeling Flip-Flops Using Always Block, Always Blocks Using Event Control Statements, Delays in Verilog, Compilation, Simulation and Synthesis of Verilog Code, Data Types and Operators, Simple Synthesis Examples for Multiplexers, Modeling Registers and Counters Using Verilog Always Statements, Behavioral and Structural Verilog, Constants, Arrays, Loop in Verilog, Testing in Verilog Model.

**UNIT III: Introduction to Programmable Logic Devices**

Brief Overview of Programmable Logic Devices, Simple Programmable Logic Devices(SPLDs),Complex Programmable Logic Devices(CPLDs),Field-Programmable Gate Arrays(FPGAs), Problems.

**Design Examples**

BCD to 7-Segment Display Decoder, A BCD Adder, 32-Bit Adders, Traffic Light Controller, State Graphs for Control Circuits, Scoreboard and Controller, Array Multiplier.

**UNIT IV: SM Charts and Microprogramming**

State Machine Charts, Derivation of SM Charts, Realization of SM Charts, Implementation of the Dice Game, Microprogramming, Linked State Machine.

**Designing with Field Programmable Gate Arrays**

Implementing Functions in FPGAs, Implementing Functions Using Shannon's Decomposition, Carry Chains in FPGAs, Examples of Logic Block in Commercial FPGAs, Dedicated memory in FPGA, Dedicated Multipliers in FPGAs, Cost of Programmability.

**UNIT V:Floating-Point Arithmetic**

Representation of Floating-Point Numbers, Floating-point Multiplication, Floating-point Additions, Other Floating-Point Operations.

**Hardware Testing and Design for Testability**

Testing Combinational Logic, Testing Sequential Logic, Scan Testing, Boundary Scan, Build-In Self-Test.

**TEXTBOOKS:**

1. By Charles Roth, Lizy K. John, Byeong Kil Lee,"Digital System Design using Verilog".
2. Zainalabdien Navabi, Verilog Digital System Design, TMH, 2nd edition.

**REFERENCE BOOKS:**

1.T.R.Padmanabhan & Bala Tripura sundari, "Design through Verilog HDL", WSE2004 IEEE press.

2.Fundamentls of Digital Logic with Veilog design by Stephen Brown, Zvonkoc Vranesic, TMH, 2nd edition, 2010.

3. Digital Logic Design using Verilog , State machine & synthesis for FPGA, Sunggu Lee, Cengage Learning ,2009.

4. Verilog HDL - Samir Palnitkar, 2nd Edition, Pearson Education, 2009.

**COURSE OUTCOMES**

The Students will be able to:

1. describe, design, simulates and synthesize the computer hardware.
2. practice verilog hardware description language.
3. develop program codes for synthesis-friendly combinational and sequential logic incorporating the concept of sustainability of design and development.
4. analyze, design and implement sequential logic circuits.
5. construct digital system design using PLD.

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| **B.Tech.** | **L** | **T-P-D** | **C** |
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| **IV Year - I Semester** | **3** | **0-0-0** | **3** |

**ADVANCED COMPUTER ARCHITECTURE**

(Open Elective -III)

**COURSE OBJECTIVES:**

The Student will

1. understand the fundamentals of computer design and technology trends.
2. familiarize with the Instruction level parallelism.
3. gain knowledge about memory design and virtual memory.
4. know about architectures of multiprocessors and storage systems.
5. analyze the Inter connection networks and design of clusters.

**UNIT-I**

Fundamentals of Computer design- Technology trends- cost- measuring and reporting performance quantitative principles of computer design. Instruction set principles and examples- classifying instruction set- memory addressing- type and size of operands- addressing modes for signal processing-operations in the instruction set- instructions for control flow- encoding an instruction set.-the role of compiler.

**UNIT-II**

Instruction level parallelism (ILP)- over coming data hazards- reducing branch costs –high performance instruction delivery- hardware based speculation- limitation of ILP. ILP software approach- compiler techniques- static branch protection - VLIW approach - Hardware support for more ILP at compile time- Hardware verses Software Solutions.

**UNIT-III**

Memory hierarchy design- cache performance- reducing cache misses penalty and miss rate – virtual memory- protection and examples of VM.

**UNIT-IV**

Multiprocessors and thread level parallelism- symmetric shared memory architectures- distributed shared memory- Synchronization- multi threading. Storage systems- Types – Buses - RAID- errors and failures- bench marking a storage device- designing a I/O system.

**UNIT-V**

Inter connection networks and clusters- interconnection network media – practical issues in interconnecting networks- examples – clusters- designing a cluster.

**TEXT BOOKS:**

1. Computer Architecture and Parallel Processing, Kai Hwang and A Briggs International edition Mcgraw-Hill.
2. Advanced Computer Architectures, Dezso Sima, Terence Fountain, Peter Kacsuk, Pearson.
3. Parallel Computer Architecture, A Hardware/Software Approach, david E Culler, Jaswinder Pal Singh, Anoop Gupta, Elseveir.

**REFERENCE BOOKS:**

1. Computer Architecture, A quantitative approach, 3rd edition, John L Hennessy and David A Patterson Morgan Kufmann (an imprint elsevier).

**COURSE OUTCOMES:**

The Students will be able to

1. understand the fundamentals of computer design and technology trends.
2. expertise with the Instruction level parallelism.
3. illustrate the concepts of memory design and virtual memory.
4. obtain knowledge on architectures of multiprocessors and storage systems.
5. design the Inter connection networks and design of clusters.

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**UGC AUTONOMOUS**

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**SOFTWARE ENGINEERING**

(Open Elective-III)

**Course objectives:**

**The Students will :**

1. Analyze basic Software engineering methods.
2. Describe software engineering layered technology and Process frame work.
3. Design software architecture and UML modeling
4. Recognize testing approaches such as unit testing and integration testing.
5. Demonstrate software evolution and related issues such as version and risk management

**UNIT - I:**

**Introduction to Software Engineering**: The evolving role of Software, changing nature of Software, Software Myths.
**A Generic view of process:** Software engineering- A layered technology, a process framework, The Capability Maturity Model Integration (CMMI), Process patterns, process assessment, personal and team process models.
**Process models:** The waterfall model, Incremental process models, Evolutionary process models, The Unified process.

**UNIT - II:**

**Software Requirements:** Functional and non-functional requirements, user requirements, system requirements, interface specification, the software requirements document**.**
**Requirements Engineering Process:** Feasibility studies, requirements elicitation and analysis, requirements validation, requirements management.
**System Analysis Models**: Context models, behavioral models, data models, object models, structured methods

**UNIT - III:**

**Design Engineering:** Design process and Design quality, Design concepts, the design model.
**Creating an architectural design:** Software architecture, Data design, Introduction to UML, Importance of modeling, Principle of modeling, Concepts of modeling and architecture.
**Object-Oriented Design:** Objects and object classes, An Object-Oriented design process, Design evolution.
**Performing User interface design:** Golden rules, User interface analysis and design, interface analysis, interface design steps, Design evaluation.

**UNIT - IV:**

**Testing Strategies:** A strategic approach to software testing, test strategies for conventional software, Black-Box and White-Box testing, Validation testing, System testing, the art of Debugging.

**Product metrics:** Software Quality, Metrics for Analysis Model, Metrics for Design Model, Metrics for source code, Metrics for testing, Metrics for maintenance.
**Metrics for Process and Products:** Software Measurement, Metrics for software quality.
**UNIT - V:**

**Risk management:** Reactive vs. Proactive Risk strategies, software risks, Risk identification, Risk projection, Risk refinement, RMMM, RMMM Plan.
**Quality Management:** Quality concepts, Software quality assurance, Software Reviews, Formal technical reviews, Statistical Software quality Assurance, Software reliability, The ISO 9000 quality standards.

**TEXT BOOKS:**

1. Software Engineering A Practitioner's Approach, Roger S Pressman, 6th edition. McGraw-Hill International Edition.
2. Software Engineering, Ian Sommerville, 7th edition, Pearson education.

**REFERENCE BOOKS:**

1. The Unified Modeling Language, User Guide by Grady Booch, James Rambaugh, Ivar Jaccobson.
2. Software Engineering, A Precise Approach, Pankaj Jalote, Wiley India, 2010.
3. Software Engineering: A Primer, Waman S Jawadekar, Tata McGraw-Hill, 2008

**Course outcomes:**

**The Students will be able to:**

1. Apply software engineering principles and techniques
2. Evaluate requirements for a software system
3. Apply the process of analysis and design using the object-oriented approach
4. Write test cases for different requirement and implement testing.
5. Evaluate different version and risk management

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| **IV Year I- Semester** | **3** | **0-0-0** | **3** |

**JAVA PROGRAMMING**
**(Open Elective-III)**

**Course Objectives:**
The students will :

1. Describe with constructors and string handling functions.
2. Explain Inheritance and Polymorphism.
3. Discuss Exception handling and Multithreading.
4. Review Applet Programming, Event Handling and scripting.
5. Discuss Collection frame work in java and Files.

**UNIT – I**

OOP concepts – Data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, classes and objects, Procedural and object oriented programming paradigms

Java programming - History of Java, comments, data types, variables, constants, scope and life time of variables, operators, operator hierarchy, expressions, type conversion and casting, enumerated types, control flow - block scope, conditional statements, loops, break and continue statements, simple java stand alone programs, arrays, console input and output, formatting output, constructors, methods, parameter passing, static fields and methods, access control, this reference, overloading methods and constructors, recursion, garbage collection,

String handling: String, StringBuffer, StringTokenizer.

**UNIT – II**

Inheritance - Inheritance hierarchies, super and sub classes, Member access rules, super keyword, preventing inheritance: final classes and methods, the Object class and its methods

Polymorphism- dynamic binding, method overriding, abstract classes and methods.

Interfaces – Interfaces vs. Abstract classes, defining an interface, implementing interfaces, accessing implementations through interface references, extending interface.

Inner classes – Uses of inner classes, local inner classes, anonymous inner classes, static Inner classes, examples.

Packages-Defining, Creating and Accessing a Package, Understanding CLASSPATH, Importing packages.

**UNIT – III**

Exception handling – Dealing with errors, benefits of exception handling, the classification of exceptions- exception hierarchy, checked exceptions and unchecked exceptions, usage of try, catch, throw, throws and finally, re-throwing exceptions, exception specification, built in exceptions, creating own exception sub classes.

Multithreading - Differences between multiple processes and multiple threads, thread states, creating threads, interrupting threads, thread priorities, synchronizing threads, inter-thread communication, producer consumer pattern.

**UNIT – IV**

Event handling - Events, Event sources, Event classes, Event Listeners, Relationship between Event sources and Listeners, Delegation event model, Examples: handling a button click, handling mouse events, Adapter classes.

Applets – Inheritance hierarchy for applets, differences between applets and applications, life cycle of an applet, passing parameters to applets, applet security issues.

**UNIT – V**

Collection Framework in Java – Introduction to Java Collections, Overview of Java Collection frame work, Generics, Commonly used Collection classes– Array List, Vector, Hash table, Stack, Enumeration, Iterator, String Tokenizer, Random, Scanner, calendar and Properties

Files – streams- byte streams, character streams, text Input/output, binary input/output, random access file operations, File management using File class.

Connecting to Database - JDBC Type 1 to 4 drivers, connecting to a database, querying a database and processing the results, updating data with JDBC.

**TEXT BOOKS:**

1. Java Fundamentals – A comprehensive Introduction, Herbert Schildt and Dale Skrien, TMH.
2. Java The complete reference, 8th editon, Herbert Schildt, TMH.

**REFERENCE BOOKS :**

1. Java for Programmers, P.J.Deitel and H.M.Deitel, Pearson education (OR) Java: How to Program P.J.Deitel and H.M.Deitel, PHI.
2. Object Oriented Programming through Java, P.Radha Krishna, Universities Press.
3. Thinking in Java, Bruce Eckel, Pearson Education
4. Programming in Java, S.Malhotra and S.Choudhary, Oxford Univ. Press.

**Course Outcomes:**

The Students will be able to:

1. Apply constructors and string Handling.
2. Demonstrate Inheritance and Polymorphism.
3. Choose Exception handling and Multithreading.
4. Practice applet Programming Solve Event Handling.
5. Choose Collection frame work and files.

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| **IV Year I- Semester** | **3** | **0-0-0** | **3** |

**SOFTWARE PROJECT MANAGEMENT**
**(Open Elective-III)**

**COURSE OBJECTIVES:**

The Students will:

1. Discuss the conventional and contemporary software project management principles.
2. Understand the ability to assess and plan project schedule and assign resources
3. Select an appropriate project development methodology among various alternating processes.
4. Identify project risks, understand the responsibilities, monitor and track project deadlines and the capability to work in a team environment.

**UNIT-I**

Conventional Software Management: The waterfall model, conventional software management performance.

Evolution of Software Economics: Software Economics.

Improving Software Economics: Reducing software product size, Improving software processes, Improving team effectiveness, Improving automation, Achieving required quality.

**UNIT-II**

The old way and the New way: The principles of conventional software engineering, Principles of modern software management.

Life Cycle Phases: Engineering and Production stages, Inception, Elaboration, Construction, Transition phases.

Artifacts of the Process: The artifact sets, Management artifacts, Engineering artifacts, Programmatic artifacts.

**UNIT-III**

Model Based Software Architectures: A Management perspective and Technical perspective.

Work Flows of the Process: Software process workflows, Iteration workflows.

Checkpoints of the Process: Major milestones, Minor milestones, Periodic status assessments.

Iterative Process Planning: Work breakdown structures, planning guidelines, cost and schedule estimating, Iteration planning process.

**UNIT-IV**

Project Organizations and Responsibilities: Line-of-business organizations, Project organizations.

Process Automation: Automation building blocks.

Project Control and Process Instrumentation: The seven core metrics, Management indicators, quality indicators, life cycle expectations, and pragmatic software metrics.

**UNIT-V**

Future Software Project Management: Modern project profiles, next generation software economics, modern process transitions.

Tailoring the Process: Process discriminants.
Case Study: The command centre processing and display system-replacement (CCPDS-R)

**TEXT BOOKS:**

1. Software Project Management, Walker Royce: Pearson Education, 2005
2. Software Project Management, Joel Henry: Pearson Education

**REFERENCE BOOKS:**

1. Software Project Management, Bob Hughes and Mike Cotterell: Tata McGraw-Hill Edition.
2. Software Project Management in practice, Pankaj Jalote, Pearson Education, 2005

**COURSE OUTCOMES:**

The Student is able to:

1. Describe the conventional s/w management and explain how to improve s/w economics
2. Understand and discuss the key phases of project management and the key skills associated with each.
3. Explain the concept of workflows and checkpoints of the processes.
4. Discuss the responsibilities in the project organization.
5. Distinguish between conventional project and modern project profiles.

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**INTRODUCTION TO INTELLIGENT SYSTEMS**
**Open Elective - III**

**Course Objectives:**

**At the end of the course, students will learn:**

1. Understand In-depth of specialist bodies of knowledge within the engineering discipline.
2. Establish engineering methods to complex engineering problem solving.
3. Be Fluent application of engineering techniques, tools and resources

**UNIT–I:**

**Introduction To Artificial Intelligence:** Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem, characteristics, Production system characteristics -Specialized production system

**UNIT–II:**

**Representation Of Knowledge**: Game playing - Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic Structured representation of knowledge.

**UNIT–III:**

Knowledge Inference: Knowledge representation -Production based system, Frame based system.

**UNIT–IV:**

Inference - Backward chaining, forward chaining, Rule value approach, Fuzzy reasoning - Certainty factors, Bayesian Theory-Bayesian Network-Dempster - Shafer theory.

**UNIT-V:**

Expert Systems: Expert systems - Architecture of expert systems, Roles of expert systems - Knowledge Acquisition –Meta knowledge, Heuristics.

**Text Books:**


1. Kevin Night, Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Tata McGraw-Hill Education Private Limited, 3rd edition, 2009, ISBN: 978-0070678163.
2. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2nd edition, 2007.ISBN, 0132097680.

**References:**


1. Peter Jackson, “Introduction to Expert Systems”, Pearson Education, 3rd edition, 2007. ISBN-13: 978-0201876864
2. Stuart Russel, Peter Norvig , “AI – A Modern Approach”, Pearson Education, 2nd edition, ISBN-13: 978-0137903955


**Course Outcomes:**

**The Students will be able to:**

1. Gain basic understanding of the underlying principles and philosophy of computational intelligence systems Technologies.
2. Be capable of constructing intelligent systems (in software) that perform useful engineering tasks

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**INTRODUCTION TO GEOLOGY**

**(OPEN ELECTIVE III)**

**COURSE OBJECTIVES:**

**The Student will:**

1. introduce rock types and their physical properties
2. acquaint with different structures occurring in rocks
3. get idea about Ground water, and aquifers
4. get idea about coal formation and its stages.
5. know about minerals occurring in India.

**UNIT-I:**

Introduction, Definitions, Importance of geology in mining, Types of rocks, Physical properties of rocks.

**UNIT-II:**

Structural Geology: Definition, terminology, and Primary and secondary structures: Bedding, lineation, foliation, cleavage, Strike and dip. Definition of faults, folds and joints and their types, Unconformities and its kinds.

**UNIT-III:**

Ground Water: Introduction, Hydrological Cycle, origin and occurrence of groundwater, water table. Aquifers: Types of aquifers, confined and unconfined aquifers, perched aquifers.

**UNIT-IV:**

Coal: Stages of formation, composition, theories of formation of coal.

**UNIT-V:**

Occurrence and distribution of important metallic mineral deposits in India: Iron – Copper, - Lead and Zinc – Manganese – Aluminum – Chromium.

Occurrence and distribution of important non-metallic mineral deposits in India: Asbestos – kyanite – Sillimanite.

**TEXTBOOKS**:

1. Structural Geology – Billings, M.P. Prentice Hall.
2. Engineering geology –by Dr. Chennkeshavulu.

**REFERENCE BOOKS:**

1. A Textbook of Geology: Mukherjee P.K., The World Press Pvt. Limited Calcutta.

**COURSE OUTCOMES:**

The student will be able to:

1. Understand about rocks and their properties
2. Learn about different structures occurring in rocks
3. Understand about ground water, water table and aquifers
4. Learn about coal and its formation theories
5. Distinguish metallic and non-metallic minerals.

# Open Elective - IV

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| **IV Year - II Semester** | **3** | **0-0-0** | **3** |

## INDUSTRIAL WASTE WATER TREATMENT
## (Open Elective-IV)

**COURSE OBJECTIVES:**

**The Students will:**

1. Distinguish between the quality of domestic and industrial water requirements and Wastewater quantity generation
2. Understand the industrial process, water utilization and waste water generation
3. Impart knowledge on selection of treatment methods for industrial wastewater
4. Acquire the knowledge on operational problems of common effluent treatment plants.
5. Gain knowledge on different techniques and approaches for minimizing the generation and application of Physio chemical and biological treatment methods for recovery, reuse and disposal of industrial wastewater.

**UNIT – I:**

Sources of Pollution - Physical, Chemical, Organic & Biological properties of Industrial Wastes- Difference between industrial & municipal waste waters - Effects of industrial effluents on sewers and Natural water Bodies.

**UNIT – II:**

Pre & Primary Treatment - Equalization, Proportioning, Neutralization, Oil separation by Floating-Waste Reduction-Volume Reduction-Strength Reduction

**UNIT-III:**

Waste Treatment Methods - Nitrification and De-nitrification-Phosphorous removal -Heavy metal removal - Membrane Separation Process - Air Stripping and Absorption Processes - Special Treatment Methods - Disposal of Treated Waste Water.

**UNIT-IV:**

Characteristics and Composition of waste water and Manufacturing Processes of Industries like Sugar, Characteristics and Composition of Industries like Food processing Industries, Steel, and Petroleum Refineries

**UNIT-V:**

Characteristics and Composition of Industries like Textiles, Tanneries, Atomic Energy Plants and other Mineral Processing Industries – Joint Treatment of Raw Industries waste water and Domestic Sewage – Common Effluent Treatment Plants(CETP) – Location, Design, Operation and Maintenance Problems – Economical aspects

**TEXT BOOKS**:

1. Metcalf & Eddy, “Wastewater engineering Treatment disposal reuse”, Tata McGraw Hill.
2. Eckenfelder, W.W., “Industrial Water Pollution Control”, McGraw-Hill

**REFERENCE BOOKS:**

1. M.N. Rao and Dutta – Industrial Waste.
2. Mark J. Hammer, Mark J. Hammer, Jr., “Water & Wastewater Technology”, Prentice Hall of India.
3. N.L. Nemerrow –Theories and practices of Industrial Waste Engineering. C.G. Gurnham – Principles of Industrial Waste Engineering

**COURSE OUTCOMES:**

The Students will be able to

1. Learn a firm foundation and knowledge of mathematics, science and engineering principles and the ability to apply the knowledge.
2. Define and reason about fundamental concepts of waste water treatment
3. Design and conduct experiments and the ability
4. To analyze the data, interpret results and draw conclusions.
5. Design a component, system or process to meet desired needs and imposed constraints.

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| **IV Year - II Semester** | **3** | **0-0-0** | **3** |

## AIR POLLUTION AND CONTROL
## (Open Elective-IV)

**Course Objectives:**

**The Students will**

1. introduce students to basic concepts of pollution.
2. gain the knowledge of causes of air pollution.
3. gain the knowledge of health related to air pollution.
4. develop skills relevant to control of air pollution.
5. Understand the quality of air.

**UNIT–I:** Air Pollution – Definitions, Scope, Significance and Episodes, Air Pollutants – Classifications – Natural and Artificial – Primary and Secondary, point and Non-Point, Line and Areal Sources of air pollution- stationary and mobile sources

**UNIT–II:** Effects of Air pollutants on man, material and vegetation; Global effects of air pollution – Green House effect, Heat Islands, Acid Rains, Ozone Holes etc.

**UNIT–III:** Thermodynamics and Kinetics of Air-pollution – Applications in the removal of gases like $SO_x$; $NO_x$; CO; HC etc., air-fuel ratio. Computation and Control of products of combustion. Meteorology and plume Dispersion; properties of atmosphere; Heat, Pressure, Wind forces, Moisture and relative Humidity; Influence of Meteorological phenomena on Air Quality-wind rose diagrams.

**UNIT–IV:** Lapse Rates, Pressure Systems, Winds and moisture plume behaviour and plume Rise Models; Gaussian Model for Plume Dispersion.
Control of particulates – Control at Sources, Process Changes, Equipment modifications, Design and operation of control.
Equipment's – Settling Chambers, Centrifugal separators, filters Dry and Wet scrubbers, Electrostatic precipitators.

**UNIT-V:** General Methods of Control of $NO_x$ and $SO_x$ emissions – In-plant Control Measures, process changes, dry and wet methods of removal and recycling.
Air Quality Management – Monitoring of SPM, $SO_x$; $NO_x$ and CO Emission Standards.

**Text Books:**

1. Air pollution By M.N.Rao and H.V.N.Rao – Tata Mc.Graw Hill Company.
2. Air pollution by Wark and Warner.- Harper & Row, New York

**References:**

1. Air pollution and control By K.V.S.G. Murali Krishna, Kaushal Publishers. Kakinada.

**Course Outcomes:**

**The Students will be able to**

1. Acquired knowledge on the basic elements of causes and occurrence of the air pollution.
2. Have awareness on the different causes of the air pollution.
3. Have awareness about different health related problems caused due to air pollution.
4. develop concepts in controlling and prevention of air pollution.
5. Analyse the quality of air.

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| **IV Year - II Semester** | **3** | **0-0-0** | **3** |

**DISTRIBUTED GENERATION AND MICROGRID**
**(OPEN ELECTIVE - IV)**

**Course Objectives:**
The Student will

1. illustrate the concept of distributed generation
2. analyze the impact of grid integration.
3. study concept of Micro grid and its configuration
4. understand the Economic and control aspect of DGs
5. find optimal size, placement and control aspects of DGs

**UNIT-I : Need for Distributed Generation**
Renewable sources in distributed generation - Current scenario in distributed generation - Planning of DGs – Siting and sizing of DGs – Optimal placement of DG sources in distribution systems.

**UNIT-II : Grid Integration of DGs**
Different types of interfaces - Inverter based DGs and rotating machine based interfaces - Aggregation of multiple DG units - Energy storage elements - Batteries, ultra capacitors, flywheels.

**UNIT-III: Technical Impacts of DGs**
Transmission systems, Distribution systems, De-regulation – Impact of DGs upon protective relaying – Impact of DGs upon transient and dynamic stability of existing distribution systems

**UNIT-IV: Economic and Control Aspects of DGs**
Market facts, issues and challenges - Limitations of DGs - Voltage control techniques, Reactive power control, Harmonics, Power quality issues - Reliability of DG based systems – Steady state and Dynamic analysis.

**UNIT-V: Introduction to Micro-grids**
Types of micro-grids – Autonomous and non-autonomous grids – Sizing of micro-grids - Modeling & analysis - Micro-grids with multiple DGs – Micro-grids with power electronic interfacing units - Transients in micro-grids - Protection of micro-grids – Case studies

**TEXT BOOKS**:


1. H. Lee Willis, Walter G. Scott , 'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press, 2000.
2. M.Godoy Simoes, Felix A.Farret, 'Renewable Energy Systems – Design and Analysis with Induction Generators', CRC press.

**REFERENCES:**


1. Robert Lasseter, Paolo Piagi, ' Micro-grid: A Conceptual Solution', PESC 2004, June 2004.
2. F. Katiraei, M.R. Iravani, 'Transients of a Micro-Grid System with Multiple Distributed Energy Resources', International Conference on Power Systems Transients (IPST'05) in Montreal, Canada on June 19-23, 2005.
3. Z. Ye, R. Walling, N. Miller, P. Du, K. Nelson, 'Facility Microgrids', General Electric Global Research Center, Niskayuna, New York, Subcontract report, May 2005.


**Course outcomes:**

The student will be able to:

1. Find the size and optimal placement DG
2. Analyze the impact of grid integration and control aspects of DGs
3. Model and analyze a micro grid taking into consideration the planning and Operational issues of the DGs to be connected in the system
4. Describe the technical impacts of DGs in power systems.
5. Implement the micro grids and their control schemes

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| **IV Year - II Semester** | **3** | **0-0-0** | **3** |

**RENEWABLE ENERGY SOURCES**
**(OPEN ELECTIVE -IV)**

**Course Objectives:**
The Student will

1. understand the various types of renewable energy sources.
2. analyze the principle and operation of direct energy conversion.
3. understand and analyze the hybrid energy systems.
4. apply the renewable energy sources to real world electrical and electronics problems.
5. apply the renewable energy sources to real world electrical and electronics applications.

**UNIT-I : Principles of Solar Radiation**
Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

**UNIT-II : Solar Energy Collection**
Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.
**Solar Energy Storage and Applications:** Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

**UNIT-III: Wind Energy**
Sources and potentials, Power from wind, Properties of air and wind, Types of wind turbines, Operating characteristics, Betz criteria.
**Bio-Mass:** Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.
**UNIT-IV: Geothermal Energy**
Resources, types of wells, methods of harnessing the energy, potential in India
**Ocean Energy:** OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

**UNIT-V: Direct Energy Conversion**
Need for DEC, Carnot cycle, limitations, and principles of DEC
**Environmental effects of energy conversion systems:**
Pollution from coal and preventive measures, Steam stations and pollution, Pollution free energy systems

**TEXT BOOKS**:

1. Non-Conventional Energy Sources /G.D. Rai, khanna publications.
2. Renewable Energy Sources /Twidell&Weir CRC Press .

**REFERENCES:**

1. Renewable Energy resources /Tiwari and Ghosal/Narosa
2. Renewable Energy Technologies /Ramesh & Kumar /Narosa
3. Non-Conventional Energy Systems / K Mittal /Wheeler
4. Renewable Energy sources and emerging technologies by D.P. Kothari, K.C. Singhal, P.H.I
5. Systems" -Academic Press, 1st Edition 2009.

**Course outcomes:**

The student will be able to:

1. Understand the need of utilization of alternate energy resources.
2. Discuss the collection of solar energy, storage of solar energy and its applications.
3. Illustrate the potential of Wind and bio mass as a renewable source.
4. Understand the potential of geothermal energy and ocean energy as a renewable source.
5. Discuss the direct energy conversion systems.

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| **IV Year - II Semester** | **3** | **0-0-0** | **3** |

**Open Elective - IV**

**DIGITAL MANUFACTURING**

**Course Objectives:**
The Student will

1. Understand the need of digital fabrication
2. Understand about Two dimensional layer by layer techniques
3. Know about extrusion based systems, post processing and the software issues involved in digital fabrication
4. Know the applications of digital fabrication

**UNIT-I :**

**INTRODUCTION TO ADDITIVE MANUFACTURING**: Introduction to AM, AM evolution, Classification of Additive Manufacturing, Distinction between AM & CNC Machining, Advantages of AM

**UNIT-II :**

**TWO- DIMENSIONAL LAYER- BY LAYER TECHNIQUES:** Stereo-lithography (SL), Solid Foil Polymerization (SFP), Selective Laser Sintering (SLS), Selective Powder Building (SPB), Ballistic Particle Manufacturing (PM)

**UNIT-III:**

**EXTRUSION BASED SYSTEMS**: Introduction, basic principles, Fused Deposition Modeling, Materials, and Limitations of FDM

**POST PROCESSING**: Introduction, Support Material Removal, Surface Texture Improvements, Accuracy Improvements, Aesthetic Improvements

**UNIT-IV:**

**SOFTWARE ISSUES FOR ADDITIVE MANUFACTURING**: Introduction, Preparation of CAD Models: The STL file, Problems with STL files, STL file manipulation, Beyond the STL file, Additional software to assist AM

**UNIT-V:**

**AM APPLICATIONS:**

Applications in design, Applications in Engineering Analysis and Planning

**Medical Applications:** Customized Implants and Prosthesis, Aerospace applications and Automotive Applications

**Other Applications**: Jewelry Industry, Coin Industry, Tableware Industry.

**TEXT BOOKS**:


1. Ian Gibson, David W Rosen, Brent Stucker, “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer 2010.
2. Chuaa Chee Kai, Leong Kah Fai, “Rapid Prototyping: Principles & Applications”, World Scientific, 2010.


**REFERENCES:**


1. Ali K.Karmani, EmandAbouel Nasr, “Rapid Prototyping: Theory and Practice”, Springer 2006.
2. Andreas Gebhardt, Understanding Additive Manufacture: Rapid Prototyping, Rapid Tooling and Rapid Manufacture, Hanser Publishers, 2013.
3. Hopkinson, N.Haque, and Dickens Rapid Manufacturing: Advanced Research in Virtual and Rapid Prototyping, Taylor and Francis, 2007.


**Course outcomes:**

The student will be able to:

1. Understand the importance of digital fabrication
2. Identify different techniques involved in two dimensional layering
3. Analyze the software issues involved in digital fabrication and know about extrusion based systems and post processing
4. Apply the knowledge gained in the digital fabrication

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## EMBEDDED SYSTEM DESIGN

(Open Elective-IV)

**COURSE OBJECTIVES:**

The Student will

1. understand the characteristics of embedded systems and application areas.
2. explain the core of embedded system and gain the knowledge of Embedded Software.
3. analyze ARM Cortex processor and its architecture.
4. gain knowledge on software aspects of embedded systems.
5. understand various communication protocols in Embedded Systems.

**UNIT-I**

The concept of embedded systems design, Embedded microcontroller cores, embedded memories. Examples of embedded systems, quality attributes- Design metrics - challenges. Embedded Hardware: Processor embedded into a system- Processor selection- embedded hardware units and devices.

**UNIT-II**

Embedded Software: An overview of programming languages- challenges and issues related to embedded software development.

Co-design-development process: Design cycle - Embedded software development tools- Target Machines - Linker/Locators - Embedded Software on Target system -Issues in co-design.

**UNIT-III**

ARM® Cortex™- M0+ processor: Overview - Architecture - Features- interfaces- configurable options-Modes of operation and Execution and Instruction Set- FRDM KL25Z Architecture - Interfacing of I/O devices with FRDM KL25Z.

**UNIT-IV**

Software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

Technological aspects of embedded systems: Interfacing between analog and digital blocks, signal conditioning, digital signal processing.

**UNIT-V**

Communication protocols: Network Embedded Systems- Serial Bus Protocols- Parallel Bus Device Protocols, Parallel Communication Network Using ISA,PCI, PIC-X and Advanced Buses- Internet Enabled Systems, Network protocols- Wireless and Mobile System Protocols.

**TEXT BOOKS:**

1. Shibu K.V, “Introduction to Embedded Systems”, McGraw Hill.
2.J.W.Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.

**REFERENCE BOOKS:**

1. Raj Kamal, “Embedded Systems”, TMH.
2. Frank Vahid, Tony Givargis, “Embedded System Design”, John Wiley.
3. Lyla, “Embedded Systems”, Pearson, 2013.
4. David E. Simon, “An Embedded Software Primer”, Pearson Education.

**COURSE OUTCOMES:**

The student will be able to

1. define the characteristics of embedded systems, classification and application areas.
2. obtain knowledge on Embedded software and Co-design development.
3. familiarize the working of ARM Cortex processor.
4. develop knowledge on software aspects of embedded systems.
5. employ various communication protocols in Embedded Systems.

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## SOFTWARE DEFINED RADIO

(Open Elective-IV)

**COURSE OBJECTIVES:**

**The Students will:**

1. study fundamentals and state of the art concepts in software defined radio.
2. Understand the concepts of Radio Resource Management.
3. Understand the reconfiguration of the network elements.
4. Remember the object oriented representation of radio and network resources.
5. Study of radio resource management in heterogeneous networks.

**UNIT -I**

**Introduction**: The Need for Software Radios, What is Software Radio, Characteristics and benefits of software radio- Design Principles of Software Radio, RF Implementation issues the Purpose of RF Front – End, Dynamic Range- The Principal Challenge of Receiver Design. RF Receiver Front- End Topologies- Enhanced Flexibility of the RF Chain with Software Radios- Importance of the Components to Overall Performance- Transmitter Architectures and Their Issues- Noise and Distortion in the RF Chain, ADC and DAC Distortion.

**UNIT -II**

**Profile and Radio Resource Management** : Communication Profiles- Introduction, Communication Profiles, Terminal Profile, Service Profile , Network Profile, User Profile, Communication Profile Architecture, Profile Data Structure, XML Structure, Distribution of Profile Data, Access to Profile Data, Management of Communication Profiles, Communication Classmarks, Dynamic Classmarks for Reconfigurable Terminals, Compression and Coding, Meta Profile Data.

**UNIT -III**

**Radio Resource Management in Heterogeneous Networks** : Introduction, Definition of Radio Resource Management, Radio Resource Units over RRM Phases, RRM Challenges and Approaches, RRM Modelling and Investigation Approaches, Investigations of JRRM in Heterogeneous Networks, Measuring Gain in the Upper Bound Due to JRRM, Circuit Switched System, Packet-Switched System, Functions and Principles of JRRM, General Architecture of JRRM, Detailed RRM Functions in Sub-Networks and Overall Systems.

**UNIT -IV**

Reconfiguration of the Network Elements : Introduction, Reconfiguration of Base Stations and Mobile Terminals, Abstract Modelling of Reconfigurable Devices, the Role of Local Intelligence in Reconfiguration, Performance Issues, Classification and Rating of Reconfigurable Hardware, Processing Elements, Connection Elements, Global Interconnect Networks, Hierarchical Interconnect Networks.

Installing a New Configuration, Applying Reconfiguration Strategies, Reconfiguration Based on Comparison, Resource Recycling, Flexible Workload Management at the Physical Layer,

Optimized Reconfiguration, Optimization Parameters and Algorithms, Optimization Algorithms, Specific Reconfiguration Requirements, Reconfiguring Base Stations, Reconfiguring Mobile Terminals.

**UNIT -V**

**Object – Oriented Representation of Radios and Network Resources**: Networks- Object Oriented Programming- Object Brokers- Mobile Application Environments- Joint Tactical Radio System.

Case Studies in Software Radio Design: Introduction and Historical Perspective, SPEAK easy-JTRS, Wireless Information Transfer System, SDR-3000 Digital Transceiver Subsystem, Spectrum Ware, CHARIOT.

**TEXT BOOKS:**

1. Software Defined Radio Architecture System and Functions- Markus Dillinger, Kambiz Madani, WILEY 2003.
2. Software Defined Radio: Enabling Technologies- Walter Tuttle Bee, 2002, Wiley Publications.

**REFERENCE BOOKS:**

1. Software Radio: A Modern Approach to Radio Engineering - Jeffrey H. Reed, 2002, PEA Publication.
2. Software Defined Radio for 3G - Paul Burns, 2002, Artech House.
3. Software Defined Radio: Architectures, Systems and Functions - Markus Dillinger,Kambiz. Madani, Nancy Alonistioti, 2003, Wiley.
4. Software Radio Architecture: Object Oriented Approaches to wireless System Engineering–Joseph Mitola, III, 2000, John Wiley & Sons.

**COURSE OUTCOMES:**

The students will be able to:

1. illustrate the design principles of software defined radio.
2. analyze the analog RF components as front end block in implementation of SDR.
3. visualize digital hardware architectures and development methods.
4. familiarize the radio recourse management in heterogeneous networks.
5. remember the object oriented representation of radio and network resources.

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**E-COMMERCE**

**(**Open Electives-IV**)**

**Course objectives:**

**The Students will :**

1. Gain knowledge about the main objective and at the same time need is transaction on your web store. Of, course if you are selling products online what you require are customers. If you are getting good reach ability then your business will definitely grow. Therefore one of the objectives is high reachability.
2. Solve conversions i.e., if people are coming on your web store and purchasing something then it will calculate as conversions and from the number of people who are buying stuff from your web store we can calculate the conversion rate.
3. Provide customer satisfaction i.e., customer is the main part of any e-commerce business so it's very important to make your customer happy and satisfied by providing quality and desirable products, on time delivery, 24*7 customer support, and timely sale & best deal offers you can make your customer happy. It is one of the main objectives of e-commerce.
4. Receive social popularity i.e., unless and until you are not famous and popular among people you cannot establish your brand. Social presence with omni channel and digital marketing is essential for any e-commerce business.
5. Understand the infrastructure for E-Commerce.

**UNIT-I:**

Introduction, Electronic Commerce Framework, The Anatomy of E-Commerce applications, E-Commerce Business Models.

E-Commerce Consumer applications, E-Commerce organization applications.

**UNIT-II:**

Consumer Oriented Applications, mercantile process models, mercantile models from the consumer's perspective, Mercantile from the merchant's perspective.

Types of Electronic Payment Systems, Digital Token-Based Electronic Payment Systems, Smart Cards & Electronic Payment Systems, Credit Card- Based Electronic Payment Systems, Risk & Electronic Payment Systems, Designing Electronic Payment Systems.

**UNIT-III:**

Electronic Data Interchange, EDI Applications in Business, EDI implementation, MIME, and value added networks.

Intra organizational E-Commerce, Macro forces and Internal Commerce, Work flow automation and Coordination, Customization and Internal Commerce, Supply Chain Management(SCM).

**UNIT-IV:**

Making a business case for a Document Library: Digital document types, Corporate Data warehouses.

Advertising and Marketing: The new age of Information Based Marketing, advertising on Internet, charting the Online marketing process, Market Research.

**UNIT-V:**

Consumer Search and Resource Discovery, information search and Retrieval, Electronic commerce catalogs or directories, Information Filtering.

Multimedia and Digital video, Key Multimedia concepts, Digital Video & Electronic Commerce, Desktop Video Processing, Desktop Video Conferencing.

**Text Books**

1. "Frontiers of electronic commerce" – Kalakota, Whinston, Pearson
2. "E-Commerce", S.Jaiswal – Galgotia

**References**

1. Ravi Kalakota, Andrew Winston, "Frontiers of Electronic Commerce", Addison-Wesley.
2. Goel, Ritendra "E-commerce", New Age International
3. Laudon, "E-Commerce: Business, Technology, Society", Pearson Education

**Course outcomes:**

**The Students will be able to:**

1. Demonstrate an understanding of the foundations and importance of e-commerce.
2. Demonstrate an understanding of retailing in e-commerce by:
    a. Analyzing branding and pricing strategies,
    b. Using and determining the effectiveness of market research.
    c. Assessing the effects of disintermediation.
3. Analyze the impact of e-commerce on business models and strategy.
4. Describe internet trading relationships including business-to-business, intra-organizational.
5. Describe the infrastructure for E-Commerce.

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**BIG DATA ANALYTICS**

(Open Elective-IV)

**Course objectives:**

**The Students will :**

1. Understand the basics of Big Data and Big data Platform
2. Attain the knowledge of Big Data analytics, Approaches and Tools
3. Describe MapReduce fundamentals and HDFC File system
4. Differentiate between Hadoop and RDBMS concepts
5. Apply analytics on Structured and Unstructured Data.

**UNIT-I**

**Big Data Analytics** : What is big data, History of Data Management ; Structuring Big Data ; Elements of Big Data ; Big Data Analytics; Distributed and Parallel Computing for Big Data;

**Big Data Analytics**:What is Big Data Analytics, What Big Data Analytics Isn't, Why this sudden Hype Around Big Data Analytics, Classification of Analytics, Greatest Challenges that Prevent Business from Capitalizing Big Data; Top Challenges Facing Big Data; Why Big Data Analytics Important; Data Science; Data Scientist; Terminologies used in Big Data Environments; Basically Available Soft State Eventual Consistency (BASE); Open source Analytics Tools

**UNIT-II:**

**Understanding Analytics and Big Data**: Comparing Reporting and Analysis, Types of Analytics; Points to Consider during Analysis; Developing an Analytic Team; Understanding Text Analytics;

**Analytical Approach and Tools to Analyze Data**: Analytical Approaches; History of Analytical Tools; Introducing Popular Analytical Tools; Comparing Various Analytical Tools.

**UNIT-III:**

**Understanding MapReduce Fundamentals and HBase** : The MapReduce Framework; Techniques to Optimize MapReduce Jobs; Uses of MapReduce; Role of HBase in Big Data Processing; Storing Data in Hadoop

**Introduction of HDFS**: Architecture, HDFC Files, File system types, commands, org.apache.hadoop.io package, HDF, HDFS High Availability; Introducing HBase, Architecture, Storing Big Data with HBase , Interacting with the Hadoop Ecosystem; HBase in Operations-Programming with HBase; Installation, Combining HBase and HDFS

**UNIT-IV:**

**Big Data Technology Landscape and Hadoop** : NoSQL, Hadoop; RDBMS versus Hadoop; Distributed Computing Challenges; History of Hadoop; Hadoop Overview; Use Case of Hadoop; Hadoop Distributors;

**HDFC (Hadoop Distributed File System):** HDFC Daemons, read,write, Replica Processing of Data with Hadoop; Managing Resources and Applications with Hadoop YARN

**UNIT-V:**

**Social Media Analytics and Text Mining**: Introducing Social Media; Key elements of Social Media; Text mining; Understanding Text Mining Process; Sentiment Analysis, Performing Social Media Analytics and Opinion Mining on Tweets;
**Mobile Analytics**: Introducing Mobile Analytics; Define Mobile Analytics; Mobile Analytics and Web Analytics; Types of Results from Mobile Analytics; Types of Applications for Mobile Analytics; Introducing Mobile Analytics Tools

**TEXT BOOKS:**


1. BIG DATA and ANALYTICS, Seema Acharya, Subhasinin Chellappan, Wiley publications.
2. BIG DATA, Black Book™ , DreamTech Press, 2015 Edition.
3. BUSINESS ANALYTICS 5e , BY Albright |Winston


**REFERENCE BOOKS:**


1. Rajiv Sabherwal, Irma Becerra- Fernandez," Business Intelligence –Practice, Technologies and Management", John Wiley 2011.
2. Lariss T. Moss,ShakuAtre, " Business Intelligence Roadmap", Addison-Wesley It Service.
3. Yuli Vasiliev, " Oracle Business Intelligence : The Condensed Guide to Analysis and Reporting", SPD Shroff, 2012


**Course Outcomes:**
**The Students will be able to:**

1. Know the basics of Big Data and its environment
2. Achieve the knowledge of Big Data analytics Tools and its Approaches
3. Define MapReduce fundamentals and HDFC Architecture
4. Distinguish between Hadoop and RDBMS concepts
5. Illustrate analytics on Structured and Unstructured Data.

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**COMPUTER FORENSICS**
**(Open Elective-IV)**

**Course objectives:**

The Students will :

1. Understand Computer forensics fundamentals.
2. Analyze various computer forensics technologies.
3. Know the principles of effective digital forensics investigation techniques.
4. Identify methods for data recovery.
5. Understand the methods for preservation of digital evidence.

**UNIT I**

Computer Forensics Fundamentals: What is Computer Forensics? Use of Computer Forensics in Law Enforcement, 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: Types of Military Computer Forensics Technology, Types of Law Enforcement - Computer Forensic Technology - Types of Business Computer Forensics Technology. Computer Forensics Evidence and Capture: Data Recovery Defined- Data Back-up and Recovery- The Role of Back-up in Data Recovery- The Data Recovery Solution.

**UNIT II**

Evidence Collection and Data Seizure: Why Collection 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.

Duplication and preservation of Digital Evidence: Preserving the Digital Crime Scene – Computer Evidence Processing Steps – Legal Aspects of Collecting Preserving Computer Forensics Evidence. Computer Image Verification and Authentication: Special Needs of Evidential Authentication – Practical Consideration – Practical Implementation.

**UNIT III**

Computer Forensics analysis and validation: Determining what data to collect and analyze, validating forensic data, addressing data – hiding techniques, performing remote acquisitions.

Network Forensics: Network Forensics overview, performing live acquisitions, developing standard procedures for network forensics, using network tools, examining the honey net project.

**UNIT IV**

Processing crime and incident scenes: Identifying digital evidence, collecting evidence in private-sector incident scenes, processing law enforcement crime scenes, preparing for a

search, securing a computer incident or crime scene, seizing digital evidence at the scene, storing digital evidence, obtaining a digital hash, reviewing a case.
Current computer forensic tools: evaluating computer forensic tool needs, computer forensics software tools, computer forensics hardware tools, validating and testing forensics software.

**UNIT V**

E-Mail investigations: Exploring the role of E-mail in investigation, exploring the role of the client and server in E-mail, investigating e-mail crimes and violations, understanding e-mail servers, using specialized e-mail forensic tools.
Cell phone and mobile device forensics: Understanding mobile device forensics, understanding acquisition procedures for cell phones and mobile devices.
Working with windows and DOS Systems: Understanding file systems, exploring Microsoft File Structures, Examining NTFS Disks, Understanding whole disk encryption, windows registry, Microsoft startup tasks, MS-DOS Startup tasks, virtual machines.

**TEXT BOOKS**

1. Computer forensics, computer crime investigation by John R.Vacca, Firewall Media, New Delhi.
2. Computer forensics and investigations by Nelson, Phillips Enfinger Steuart, CENGAGE Learning.

**REFERENCE BOOKS**

1. Real Digital Forensics by Keith J.Jones, Rechard Bejtlich, Curtis W.Rose, Addison-Wesley Pearson Education.
2. Forensic compiling, A Tractitioneris Guide By Tony Sammes and Brain Jenkinson, Springer International Edition.
3. Computer Evidence Collection & Presentation by Christopher L.T.Brown, Firewall Media.

**Course Outcomes:**

The Students will be able to:

1. Utilize a systematic approach to computer investigations, various forensic tools, and collect digital evidence.
2. Perform digital forensics analysis upon Windows, MAC and LINUX operating systems, email investigations.
3. Analyze and carve image files both logical and physical
4. Explain guidelines for investigation reporting.
5. Apply the implications of anti-forensics to the digital forensics investigator

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**E-DISASTER MANAGEMENT**
**(Open Elective-IV)**

**Course Objectives**

The Students will :

1. Explain various disasters and their impacts.
2. Describe storage networking technologies such as FC-SAN, NAS, IP-SAN and data archival solution – CAS.
3. Identify different storage virtualization technologies and their benefits.
4. Understand and articulate business continuity solutions including, backup technologies, and local and remote replication.
5. Identify parameters of managing and monitoring storage infrastructure and describe common storage management activities and solutions.

**UNIT - I:**

Introduction to Disasters: Information Availability, Causes of Information Unavailability, Measuring Information Availability.

Consequences of Downtime; Failure Analysis, Single Point of Failure, Fault Tolerance, Multipathing Software.

**UNIT II:**

Backup and Recovery: Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations.

Backup Methods, Backup Process, Backup and Restore Operations, Backup Topologies, Backup in NAS Environments, Backup Technologies.

**UNIT - III:**

Local Replication: Source and Target, Uses of Local Replica, Data Consistency, Local Replication Technologies, Restore and Restart Considerations Creating Multiple Replicas, Management Interface.

Remote Replication: Modes of Remote Replication, Remote Replication Technologies Network Infrastructure.

**UNIT - IV:**

Securing the Storage Infrastructure: Storage Security Framework, Risk Triad, Assets, Threats, Vulnerability. Storage Security Domains, Securing the Application Access Domain. Securing the Management Access Domain, Securing Backup, Recovery, and Archive (BURA) , Security Implementations in Storage Networking SAN , NAS, IP SAN.

**UNIT - V:**

Monitoring the Storage Infrastructure: Parameters Monitored, Components Monitored , Monitoring Examples , Alerts, Storage Management Activities , Availability management , Capacity management , Performance management ,Security Management.

Reporting, Storage Management Examples, Storage Infrastructure Management Challenges, Developing an Ideal Solution, Storage Management Initiative, Enterprise Management Platforms.

**Text Books:**

1. Information Storage and Management: Storing, Managing, and Protecting Digital Information, Ganesh Rajaratnam,EMC Education Services. Wiley Publications.
2. Executive Guide to Preventing Information Technology Disasters By Richard Ennals. Springer.

**Reference Books:**

1. Information Management & Computer Security, Port Elizabeth Technikon, Port Elizabeth, MCB UP Ltd.
2. Information Security Management Systems, Godesberger Allee, BSI.

**Course Outcomes**

The Students will be able to:

1. Apply important storage technologies and their features such as availability, replication, scalability and performance.
2. Show employs project teams to install, administer and upgrade popular storage solutions.
3. Illustrate virtual servers and storage between remote locations.
4. Use the knowledge of Disaster Management Phases.
5. Implement the parameters of managing and monitoring storage infrastructure and describe common storage management activities and solutions.

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**INTRODUCTION TO NEURAL NETWORKS**
**Open Elective - IV**

**Course Objectives:**
**The Students will learn:**

1. Understand the differences and similarities neural network, human brain and feedback systems
2. Learn the different learning techniques
3. Familiar with the concept of single layer perceptron and its algorithms.
4. Familiar with the concept of multilayer perceptron and its algorithms
5. Know the self-organisation mapping techniques.

**UNIT–I:**
Introduction: What is a neural network? Human Brain, Models of a Neuron, Neural networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks.

**UNIT–II:**
Learning Process: Error Correction learning, Memory based learning, Hebbian learning, Competitive, Boltzmann learning, Credit Assignment Problem, Memory, Adaption, Statistical nature of the learning process.

**UNIT–III:**
Single layer perceptron's: Adaptive filtering problem, Unconstrained Organization Techniques, Linear least square filters, least mean square algorithm, learning curves, Learning rate annealing techniques, perception-convergence theorem, Relation between perception and Bayes classifier foe a Gaussian Environment.

**UNIT–IV:**
Multilayer Perceptron's: Back propagation algorithm XOR problem, Heuristics, Output representation and decision rule, computer experiment, feature detection.

**UNIT-V:**
Self –Organization Maps: Two basic feature mapping models, Self-Organization maps, SOM algorithm.

Hopfield models: Hopfield models, computer experiment.

**Text Books:**

1. Neural networks A comprehensive foundation, Simon Hhaykin, PHI edition.
2. Artificial neural networks-B.Vegnanarayana Prentice Halll of India P Ltd 2005.

**References:**

1. Neural networks in Computer intelligence, Li Min Fu TMH 2003.
2. Neural networks James A Freeman David M S kapurapearson education 2004.

**Course Outcomes:**

**The Students will be able to:**

1. Know differences and similarities between neural network, human brain and feedback systems
2. Get the knowledge of different learning techniques
3. Describe the concept of single layer perceptron and its algorithms.
4. Describe the concept of multilayer perceptron and its algorithms.
5. Analyse the self-organisation mapping techniques.

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**INTRODUCTION TO MINE ENVIRONMENT**

**(OPEN ELECTIVE IV)**

**COURSE OBJECTIVES:**

**The Students will:**

1. introduce about atmospheric, mine air & their limitations
2. acquaint with spontaneous heating and explosions in coal mines
3. get idea about sources of dust, and its control in mines
4. get idea about miners' diseases & lighting in mines
5. know about reclamation of mines, impact of mining on environment & sustainable mining

**UNIT-I:**

Atmosphere and mine air composition. Origin of gases, properties, limitations of gases in underground mines

**UNIT-II:**

Spontaneous Combustion: Factors, control measures.

Explosions: Causes of firedamp explosion, preventive measures against firedamp explosion.

**UNIT-III:**

Dust: Sources in underground and opencast mines, standards and control measures.

**UNIT-IV:**

Miners diseases, Lighting standards in underground and opencast mines**.**

**UNIT-V:**

Reclamation, plantation of surface mines, Impact of mining on environment & sustainable mining.

**TEXTBOOKS**:

1. Elements of Mining Technology (VOL-2) – by D.J. Deshmukh.
2. Surface Mining – by S.K. Das.

**REFERENCE BOOKS:**

1. Mine Ventilation – by G.B. Mishra.

**COURSE OUTCOMES:**

The student will be able to:

1. Learn about atmospheric and mine air
2. Learn about spontaneous combustion and explosion in coal mines
3. Understand about dust sources and its control in mines
4. Learn about miners' diseases, mine lighting and its standards
5. Learn about reclamation of mines, impacts of mining on environment and sustainable mining