JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

*(Established by State Act No. 30 of 2008)*

Kukatpally, Hyderabad, Telangana (India).

# ACADEMIC REGULATIONS FOR B.TECH. REGULAR STUDENTS WITH EFFECT FROM ACADEMIC YEAR 2016-17 (R-16)

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

**1.1** JNTUH offers a 4-year (8 semesters) **Bachelor of Technology** (B.Tech.) degree programme, under Choice Based Credit System (CBCS) at its non-autonomous constituent and affiliated colleges with effect from the academic year 2016-17 in the following branches of Engineering:

| Branch |
|---|
| Civil Engineering |
| Electrical and Electronics Engineering |
| Mechanical Engineering |
| Electronics and Communication Engineering |
| Computer Science and Engineering |
| Chemical Engineering |
| Electronics and Instrumentation Engineering |
| Bio-Medical Engineering |
| Information Technology |
| Mechanical Engineering (Mechatronics) |
| Electronics and Telematics Engineering |
| Metallurgy and Material Technology |
| Electronics and Computer Engineering |
| Mechanical Engineering (Production) |
| Aeronautical Engineering |
| Instrumentation and Control Engineering |
| Biotechnology |
| Automobile Engineering |
| Mining Engineering |
| Petroleum Engineering |
| Civil and Environmental Engineering |
| Mechanical Engineering (Nano Technology) |
| Computer Science & Technology |
| Pharmaceutical Engineering |

**2.0 Eligibility for admission**

**2.1** Admission to the under graduate programme shall be 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 the University 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 E&T will be **English** only.

**3.0 B.Tech. Programme structure**

**3.1** A student after securing admission shall pursue the under graduate programme in B.Tech. 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, failing which student shall forfeit seat in B.Tech course.

Each semester is structured to provide 24 credits, totaling to 192 credits for the entire B.Tech. programme.

Each student shall secure 192 credits (with CGPA $\geq$ 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 under graduate programme is of 4 academic years (8 semesters) with the academic year being divided into two semesters of 22 weeks ($\geq$ 90 instructional days) each, each semester having - 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)'. Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) 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 shall be 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.
- One credit for two hours/ week/ semester for laboratory/ practical (P) courses or Tutorials (T).

Courses like Environmental Science, Professional Ethics, Gender Sensitization lab and other student activities like NCC/NSO and NSS are identified as 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 university 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 - Engineering 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 | Elective Courses (EℓC) | PE – Professional Electives | Includes elective subjects related to the parent discipline/ department/ branch of Engineering. |
| 6 | | OE – Open Electives | Elective subjects which include inter-disciplinary subjects or subjects in an area outside the parent discipline/ department/ branch of Engineering. |
| 7 | Core Courses | Project Work | B.Tech. project or UG project or UG major project |
| 8 | | Industrial training/ Mini- project | Industrial training/ Internship/ UG Mini-project/ Mini-project |
| 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’ shall be assigned to a group of 15 students, who will advise student 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** The academic section of the college invites 'registration forms' from students before the beginning of the semester through 'on-line registration', ensuring 'date and time stamping'. The on-line registration requests for any 'current semester' shall be **completed before the commencement of SEEs (Semester End Examinations) of the 'preceding semester'**.

**4.3** A student can apply for **on-line** registration, **only after** obtaining the '**written approval**' from faculty advisor/counselor, which should be submitted to the college academic section through the Head of the Department. A copy of it shall be retained with Head of the Department, faculty advisor/ counselor and the student.

**4.4** A student may be permitted to register for the subjects/ courses of **choice** with a total of 24 credits per semester (minimum of 20 credits and maximum of 28 credits per semester and permitted deviation of ± 17%), based on **progress** and SGPA/ CGPA, and completion of the '**pre-requisites'** as indicated for various subjects/ courses, in the department course structure and syllabus contents. However, a **minimum** of 20 credits per semester must be registered to ensure the '**studentship**' in any semester.

**4.5** Choice for '**additional subjects/ courses**' to reach the maximum permissible limit of 28 credits (above the typical 24 credit norm) must be clearly indicated, which needs the specific approval and signature of the faculty advisor/ counselor.

**4.6** If the student submits ambiguous choices or multiple options or erroneous entries during **on-line** registration for the subject(s) / course(s) under a given/ specified course group/ category as listed in the course structure, only the first mentioned subject/ course in that category will be taken into consideration.

**4.7** Subject/ course options exercised through **on-line** registration are final and **cannot** be changed or inter-changed; further, alternate choices also will not be considered. However, if the subject/ course that has already been listed for registration by the Head of the Department in a semester could not be offered due to any unforeseen or unexpected reasons, then the student shall be allowed to have alternate choice either for a new subject (subject to offering of such a subject), or for another existing subject (subject to availability of seats). Such alternate arrangements will be made by the head of the department, with due notification and time-framed schedule, within the **first week** after the commencement of class-work for that semester.

**4.8** Dropping of subjects/ courses may be permitted, only after obtaining prior approval from the faculty advisor/ counselor (subject to retaining a minimum of 20 credits), '**within a period of 15 days**' from the beginning of the current semester.

**4.9** **Open electives**: The students have to choose one open elective (OE-I) during III year I semester, one (OE-II) during III year II semester, and one (OE-III) in IV year II semester, from the list of open electives given. However, the student cannot opt for an open elective subject offered by their own (parent) department, if it is already listed under any category of the subjects offered by parent department in any semester.

**4.10** **Professional electives**: students have to choose professional elective (PE-I) in III year II semester, Professional electives II, III, and IV (PE-II, III and IV) in IV year I semester, Professional electives V, and VI (PE-V and VI) in IV year II semester, from the list of professional electives given. However, the students may opt for professional elective subjects offered in the related area.

**5.0 Subjects/ courses to be offered**

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

**5.2** A subject/ course may be offered to the students, **only if** a minimum of 20 students (1/3 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 with the corresponding theory subject in the same semester) in any semester. However, selection of choice for students will be based on - '**first come first serve** basis and CGPA criterion' (i.e. the first focus shall be 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 picture, then the Head of Department concerned shall decide, whether or not to offer such a subject/ course for **two (or multiple) sections**.

**5.5** In case of options coming from students of other departments/ branches/ disciplines (not considering **open electives**), first **priority** shall be given to the student of the '**parent department**'.

**6.0 Attendance requirements:**

**6.1** A student shall be eligible to appear for the semester end examinations, if student acquires a minimum of 75% of attendance in aggregate of all the subjects/ courses (excluding attendance in mandatory courses Environmental Science, Professional Ethics, Gender Sensitization Lab, NCC/NSO and NSS) for that semester.

**6.2** Shortage of attendance in aggregate up to 10% (65% and above, and below 75%) in each semester may be condoned by the college academic committee on genuine and valid grounds, based on the student's representation with supporting evidence.

**6.3** A stipulated fee shall be payable towards condoning of shortage of attendance.

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

**6.5** **Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examinations of that semester. They get detained and their registration for that semester shall stand cancelled. They will not be promoted to the next semester.** They may seek re-registration for all those subjects registered in that semester in which student was detained, by seeking re-admission into that semester as and when offered; in case if there are any professional electives and/ or open electives, the same may also be re-registered if offered. However, if those electives are not offered in later semesters, then alternate electives may be chosen from the **same** set of elective subjects offered under that category.

**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 shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course, if student secures not less than 35% marks (26 out of 75 marks) in the semester end examination, and a minimum of 40% of marks in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together; in terms of letter grades, this implies securing **'C'** grade or above in that subject/ course.

**7.2** A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to UG Mini Project and seminar, if student secures not less than 40% marks (i.e. 40 out of 100 allotted marks) in each of them. The student would be treated as failed, if student (i) does not submit a report on UG Mini Project, or does not make a presentation of the same before the evaluation committee as per schedule, or (ii) does not present the seminar as required in the IV year I Semester, or (iii) secures less than 40% marks in industry UG Mini Project / seminar evaluations.

Student may reappear once for each of the above evaluations, when they are scheduled again; if student fails in such 'one reappearance' evaluation also, student has to reappear for the same in the next subsequent semester, as and when it is scheduled.

### 7.3 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 24 credits out of 48 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** | **(i) Regular course of study of second** |

| | | |
|---|---|---|
| | **to third year first semester** | **year second semester.**<br>**(ii) Must have secured at least 58 credits out of 96 credits i.e., 60% 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 86 credits out of 144 credits i.e., 60% 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.** |

**7.4** A student shall register for all subjects covering 192 credits as specified and listed in the course structure, fulfills all the attendance and academic requirements for 192 credits, 'earn all 192 credits by securing SGPA ≥ 5.0 (in each semester), and CGPA (at the end of each successive semester) ≥ 5.0, to successfully complete the under graduate programme.

**7.5** After securing the necessary 192 credits as specified for the successful completion of the entire under graduate programme, the student can avail exemption of two subjects up to 6 credits, that is, one open elective and one professional elective subject or two professional elective subjects for optional drop out from these 192 credits earned; resulting in 186 credits for under graduate programme performance evaluation, i.e., the performance of the student in these 186 credits shall alone be taken into account for the calculation of 'the final CGPA (at the end of under graduate programme, which takes the SGPA of the IV year II semester into account)' , and shall be indicated in the grade card of IV year II semester. However, the performance of student in the earlier individual semesters, with the corresponding SGPA and CGPA for which grade cards have already been given will not be altered.

**7.6** If a student registers for some more '**extra subjects'** (in the parent department or other departments/branches of engg.) other than those listed subjects totaling to 192 credits as specified in the course structure of his department, the performances in those '**extra subjects**' (although evaluated and graded using the same procedure as that of the required 192 credits) will not be taken into account while calculating the SGPA and CGPA. For such **'extra subjects'** registered, % of marks and letter grade alone will be indicated in the grade card as a performance measure, subject to completion of the attendance and academic requirements as stated in regulations 6 and 7.1 – 7.5 above.

**7.7** A student eligible to appear in the end semester 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.

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

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

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

**8.1** The performance of a student in every subject/course (including practicals and UG major project) will be evaluated for 100 marks each, with 25 marks allotted for CIE (Continuous Internal Evaluation) and 75 marks for SEE (Semester End-Examination).

**8.2** For theory subjects, during a semester, there shall be two mid-term examinations. Each mid-term examination consists of one objective paper, one descriptive paper and one assignment. The objective paper and the descriptive paper shall be for 10 marks each with a total duration of 1 hour 20 minutes (20 minutes for objective and 60 minutes for descriptive paper). The objective paper is set with 20 bits of multiple choice, fill-in the blanks and matching type of questions for a total of 10 marks. The descriptive paper shall contain 4 full questions out of which, the student has to answer 2 questions, each carrying 5 marks. While the first mid-term examination shall be conducted on 50% of the syllabus, the second mid-term examination shall be conducted on the remaining 50% of the syllabus. Five marks are allocated for assignments (as specified by the subject teacher concerned). The first assignment should be submitted before the conduct of the first mid-examination, and the second assignment should be submitted before the conduct of the second mid-examination. The total marks secured by the student in each mid-term examination are evaluated for 25 marks, and the average of the two mid-term examinations shall be taken as the final marks secured by each student in internals/sessionals. If any student is absent from any subject of a mid-term examination, an on-line test will be conducted for him by the university. The details of the question paper pattern are as follows,

- The end semester examinations will be conducted for 75 marks consisting of two parts viz. i) **Part- A** for 25 marks, ii) **Part - B** for 50 marks.
- Part-A is compulsory question which consists of ten sub-questions. The first five sub-questions are from each unit and carry 2 marks 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.

**8.3** For practical subjects there shall be a continuous internal evaluation during the semester for 25 sessional marks and 75 semester end examination marks. Out of the 25 marks for internal evaluation, day-to-day work in the laboratory shall be evaluated for 15 marks and internal practical examination shall be evaluated for 10 marks conducted by the laboratory teacher concerned. The semester end examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed from the clusters of colleges which are decided by the examination branch of the university.

**8.4** For the subject having design and/or drawing, (such as engineering graphics, engineering drawing, machine drawing) and estimation, the distribution shall be 25 marks for continuous internal evaluation (15 marks for day-to-day work and 10 marks for internal tests) and 75 marks for semester end examination. There shall be two internal tests in a semester and the average of the two shall be considered for the award of marks for internal tests.

**8.5** There shall be an UG mini-project, in collaboration with an industry of their specialization. Students will register for this immediately after III year II semester examinations and pursue it during summer vacation. The UG mini-project shall be submitted in a report form and presented before the committee in IV year I semester. It shall be evaluated for 100 marks. The committee consists of an external examiner, Head of the Department, supervisor of the UG mini-project and a senior faculty member of the department. There shall be no internal marks for UG mini-project.

**8.6** There shall be a seminar presentation in IV year I 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 shall be evaluated by the departmental committee consisting of Head of the Department, seminar supervisor and a senior faculty member. The seminar report shall be evaluated for 100 marks. There shall be no semester end examination for the seminar.

**8.7** Out of a total of 100 marks for the UG major Project, 25 marks shall be allotted for internal evaluation and 75 marks for the end semester examination (viva voce). The end semester examination of the UG major Project shall be conducted by the same committee as appointed for the UG mini-project. In addition, the UG major Project supervisor shall also be included in the committee. The topics for UG mini project, seminar and UG major Project shall be different from one another. The evaluation of UG major Project shall be made at the end of IV year II semester. The internal evaluation shall be on the basis of two seminars given by each student on the topic of UG major Project.

**8.8** The laboratory marks and the sessional marks awarded by the college are subject to scrutiny and scaling by the university wherever necessary. In such cases, the sessional and laboratory marks awarded by the college will be referred to a committee. The committee will arrive at a scaling factor and the marks will be scaled accordingly. The recommendations of the committee are final and binding. The laboratory records and internal test papers shall be preserved in the respective institutions as per the university rules and produced before the committees of the university as and when asked for.

**8.9** For mandatory courses Environmental Science, Professional Ethics 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.

**8.10** For mandatory courses NCC/ NSO and NSS, a 'satisfactory participation certificate' shall be issued to the student from the authorities concerned, only after securing ≥ 65% attendance in such a course.

**8.11** No marks or letter grade shall be allotted for all mandatory/non-credit courses.

## 9.0 Grading procedure

**9.1** Marks will be awarded to indicate the performance of student in each theory subject, labaratory / practicals, seminar, UG mini project, UG major project. 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 shall be given.

**9.2** As a measure of the performance of student, a 10-point absolute grading system using the following letter grades (as per UGC/AICTE guidelines) and corresponding percentage of marks shall be 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 obtaining '**F'** grade in any subject shall be 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** A student who has not appeared for examination in any subject, '**Ab'** grade will be allocated in that subject, and student shall be considered '**failed'**. Student will be required to reappear as a 'supplementary student' in the semester end examination, as and when offered.

**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** The 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 (ΣCP) 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

$$\text{SGPA} = \{ \sum_{i=1}^{N} C_i \; G_i \} \,/\, \{ \sum_{i=1}^{N} C_i \} \text{ …. For each semester},$$

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

$$\textbf{CGPA} = \{ \textstyle\sum_{j=1}^{M} C_j\ G_j \} / \{ \textstyle\sum_{j=1}^{M} C_j \} \ \ldots \textbf{ for all S semesters registered}$$

**(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 1st semester onwards up to and inclusive of the 8th 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 jth subject, and $G_j$ represents the grade points (GP) corresponding to the letter grade awarded for that jth 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**

**Illustration of calculation of CGPA:**

| **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 = 7.23

| **Semester** | **Credits** | **SGPA** | **Credits x SGPA** |
|---|---|---|---|
| Semester I | 24 | 7 | 24 x 7 = 168 |
| Semester II | 24 | 6 | 24 x 6 = 144 |
| Semester III | 24 | 6.5 | 24 x 6.5 = 156 |
| Semester IV | 24 | 6 | 24 x 6 = 144 |
| Semester V | 24 | 7.5 | 24 x 7.5 = 180 |

| | | | |
|---|---|---|---|
| Semester VI | 24 | 8 | 24 x 8 = 192 |
| Semester VII | 24 | 8.5 | 24 x 8.5 = 204 |
| Semester VIII | 24 | 8 | 24 x 8 = 192 |
| | 192 | | 1380 |

CGPA = 1380/192 = 7.18

**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** For calculations listed in regulations 9.6 to 9.9, performance in failed subjects/ courses (securing **F** grade) will also be taken into account, and the credits of such subjects/ courses will also be included in the multiplications and summations. After passing the failed subject(s) newly secured letter grades will be taken into account for calculation of SGPA and CGPA. However, mandatory courses will not be taken into consideration.

**10.0 Passing standards**

**10.1** A student shall be declared successful or 'passed' in a semester, if student secures a GP ≥ 5 ('C' grade or above) in every subject/course in that semester (i.e. when student gets an SGPA ≥ 5.00 at the end of that particular semester); and a student shall be 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 (or transcript) shall be 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, and grade earned etc.), credits earned, SGPA, and CGPA.

**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 192 credits (with CGPA ≥ 5.0), within 8 academic years from the date of commencement of the first academic year, shall be declared to have '**qualified'** for the award of the B.Tech. degree in the chosen branch of Engineering as selected at the time of admission.

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

**12.3** Students with final CGPA (at the end of the under graduate programme) ≥ 8.00, and fulfilling the following conditions -

(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 end semester examinations in any semester due to shortage of attendance or any other reason, shall be placed in '**first class with distinction'**.

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

**12.5** Students with final CGPA (at the end of the under graduate programme) ≥ 5.50 but < 6.50, shall be 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, shall be 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 '**university rank**' and '**gold medal**'.

**13.0 Withholding of results**

**13.1** If the student has not paid the fees to the university/ 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 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 Transitory regulations**

A. **For students detained due to shortage of attendance**:

1. A Student who has been detained in I year of R09/R13/R15 Regulations due to lack of attendance, shall be permitted to join I year I Semester of R16 Regulations and he is required to complete the study of B.Tech./B. Pharmacy programme within the stipulated period of eight academic years from the date of first admission in I Year.
2. A student who has been detained in any semester of II, III and IV years of R09/R13/R15 regulations for want of attendance, shall be permitted to join the corresponding semester of R16 regulations and is required to complete the study of

B.Tech./B. Pharmacy within the stipulated period of eight academic years from the date of first admission in I Year. The R16 Academic Regulations under which a student has been readmitted shall be applicable to that student from that semester.

See rule (C) for further Transitory Regulations.

B. **For students detained due to shortage of credits**:

3. A student of R09/R13/R15 Regulations who has been detained due to lack of credits, shall be promoted to the next semester of R16 Regulations only after acquiring the required credits as per the corresponding regulations of his/her first admission. The student is required to complete the study of B.Tech./B. Pharmacy within the stipulated period of eight academic years from the year of first admission. The R16 Academic Regulations are applicable to a student from the year of readmission onwards.

See rule (C) for further Transitory Regulations.

C. **For readmitted students in R16 Regulations**:

4. A student who has failed in any subject under any regulation has to pass those subjects in the same regulations.
5. The maximum credits that a student acquires for the award of degree, shall be the sum of the total number of credits secured in all the regulations of his/her study including R16 Regulations. The performance evaluation of the student will be done after the exemption of two subjects if total credits acquired are ≤ 206, three subjects if total credits acquired are > 206 (see R16 Regulations for exemption details).
6. If a student readmitted to R16 Regulations, has any subject with 80% of syllabus common with his/her previous regulations, that particular subject in R16 Regulations will be substituted by another subject to be suggested by the University.

**Note**: If a student readmitted to R16 Regulations, has not studied any subjects/topics in his/her earlier regulations of study which is prerequisite for further subjects in R16 Regulations, the College Principals concerned shall conduct remedial classes to cover those subjects/topics for the benefit of the students.

**15.0 Student transfers**

**15.1** There shall be no branch transfers after the completion of admission process.

**15.2** There shall be no transfers from one college/stream to another within the constituent colleges and units of Jawaharlal Nehru Technological University Hyderabad.

**15.3** The students seeking transfer to colleges affiliated to JNTUH from various other Universities/institutions have to pass the failed subjects which are equivalent to the subjects of JNTUH, and also pass the subjects of JNTUH which the students have not studied at the earlier institution. Further, though the students have passed some of the subjects at the earlier institutions, if the same subjects are prescribed in different semesters of JNTUH, the students have to study those subjects in JNTUH in spite of the fact that those subjects are repeated.

**15.4** The transferred students from other Universities/institutions to JNTUH affiliated colleges who are on rolls to be provide one chance to write the CBT (internal marks) in the **failed subjects and/or subjects not studied** as per the clearance letter issued by the university.

**15.5** The autonomous affiliated colleges have to provide one chance to write the internal examinations in the **failed subjects and/or subjects not studied,** to the students transferred from other universities/institutions to JNTUH autonomous affiliated colleges who are on rolls, as per the clearance (equivalence) letter issued by the University.

**16.0 Scope**

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

**16.2** In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the vice-chancellor is final.

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

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

*(Established by State Act No. 30 of 2008)*

Kukatpally, Hyderabad, Telangana (India).

## Academic Regulations for B.Tech. (Lateral Entry Scheme) from the AY 2017-18

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 144 credits and secure 144 credits with CGPA ≥ 5 from II year to IV year B.Tech. programme (LES) for the award of B.Tech. degree. **Out of the 144 credits secured, the student can avail exemption up to 6 credits**, that is, one open elective subject and one professional elective subject or two professional elective subjects resulting in 138 credits for B.Tech programme performance evaluation.

3. The students, who fail to fulfil the requirement for the award of the degree in six academic years from the year of admission, shall forfeit their seat in B.Tech.

4. The attendance requirements of B. Tech. (Regular) shall be 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 29 credits out of 48 credits i.e., 60% 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 58 credits out of 96 credits i.e., 60% 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

| | Nature of Malpractices/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 student which can be used as an aid in the subject of the examination) | Expulsion from the examination hall and cancellation of the performance in that subject only. |
| (b) | Gives assistance or guidance or receives it from any other 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 that 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 project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. |

| | | |
|---|---|---|
| | | 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 project work) 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 seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him. |
| 4. | Smuggles in the answer book or additional sheet or takes out 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 that subject and all the other subjects the student has already appeared including practical examinations and project work 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 organizes a walk out or instigates | 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 |

| | | |
|---|---|---|
| | 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 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 duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination. | 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. |
| 7. | Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall. | Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and project work 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 the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred and forfeits the seat. |
| 9. | If student of the college, who is not a student for the particular examination or any person not connected with the | Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other |

| | | |
|---|---|---|
| | college indulges in any malpractice or improper conduct mentioned in clause 6 to 8. | subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred and forfeits the 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 the performance in that subject and all other subjects the student has already appeared including practical examinations and project work 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 the performance in that subject and all other subjects the student has appeared including practical examinations and project work of that semester/year examinations. |
| 12. | If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the university for further action to award suitable punishment. | |

**Malpractices identified by squad or special invigilators**

1. Punishments to the students as per the above guidelines.
2. Punishment for institutions : (if the squad reports that the college is also involved in encouraging malpractices)
   a. A show cause notice shall be issued to the college.
   b. Impose a suitable fine on the college.
   c. Shifting the examination centre from the college to another college for a specific period of not less than one year.

* * * * *

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

## B.TECH. I YEAR COURSE STRUCTURE AND SYLLABUS (R16)
(Common for Civil, ME, AE, ME (M), MME, AU, Mining, Petroleum, CEE, ME (Nanotech))

**Applicable From 2017-18 Admitted Batch**

### I YEAR I SEMESTER

| S. No | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | MA101BS | Mathematics-I | 3 | 1 | 0 | 3 |
| 2 | MA102BS | Mathematics-II | 4 | 1 | 0 | 4 |
| 3 | PH103BS | Engineering Physics | 3 | 0 | 0 | 3 |
| 4 | CS104ES | Computer Programming in C | 3 | 0 | 0 | 3 |
| 5 | ME105ES | Engineering Mechanics | 3 | 0 | 0 | 3 |
| 6 | ME106ES | Engineering Graphics | 2 | 0 | 4 | 4 |
| 7 | PH107BS | Engineering Physics Lab | 0 | 0 | 3 | 2 |
| 8 | CS108ES | Computer Programming in C Lab | 0 | 0 | 3 | 2 |
| 9 | *EA109MC | NSS | 0 | 0 | 0 | 0 |
| | | **Total Credits** | **18** | **2** | **10** | **24** |

### I YEAR II SEMESTER

| S. No | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | AP201BS | Applied Physics | 3 | 0 | 0 | 3 |
| 2 | CH202BS | Engineering Chemistry | 4 | 0 | 0 | 4 |
| 3 | MA203BS | Mathematics-III | 4 | 1 | 0 | 4 |
| 4 | EN204HS | Professional Communication in English | 3 | 0 | 0 | 3 |
| 5 | EE205ES | Basic Electrical and Electronics Engineering | 4 | 0 | 0 | 4 |
| 6 | CH206BS | Engineering Chemistry Lab | 0 | 0 | 3 | 2 |
| 7 | EN207HS | English Language Communication Skills Lab | 0 | 0 | 3 | 2 |
| 8 | ME208ES | Engineering Workshop | 0 | 0 | 3 | 2 |
| 9 | *EA209MC | NCC/NSO | 0 | 0 | 0 | 0 |
| | | **Total Credits** | **18** | **1** | **9** | **24** |

***Mandatory Course- Satisfactory/Unsatisfactory**

## JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

## B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANO TECHNOLOGY)
## II, III, IV YEARS COURSE STRUCTURE & SYLLABUS (R16)

**Applicable From 2016-17 Admitted Batch**

### II YEAR I SEMESTER

| S. No | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | MA301BS | Mathematics - IV | 4 | 1 | 0 | 4 |
| 2 | ME305ES | Metallurgy and material science | 4 | 1 | 0 | 4 |
| 3 | ME302ES | Kinematics of machinery | 4 | 1 | 0 | 4 |
| 4 | ME303ES | Mechanics of solids | 3 | 0 | 0 | 3 |
| 5 | ME304ES | Thermodynamics | 3 | 0 | 0 | 3 |
| 6 | ME308ES | Metallurgy and material science Lab | 0 | 0 | 3 | 2 |
| 7 | ME307ES | Mechanics of solids Lab | 0 | 0 | 3 | 2 |
| 8 | EE308ES | Electrical and Electronics Engineering Lab | 0 | 0 | 3 | 2 |
| 9 | *MC300HS | Gender Sensitization lab | 0 | 0 | 3 | 0 |
| | | **Total Credits** | **18** | **3** | **12** | **24** |

### II YEAR II SEMESTER

| S. No | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | NT401ES | Production Technology | 4 | 1 | 0 | 4 |
| 2 | NT402ES | Design of Machine Members-I | 4 | 1 | 0 | 4 |
| 3 | ME401ES | Fluid Mechanics and Hydraulic Machines | 4 | 1 | 0 | 4 |
| 4 | NT403ES | Dynamics of Machines | 3 | 0 | 0 | 3 |
| 5 | SM405MS | Business Economics and Financial Analysis | 3 | 0 | 0 | 3 |
| 6 | NT406ES | Production Technology Lab | 0 | 0 | 3 | 2 |
| 7 | ME407ES | Fluid Mechanics and Hydraulic Machines Lab | 0 | 0 | 3 | 2 |
| 8 | NT408ES | Dynamics of Machines Lab | 0 | 0 | 3 | 2 |
| 9 | *MC400ES | Environmental Science and Technology | 3 | 0 | 0 | 0 |
| | | **Total Credits** | **21** | **3** | **9** | **24** |

**III YEAR I SEMESTER**

| S. No | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | NT501PC | Thermal Engineering | 4 | 1 | 0 | 4 |
| 2 | NT502PC | Machine Tools | 4 | 1 | 0 | 4 |
| 3 | NT503PC | Design of Machine Members -II | 4 | 1 | 0 | 4 |
| 4 | SM504MS | Fundamentals of Management | 3 | 0 | 0 | 3 |
| 5 | | Open Elective – I | 3 | 0 | 0 | 3 |
| 6 | ME505PC | Thermal Engineering Lab | 0 | 0 | 3 | 2 |
| 7 | ME506PC | Machine Tools Lab | 0 | 0 | 3 | 2 |
| 8 | NT507PC | Machine Drawing Lab | 0 | 0 | 3 | 2 |
| 9 | *MC500HS | Professional Ethics | 3 | 0 | 0 | 0 |
| | | **Total Credits** | **21** | **3** | **9** | **24** |

**III YEAR II SEMESTER**

| S. No | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | NT601PC | Engineering Metrology | 4 | 1 | 0 | 4 |
| 2 | NT602PC | Properties of Nano Materials | 4 | 1 | 0 | 4 |
| 3 | NT603PC | Finite Element Methods | 4 | 1 | 0 | 4 |
| 4 | | Open Elective – II | 3 | 0 | 0 | 3 |
| 5 | | Professional Elective - I | 3 | 0 | 0 | 3 |
| 6 | NT604PC | Metrology and Surface Engineering Lab | 0 | 0 | 3 | 2 |
| 7 | NT605PC | Production Drawing Practice Lab | 0 | 0 | 3 | 2 |
| 8 | EN606HS | Advanced English Communication Skills Lab | 0 | 0 | 3 | 2 |
| | | **Total Credits** | **18** | **3** | **9** | **24** |

**During Summer Vacation between III and IV Years: Industry Oriented Mini Project**

**IV YEAR I SEMESTER**

| S. No | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | NT701PC | Synthesis and Characterization of Nano Materials | 4 | 1 | 0 | 4 |
| 2 | AM701PC | Heat Transfer | 4 | 1 | 0 | 4 |
| 3 | | Professional Elective - II | 3 | 0 | 0 | 3 |
| 4 | | Professional Elective - III | 3 | 0 | 0 | 3 |
| 5 | | Professional Elective - IV | 3 | 0 | 0 | 3 |
| 6 | AM703PC | Heat Transfer Lab | 0 | 0 | 3 | 2 |
| 7 | NT704PC | Synthesis and Characterization of Nano | 0 | 0 | 3 | 2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Materials Lab | | | | |
| 8 | NT705PC | Industry Oriented Mini Project | 0 | 0 | 3 | 2 |
| 9 | NT706PC | Seminar | 0 | 0 | 2 | 1 |
| | | **Total Credits** | **17** | **2** | **11** | **24** |

**IV YEAR II SEMESTER**

| S. No | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | - | Open Elective -III | 3 | 0 | 0 | 3 |
| 2 | | Professional Elective - V | 3 | 0 | 0 | 3 |
| 3 | | Professional Elective - VI | 3 | 0 | 0 | 3 |
| 4 | NT801PC | Major Project | 0 | 0 | 30 | 15 |
| | | **Total Credits** | **9** | **0** | **30** | **24** |

**Professional Elective - I**

| | |
|---|---|
| NT611PE | Mechanical Vibrations |
| ME612PE | Refrigeration and Air conditioning |
| NT613PE | Operations Research |
| NT614PE | Maintenance and Safety Engineering |

**Professional Elective - II**

| | |
|---|---|
| NT721PE | Renewable Energy Sources |
| NT722PE | Material Handling Systems |
| NT723PE | Additive Manufacturing |
| NT724PE | CNC Technology |

**Professional Elective - III**

| | |
|---|---|
| NT731PE | CAD/CAM |
| ME732PE | Computational Fluid Dynamics |
| NT733PE | Power Plant Engineering |
| NT734PE | Unconventional Machining Processes |

**Professional Elective - IV**

| | |
|---|---|
| NT741PE | Non-Destructive Testing Techniques |
| NT742PE | Tool Design |
| NT743PE | Robotics |

**Professional Elective - V**

| | |
|---|---|
| ME851PE | Automation in Manufacturing |
| NT852PE | Tribology |
| NT853PE | Automobile Engineering |
| NT854PE | Mechanics of Composite Materials |

**Professional Elective – VI**

| | |
|---|---|
| NT861PE | Carbon Nano Materials and Applications |
| NT862PE | Nano Composites |
| NT863PE | MEMS - NEMS Design and Applications |
| NT864PE | Nano Sensors and Actuators |

***Open Elective** subjects' syllabus is provided in a separate document.

***Open Elective –** Students should take Open Electives from the List of Open Electives Offered by Other Departments/Branches Only.

**Ex: -** A Student of Mechanical Engineering can take Open Electives from all other departments/branches except Open Electives offered by Mechanical Engineering Dept.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**
**LIST OF OPEN ELECTIVES OFFERED BY VARIOUS DEPARTMENTS FOR B.TECH. III AND IV YEARS**

| S. No. | Name of the Department Offering Open Electives | Open Elective – I (Semester – V) | Open Elective – II (Semester – VI) |
|---|---|---|---|
| 1 | Aeronautical Engg. | AE511OE: Introduction to Space Technology | AE621OE: Introduction to Aerospace Engineering |
| 2 | Automobile Engg. | CE511OE: Disaster Management<br>MT512OE: Intellectual Property Rights | MT621OE: Data Structures<br>MT622OE: Artificial Neural Networks |
| 3 | Biomedical Engg. | BM511OE: Reliability Engineering | BM621OE: Medical Electronics |
| 4 | Civil Engg. | CE511OE: Disaster Management. | CE621OE: Remote Sensing and GIS<br>CE622OE: Geo-Informatics<br>CE623OE: Intellectual Property Rights |
| 5 | Civil and Environmental Engg. | CE511OE: Disaster Management | CN621OE: Environmental Impact Assessment<br>CE623OE: Intellectual Property Rights |
| 6 | Computer Science and Engg. / Information Technology | CS511OE: Operating Systems<br>CS512OE: Database Management Systems | CS621OE: Java Programming<br>CS622OE: Software Testing Methodologies<br>CS623OE: Cyber Security |
| 7 | Electronics and Communication Engg. / Electronics and Telematics Engg. | EC511OE: Principles of Electronic Communications | EC621OE: Principles of Computer Communications and Networks |
| 8 | Electronics and Computer Engg. | EM511OE: Scripting Languages | EM621OE: Soft Computing Techniques |
| 9 | Electrical and Electronics Engg. | EE511OE: Non-Conventional Power Generation<br>EE512OE: Electrical Engineering Materials<br>EE513OE: Nanotechnology | EE621OE: Design Estimation and Costing of Electrical Systems<br>EE622OE: Energy Storage Systems<br>EE623OE: Introduction to Mechatronics |
| 10 | Electronics and Instrumentation Engg. | EI511OE: Electronic Measurements and Instrumentation | EI621OE: Industrial Electronics |
| 11 | Mechanical Engg. | ME511OE: Optimization Techniques<br>ME512OE: Computer Graphics<br>ME513OE: Introduction | ME621OE: World Class Manufacturing<br>ME622OE: Fundamentals of Robotics<br>ME623OE: Fabrication |

| | | | |
|---|---|---|---|
| | | to Mechatronics<br>ME514OE: Fundamentals of Mechanical Engineering | Processes |
| 12 | Mechanical Engg. (Material Science and Nanotechnology) | NT511OE: Fabrication Processes<br>NT512OE: Non destructive Testing Methods<br>NT513OE: Fundamentals of Engineering Materials | NT621OE: Introduction to Material Handling<br>NT622OE: Non-Conventional Energy Sources<br>NT623OE: Robotics |
| 13 | Mechanical Engg. (mechatronics) | MT511OE: Analog and Digital I.C. Applications<br>MT512OE: Intellectual Property Rights<br>MT513OE: Computer Organization | MT621OE: Data Structures<br>MT622OE: Artificial Neural Networks<br>MT623OE: Industrial Management |
| 14 | Metallurgical and Materials Engg. | MM511OE: Materials Characterization Techniques | MM621OE: Science and Technology of Nano Materials<br>MM622OE: Metallurgy of Non Metallurgists |
| 15 | Mining Engg. | MN511OE: Introduction to Mining Technology | MN621OE: Coal Gasification, Coal Bed Methane and Shale Gas |
| 16 | Petroleum Engg. | PE511OE: Materials Science and Engineering<br>PE512OE: Renewable Energy Sources<br>PE513OE: Environmental Engineering | PE621OE: Energy Management and Conservation<br>PE622OE: Optimization Techniques<br>PE623OE: Entrepreneurship and Small Business Enterprises |

| S. No. | Name of the Department Offering Open Electives | Open Elective –III (Semester – VIII) |
|---|---|---|
| 1 | Aeronautical Engg. | AE831OE: Air Transportation Systems<br>AE832OE: Rockets and Missiles |
| 2 | Automobile Engg. | AM831OE: Introduction to Mechatronics<br>AM832OE: Microprocessors and Microcontrollers |
| 3 | Biomedical Engg. | BM831OE: Telemetry and Telecontrol<br>BM832OE: Electromagnetic Interference and Compatibility |
| 4 | Civil Engg. | CE831OE: Environmental Impact Assessment<br>CE832OE: Optimization Techniques in Engineering<br>CE833OE: Entrepreneurship and Small Business Enterprises |
| 5 | Civil and Environmental Engg. | CN831OE: Remote Sensing and GIS<br>CE833OE: Entrepreneurship and Small Business |

| | | |
|---|---|---|
| | | Enterprises |
| 6 | Computer Science and Engg. / Information Technology | CS831OE: Linux Programming<br>CS832OE: R Programming<br>CS833OE: PHP Programming |
| 7 | Electronics and Communication Engg. / Electronics and Telematics Engg. | EC831OE: Electronic Measuring Instruments |
| 8 | Electronics and Computer Engg. | EM831OE: Data Analytics |
| 9 | Electrical and Electronics Engg. | EE831OE: Entrepreneur Resource Planning<br>EE832OE: Management Information Systems<br>EE833OE: Organizational Behaviour |
| 10 | Electronics and Instrumentation Engg. | EI831OE: Sensors and Transducers,<br>EI832OE: PC Based Instrumentation |
| 11 | Mechanical Engg. | ME831OE: Total Quality Management<br>ME832OE: Industrial Safety, Health, and Environmental Engineering<br>ME833OE: Basics of Thermodynamics<br>ME834OE: Reliability Engineering |
| 12 | Mechanical Engg. (Material Science and Nanotechnology) | NT831OE: Concepts of Nano Science And Technology<br>NT832OE: Synthesis of Nanomaterials<br>NT833OE: Characterization of Nanomaterials |
| 13 | Mechanical Engg. (mechatronics) | MT831OE: Renewable Energy Sources<br>MT832OE: Production Planning and Control<br>CE833OE: Entrepreneurship and Small Business Enterprises |
| 14 | Metallurgical and Materials Engg. | MM831OE: Design and Selection of Engineering Materials |
| 15 | Mining Engg. | MN831OE: Solid Fuel Technology<br>MN832OE: Health & Safety in Mines |
| 16 | Petroleum Engg. | PE831OE: Disaster Management<br>PE832OE: Fundamentals of Liquefied Natural Gas<br>PE833OE: Health, Safety and Environment in Petroleum Industry |

***Open Elective –** Students should take Open Electives from List of Open Electives Offered by Other Departments/Branches Only.

**Ex: -** A Student of Mechanical Engineering can take Open Electives from all other departments/branches except Open Electives offered by Mechanical Engineering Dept.

# MATHEMATICS - I
## (Linear Algebra and Differential Equations)

| **B.Tech. I Year I Sem.** | **L** | **T/P/D** | **C** |
|---|---|---|---|
| Course Code: **MA101BS** | **3** | **1/0/0** | **3** |

**Prerequisites:** Foundation course (No prerequisites).

**Course Objectives:** To learn

- types of matrices and their properties
- the concept of rank of a matrix and applying the same to understand the consistency
- solving the linear systems
- the concepts of eigen values and eigen vectors and reducing the quadratic forms into their canonical forms
- partial differentiation, concept of total derivative
- finding maxima and minima of functions of two variables
- methods of solving the linear differential equations of first and higher order
- the applications of the differential equations
- formation of the partial differential equations and solving the first order equations.

**Course Outcomes:** After learning the contents of this paper the student must be able to

- write the matrix representation of a set of linear equations and to analyze the solution of the system of equations
- find the Eigen values and Eigen vectors which come across under linear transformations
- find the extreme values of functions of two variables with/ without constraints.
- identify whether the given first order DE is exact or not
- solve higher order DE's and apply them for solving some real world problems

**UNIT–I**

**Initial Value Problems and Applications**

Exact differential equations - Reducible to exact.

Linear differential equations of higher order with constant coefficients: Non homogeneous terms with RHS term of the type $e^{ax}$, sin ax, cos ax, polynomials in x, $e^{ax}$V(x), xV(x)- Operator form of the differential equation, finding particular integral using inverse operator, Wronskian of functions, method of variation of parameters.

Applications: Newton's law of cooling, law of natural growth and decay, orthogonal trajectories, Electrical circuits.

**UNIT–II**

**Linear Systems of Equations**

Types of real matrices and complex matrices, rank, echelon form, normal form, consistency and solution of linear systems (homogeneous and Non-homogeneous) - Gauss elimination, Gauss Jordon and LU decomposition methods- Applications: Finding current in the electrical circuits.

**UNIT–III**

**Eigen values, Eigen Vectors and Quadratic Forms**

Eigen values, Eigen vectors and their properties, Cayley - Hamilton theorem (without proof), Inverse and powers of a matrix using Cayley - Hamilton theorem, Diagonalization, Quadratic forms, Reduction of Quadratic forms into their canonical form, rank and nature of the Quadratic forms – Index and signature.

**UNIT–IV**

**Partial Differentiation**

Introduction of partial differentiation, homogeneous function, Euler's theorem, total derivative, Chain rule, Taylor's and Mclaurin's series expansion of functions of two variables, functional dependence, Jacobian.

Applications: maxima and minima of functions of two variables without constraints and Lagrange's method (with constraints)

**UNIT-V**

**First Order Partial Differential Equations**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions, Lagranges method to solve the first order linear equations and the standard type methods to solve the non linear equations.

**Text Books:**

1. A first course in differential equations with modeling applications by Dennis G. Zill, Cengage Learning publishers.
2. Higher Engineering Mathematics by Dr. B. S. Grewal, Khanna Publishers.

**References:**

1. Advanced Engineering Mathematics by E. Kreyszig, John Wiley and Sons Publisher.
2. Engineering Mathematics by N. P. Bali, Lakshmi Publications.

**MATHEMATICS- II**
**(Advanced Calculus)**

| **B.Tech. I Year I Sem.** | **L** | **T/P/D** | **C** |
|---|---|---|---|
| Course Code: **MA102BS/MA202BS** | **4** | **1/0/0** | **4** |

**Prerequisites:** Foundation course (No prerequisites)**.**

**Course Objectives:** To learn

- concepts & properties of Laplace Transforms
- solving differential equations using Laplace transform techniques
- evaluation of integrals using Beta and Gamma Functions
- evaluation of multiple integrals and applying them to compute the volume and areas of regions
- the physical quantities involved in engineering field related to the vector valued functions.
- the basic properties of vector valued functions and their applications to line, surface and volume integrals.

**Course Outcomes:** After learning the contents of this course the student must be able to

- use Laplace transform techniques for solving DE's
- evaluate integrals using Beta and Gamma functions
- evaluate the multiple integrals and can apply these concepts to find areas, volumes, moment of inertia etc of regions on a plane or in space
- evaluate the line, surface and volume integrals and converting them from one to another

**UNIT–I**

**Laplace Transforms:** Laplace transforms of standard functions, Shifting theorems, derivatives and integrals, properties- Unit step function, Dirac's delta function, Periodic function, Inverse Laplace transforms, Convolution theorem (without proof).
Applications: Solving ordinary differential equations (initial value problems) using Laplace transforms.

**UNIT-II**

**Beta and Gamma Functions:** Beta and Gamma functions, properties, relation between Beta and Gamma functions, evaluation of integrals using Beta and Gamma functions.
Applications: Evaluation of integrals.

**UNIT–III**

**Multiple Integrals:** Double and triple integrals, Change of variables, Change of order of integration.

Applications: Finding areas, volumes& Center of gravity (evaluation using Beta and Gamma functions).

**UNIT–IV**

**Vector Differentiation:** Scalar and vector point functions, Gradient, Divergence, Curl and their physical and geometrical interpretation, Laplacian operator, Vector identities.

**UNIT–V**

**Vector Integration:** Line Integral, Work done, Potential function, area, surface and volume integrals, Vector integral theorems: Greens, Stokes and Gauss divergence theorems (without proof) and related problems.

**Text Books:**

1. Advanced Engineering Mathematics by R K Jain & S R K Iyengar, Narosa Publishers
2. Engineering Mathematics by Srimanthapal and Subodh C. Bhunia, Oxford Publishers

**References:**

1. Advanced Engineering Mathematics by Peter V. O. Neil, Cengage Learning Publishers.
2. Advanced Engineering Mathematics by Lawrence Turyn, CRC Press

## ENGINEERING PHYSICS/ENGINEERING PHYSICS - I

| | |
|---|---|
| **B.Tech. I Year I Sem.** | **L T/P/D C** |
| Course Code: **PH103BS** | **3 0/0/0 3** |

**Course Objectives:**

- To understand interaction of light with matter through interference, diffraction and polarization.
- To able to distinguish ordinary light with a laser light and to realize propagation of light through optical fibers.
- To understand various crystal systems and there structures elaborately.
- To study various crystal imperfections and probing methods like X-RD.

**Course outcomes:** after completion of this course the student is able to

- Realize the importance of light phenomena in thin films and resolution.
- Learn principle, working of various laser systems and light propagation through optical fibers.
- Distinguish various crystal systems and understand atomic packing factor.
- Know the various defects in crystals.

**UNIT-I**

**Interference:** Coherence, division of amplitude and division of wave front, interference in thin films (transmitted and reflected light), Newton's rings experiment.

**Diffraction:** Distinction between Fresnel and Fraunhoffer diffraction, diffraction due to single slit, N-slits, Diffraction grating experiment.

**UNIT-II**

**Polarization:** Introduction, Malus's law, double refraction, Nicol prism, Quarter wave and half wave plates.

**Lasers:** Characteristics of lasers, spontaneous and stimulated emission of radiation, Einstein coefficients, population inversion, ruby laser, helium – neon laser, semi conductor laser, applications of lasers

**UNIT-III**

**Fiber Optics:** Principle of optical fiber, construction of fiber, acceptance angle and acceptance cone, numerical aperture, types of optical fibers: step index and graded index fibers, attenuation in optical fibers, applications of optical fibers in medicine and sensors**.**

**UNIT-IV**

**Crystallography:** Space lattice, unit cell and lattice parameters, crystal systems, Bravais lattices, atomic radius, co-ordination number and packing factor of SC, BCC, FCC, HCP and diamond, Miller indices, crystal planes and directions, inter planar spacing of orthogonal crystal systems.

**UNIT-**V

**X-ray Diffraction and Defects in Crystals:** Bragg's law, X-ray diffraction methods: Laue method, powder method; point defects: vacancies, substitutional, interstitial, Frenkel and Schottky defects, line defects (qualitative) and Burger's vector, surface defects: stacking faults, twin, tilt and grain boundaries.

**Text Books:**

1. Physics Vol. 2, Halliday, Resnick and Kramer John wiley and Sons, Edition 4.
2. Modern Engineering Physics, K. Vijaya Kumar and S. Chandra Lingam, S. Chand and Co. Pvt. Ltd.
3. Introduction to Solid State Physics, Charles Kittel, Wiley Student edition.

**Reference Books:**

1. X-Ray Crystallography, Phillips, John Wiley publishers.
2. Waves, Frank S Crawford Jr, Berkeley Physics course, Volume 3.
3. Solid State Physics, AJ Dekker, MacMilan Publishers.
4. Introduction to Crystallography, Phillips, John Wiley publishers.

# COMPUTER PROGRAMMING IN C

| | |
|---|---|
| **B.Tech. I Year I Sem.** | **L T/P/D C** |
| Course Code: **CS104ES/CS204ES** | **3 0/0/0 3** |

**Course Objectives:**

- To learn the fundamentals of computers.
- To understand the various steps in Program development.
- To learn the syntax and semantics of C Programming Language.
- To learn how to write modular and readable C Programs.
- To learn to write programs using structured programming approach in C to solve problems.

**Course Outcomes:**

- Demonstrate the basic knowledge of computer hardware and software.
- Ability to write algorithms for solving problems.
- Ability to draw flowcharts for solving problems.
- Ability to code a given logic in C programming language.
- Gain knowledge in using C language for solving problems.

## UNIT - I

Introduction to Computers – Computer Systems, Computing Environments, Computer Languages, Creating and running programs, Program Development, algorithms and flowcharts , Number systems-Binary, Decimal, Hexadecimal and Conversions, storing integers and real numbers.
Introduction to C Language – Background, C Programs, Identifiers, Types, Variables, Constants, Input / Output, Operators(Arithmetic, relational, logical, bitwise etc.), Expressions, Precedence and Associativity, Expression Evaluation, Type conversions, Statements- Selection Statements(making decisions) – if and switch statements, Repetition statements ( loops)-while, for, do-while statements, Loop examples, other statements related to looping – break, continue, goto, Simple C Program examples.

## UNIT - II

Functions-Designing Structured Programs, Functions, user defined functions, inter function communication, Standard functions, Scope, Storage classes-auto, register, static, extern, scope rules, type qualifiers, recursion- recursive functions, Limitations of recursion, example C programs.
Arrays – Concepts, using arrays in C, inter function communication, array applications- linear search, binary search and bubble sort, two – dimensional arrays, multidimensional arrays, C program examples.

## UNIT - III

Pointers – Introduction (Basic Concepts), Pointers for inter function communication, pointers to pointers, compatibility, Pointer Applications-Arrays and Pointers, Pointer Arithmetic and arrays,

Passing an array to a function, memory allocation functions, array of pointers, programming applications, pointers to void, pointers to functions.
Strings – Concepts, C Strings, String Input / Output functions, arrays of strings, string manipulation functions, string / data conversion, C program examples.

**UNIT - IV**
Enumerated, Structure ,and Union Types– The Type Definition (typedef), Enumerated types, Structures –Declaration, initialization, accessing structures, operations on structures, Complex structures-Nested structures, structures containing arrays, structures containing pointers, arrays of structures, structures and functions, Passing structures through pointers, self referential structures, unions, bit fields, C programming examples, command–line arguments, Preprocessor commands.

**UNIT – V**
Input and Output – Concept of a file, streams, text files and binary files, Differences between text and binary files, State of a file, Opening and Closing files, file input / output functions (standard library input / output functions for files), file status functions (error handling), Positioning functions (fseek ,rewind and ftell), C program examples.

**Text books:**

1. Computer Science: A Structured Programming Approach Using C, B.A. Forouzan and R. F. Gilberg, Third Edition, Cengage Learning.
2. Programming in C. P. Dey and M Ghosh , Second Edition, Oxford University Press.

**Reference books:**

1. The C Programming Language, B.W. Kernighan and Dennis M. Ritchie, Second Edition, Pearson education.
2. Programming with C, B. Gottfried, 3rd edition, Schaum's outlines, McGraw Hill Education (India) Pvt Ltd.
3. C From Theory to Practice, G S. Tselikis and N D. Tselikas, CRC Press.
4. Basic computation and Programming with C, Subrata Saha and S. Mukherjee, Cambridge University Press.

## ENGINEERING MECHANICS

| | |
|---|---|
| **B.Tech. I Year I Sem.** | **L T/P/D C** |
| Course Code: **ME105ES** | **3 0/0/0 3** |

**Pre Requisites:** None

**Course Objectives:**

- To understand the resolving forces and moments for a given force system
- To analyze the types of friction for moving bodies and problems related to friction.
- To determine the centroid and second moment of area

**UNIT-I**

**Introduction to Mechanics**: Basic Concepts, system of Forces Coplanar Concurrent Forces - Components in Space Resultant -Moment of Forces and its Application - Couples and Resultant of Force Systems. Equilibrium of system of Forces: Free body diagrams, Equations of Equilibrium of Coplanar Systems.

**UNIT-II**

**Friction**: Types of friction -Limiting friction -Laws of Friction -static and Dynamic Frictions -Motion of Bodies – Wedge & Screw, Screw-jack.

**UNIT-III**

**Centroid and Center of Gravity**: Introduction – Centroids of lines – Centroids of area - Centroids of Composite figures - Theorem of Pappus - Centre of Gravity of Bodies – Centroids of Volumes – Center of gravity of composite bodies.

**Area moments of Inertia**: Introduction – Definition of Moment of Inertia -Polar Moment of Inertia – Radius of gyration. Transfer Theorem for moment of inertia – Moments of inertia by integration - Moments of Inertia of Composite Figures.

**UNIT-IV**

**Mass Moment of Inertia:** Introduction - Moment of Inertia of Masses – Radius of gyration - Transfer Formula for Mass Moments of Inertia – Mass moments of inertia by integration - Mass moment of inertia of composite bodies.

**UNIT-V**

**Kinetics:** Kinetics of a particle-D'Alemberts principle. Work-energy and power. Principle of conservation of energy- Kinetics of rigid body in translation, rotation-work done-Principle of work-energy.

**TEXT BOOKS:**

1. Singer's Engineering Mechanics Statics and Dynamics/ K. Vijaya Kumar Reddy, J. Suresh Kumar/ BSP
2. Engineering Mechanics/ Irving Shames, G. Krishna Mohan Rao / Prentice Hall
3. Foundations and applications of Engineering Mechanics by HD Ram and AK Chouhan, Cambridge publications.
4. A Text Book of Engineering Mechanics/S.S. Bhavikatti/New Age International (P) Limited Publications, New Delhi.
5. Engineering Mechanics Statics and Dynamics/N.H. Dubey/ McGraw Hill Education (India) Private Limited, New Delhi.

**REFERENCES:**

1. A Text of Engineering Mechanics /YVD Rao/ K. Govinda Rajulu/ M. Manzoor Hussain / Academic Publishing Company
2. Engineering Mechanics / Bhattacharyya/ Oxford.

## ENGINEERING GRAPHICS

| **B.Tech. I Year I Sem.** | **L T/P/D C** |
|---|---|
| Course Code: **ME106ES/ME205ES** | **2 0/0/4 4** |

**Pre-requisites:** None

**Course objectives:**

- To provide basic concepts in engineering drawing.
- To impart knowledge about standard principles of orthographic projection of objects.
- To draw sectional views and pictorial views of solids.

**Course Outcomes:**

- Ability to prepare working drawings to communicate the ideas and information.
- Ability to read, understand and interpret engineering drawings.

**UNIT – I**

**Introduction to Engineering Drawing:** Principles of Engineering Graphics and their Significance, Conic Sections. Involute, Cycloid, Epicycloid and Hypocycloid Scales – Plain & Diagonal.

**UNIT - II**

**Orthographic Projections:** Principles of Orthographic Projections – Conventions – Projections of Points and Straight Lines. Projections of Plane regular geometric figures.— Auxiliary Planes.

**UNIT – III**

Projections of Regular Solids – Auxiliary Views.

**UNIT – IV**

**Sections and Developments**: Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views. Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid, and Cone.

**UNIT – V**

**Isometric & Orthographic Projections:** Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions – Isometric Views of Lines, Plane Figures, Simple Solids – Conversion of Isometric Views to Orthographic Views.

**Text Books:**

1. Engineering Drawing N.D. Bhatt / Charotar
2. Engineering Drawing / Basant Agrawal and McAgrawal/ McGraw Hill
3. Engineering Drawing/ M. B. Shah, B.C. Rane / Pearson.
4. Engineering Drawing / N. S. Parthasarathy and Vela Murali/ Oxford

## ENGINEERING PHYSICS LAB

| | |
|---|---|
| **B.Tech. I Year I Sem.** | **L T/P/D C** |
| Course Code: **PH107BS/PH207BS** | **0 0/3/0 2** |

**(Any TEN experiments compulsory)**

1. Dispersive power of the material of a prism – Spectrometer.
2. Determination of wavelengths of white source – Diffraction grating.
3. Newton’s Rings – Radius of curvature of Plano convex lens.
4. Melde’s experiment – Transverse and longitudinal modes.
5. Charging, discharging and time constant of an R-C circuit.
6. L-C-R circuit – Resonance & Q-factor.
7. Magnetic field along the axis of current carrying coil – Stewart and Gees method and to verify Biot – Savart’s law.
8. Study the characteristics of LED and LASER diode.
9. Bending losses of fibres & Evaluation of numerical aperture of a given fibre.
10. Energy gap of a material of p-n junction.
11. Torsional pendulum – Rigidity modulus.
12. Wavelength of light, resolving power and dispersive power of a diffraction grating using laser.
13. V-I characteristics of a solar cell.

## COMPUTER PROGRAMMING IN C LAB

| | |
|---|---|
| **B.Tech. I Year I Sem.** | **L T/P/D C** |
| Course Code: **CS108ES/CS208ES** | **0 0/3/0 2** |

**Course Objective:**

- To write programs in C using structured programming approach to solve the problems.

**Course Outcomes**

- Ability to design and test programs to solve mathematical and scientific problems.
- Ability to write structured programs using control structures and functions.

**Recommended Systems/Software Requirements:**

- Intel based desktop PC
- GNU C Compiler

**1. a)** Write a C program to find the factorial of a positive integer.

**b)** Write a C program to find the roots of a quadratic equation.

**2. a)** Write a C program to determine if the given number is a prime number or not.

**b)** 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 the sequence.

**3. a)** Write a C program to construct a pyramid of numbers.

**b)** Write a C program to calculate the following Sum:

$Sum=1-x^2/2! +x^4/4!-x^6/6!+x^8/8!-x^{10}/10!$

**4. a)** The least common multiple (lcm) of two positive integers a and b is the smallest integer that is evenly divisible by both a and b. Write a C program that reads two integers and calls lcm (a, b) function that takes two integer arguments and returns their lcm. The lcm (a, b) function should calculate the least common multiple by calling the gcd (a, b) function and using the following relation:

LCM (a,b) = ab / gcd (a,b)

**b)** Write a C program that reads two integers n and r to compute the ncr value using the following relation:

ncr (n,r) = n! / r! (n-r)! . Use a function for computing the factorial value of an integer.

**5. a)** Write C program that reads two integers x and n and calls a recursive function to compute $x^n$

**b)** Write a C program that uses a recursive function to solve the Towers of Hanoi problem.

**c)** Write a C program that reads two integers and calls a recursive function to compute ncr value.

**6. a)** Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user using Sieve of Eratosthenes algorithm.

**b)** Write a C program that uses non recursive function to search for a Key value in a given list of integers. Use linear search method.

**7. a)** Write a menu-driven C program that allows a user to enter n numbers and then choose between finding the smallest, largest, sum, or average. The menu and all the choices are to be functions. Use a switch statement to determine what action to take. Display an error message if an invalid choice is entered.

**b)** Write a C program that uses non recursive function to search for a Key value in a given sorted list of integers. Use binary search method.

**8 a)** Write a C program that implements the Bubble sort method to sort a given list of integers in ascending order.

**b)** Write a C program that reads two matrices and uses functions to perform the following:

i) Addition of two matrices

ii) Multiplication of two matrices

**9. a)** Write a C program that uses functions to perform the following operations:

i) to insert a sub-string into a given main string from a given position.

ii) to delete n characters from a given position in a given string.

**b)** Write a C program that uses a non recursive function to determine if the given string is a palindrome or not.

**10. a)** Write a C program to replace a substring with another in a given line of text.

**b)** Write a C program that reads 15 names each of up to 30 characters, stores them in an array, and uses an array of pointers to display them in ascending (ie. alphabetical) order.

**11. a)** 2's complement of a number is obtained by scanning it from right to left and complementing all the bits after the first appearance of a 1. Thus 2's complement of 11100 is 00100. Write a C program to find the 2's complement of a binary number.

**b)** Write a C program to convert a positive integer to a roman numeral. Ex. 11 is converted to XI.

**12. 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.

**13. a)** Writ**e 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.

**b)** Write a C program to compare two files, printing the first line where they differ.

**14. a)** Write a C program to change the nth character (byte) in a text file. Use fseek function.

**b)** Write a C program to reverse the first n characters in a file. The file name and n are specified on the command line. Use fseek function.

**15. a)** Write a C program to merge two files into a third file (i.e., the contents of the firs t file followed by those of the second are put in the third file).

**b)** Define a macro that finds the maximum of two numbers. Write a C program that uses the macro and prints the maximum of two numbers.

**Reference Books:**

1. Mastering C, K.R. Venugopal and S.R. Prasad, TMH Publishers.
2. Computer Programming in C, V. Rajaraman, PHI.
3. Programming in C, Stephen G. Kochan, Fourth Edition, Pearson Education.
4. C++: The complete reference, H. Schildt, TMH Publishers.

# AP201BS: APPLIED PHYSICS

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

**Course Objectives:**

- To understand the elastic behavior of materials.
- To understand basic principles of acoustics and architecture of buildings.
- To study production and applications of ultrasonics.
- To understand magnetic, dielectric and superconducting properties.

**Course Outcomes:** after completion of this course the student is able to

- Realize the importance of elastic behavior of materials.
- Learn Sabine's formula for reverberation time and apply in architecture of buildings.
- Learn various methods of producing ultrasonics and their uses.
- Learn magnetic, dielectric and superconducting properties of materials and their applications.

**UNIT - I**

**Elastic properties:** stress and strain, Hooke's law, elastic behaviour of a material, factors affecting elasticity, three modulii of elasticity, work done for unit volume in deforming a body, relation between three modulii of elasticity, determination of rigidity modulus – torsional pendulum.

**UNIT - II**

**Acoustics of buildings and acoustic quieting:** Introduction, basic requirement for the acoustically good halls, reverberation and time of reverberation, transmission of sound and transmission loss, factors affecting the architectural acoustics and their remedy, sound absorbing materials, sabine formulae, absorption coefficients, stadium seating, movie theater, acoustic quieting,

**UNIT - III**

**Ultrasonics:** Introduction, production of ultrasonic waves, magnetostriction method, piezo electric method, detection of ultrasonic waves, properties of ultrasonic waves, use of ultrasonics for nondestructive testing, applications of ultrasonics.

**UNIT - IV**

**Dielectric Properties:** Electric dipole, dipole moment, dielectric constant, polarizability, electric susceptibility, displacement vector, electronic, ionic and orientation polarizations and calculation of their polarizabilitites, internal field, Clausius-Mossotti relation, Piezoelectricity, pyroelectricity and ferroelectricity-$BaTiO_3$ structure.

**UNIT - V**

**Magnetic Properties:** Permeability, field intensity, magnetic field induction, magnetization, magnetic susceptibility, origin of magnetic moment, Bohr magneton, classification of dia, para and ferro magnetic materials on the basis of magnetic moment, hysteresis curve based on domain theory, soft and hard magnetic materials, properties of anti-ferro and ferri magnetic materials.

**Superconductivity**: Superconductivity phenomenon, Meissner effect, applications of superconductivity.

**Text books:**

1. Solid State Physics, A. J. Dekkar, MacMillan publishers
2. Fundamentals of Physics, Alan Giambattisa, BM Richardson and Robert C Richardson, Tata Mcgrahill Publishers
3. Fundamentals of Acoustics, Kinster and Frey, John Wiley and Sons.

**Reference Books:**

1. Solid state physics, Charles Kittel, Wiley student edition
2. University Physics, Francis W. Sears, Hugh D. Young, Marle Zeemansky and Roger A Freedman, Pearson Education.
3. Introduction to Magnetic Materials, B.D. Cullity, C.D.Graham, A John Wiley & Sons, Inc., Publication.
4. Elastic and Inelastic Stress Analysis, Irving H. Shames, Francis A. Cozzarelli, Taylor & Francis Group.

## CH102BS/CH202BS: ENGINEERING CHEMISTRY

**I Year II Sem. B.Tech.** **L T/P/D C**
**4 0/0/0 4**

**Course Objectives:**

- To bring adaptability to new developments in Engineering Chemistry and to acquire the skills required to become a perfect engineer.
- To include the importance of water in industrial usage, significance of corrosion control to protect the structures, polymers and their controlled usage.
- To acquire knowledge of engineering materials and about fuels and batteries.
- To acquire required knowledge about engineering materials like cement, refractories and composites..

**Course Outcomes:** Students will gain the basic knowledge of electrochemical procedures related to corrosion and its control. They can understand the basic properties of water and its usage in domestic and industrial purposes. They learn the use of fundamental principles to make predictions about the general properties of materials. They can predict potential applications of chemistry and practical utility in order to become good engineers and entrepreneurs

**UNIT - I**

**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. Numerical problems. Potable water and its specifications- Steps involved in the treatment of potable water - Disinfection of potable water by chlorination and Ozonization. Defluoridation – Nalgonda technique - Determination of $F^-$ ion by ion-selective electrode method.

**Boiler troubles:** sludges, scales and Caustic embrittlement. Internal treatment of Boiler feed water – Calgon conditioning – Phosphate conditioning - Colloidal conditioning – Softening of water by ion-exchange processes. Desalination of water – Reverse osmosis. Numerical problems – Sewage water - Steps involved in treatment of sewage.

**UNIT - II**

**Electrochemistry:** Electrode- electrode potential, standard electrode potential, types of electrodes – Construction and functioning of Standard hydrogen electrode, calomel and glass electrode. Nernst equation - electrochemical series and its applications. Electrochemical cells: Daniel cell – cell notation, cell reaction and cell emf -– Concept of concentration cells – Electrolyte concentration cell –Numerical problems.

**Batteries:** Cell and battery - Primary battery (dry cell, alkaline cell and Lithium cell) and Secondary battery (lead acid, Ni-Cd and lithium ion cell),**Fuel cells:** Hydrogen –oxygen and methanol-oxygen fuel cells – Applications.

**UNIT – III**

**Polymers**: Definition – Classification of polymers with examples – Types of polymerization – addition (free radical addition) and condensation polymerization with examples.

**Plastics:** Definition and characteristics- thermoplastic and thermosetting plastics, compounding and fabrication of plastics (compression and injection moulding). Preparation, Properties and engineering applications of PVC and Bakelite.

**Fibers:** Characteristics of fibers – preparation, properties and applications of Nylon-6,6 and Dacron. Fiber reinforced plastics (FRP) – Applications.

**Rubbers:** Natural rubber and its vulcanization - compounding of rubber.

**Elastomers:** Characteristics –preparation – properties and applications of Buna-S, Butyl and Thiokol rubber.

**Conducting polymers:** Characteristics and Classification with examples-mechanism of conduction in trans-polyacetylene and applications of conducting polymers.

**Biodegradable polymers:** Concept and advantages - Polylactic acid and poly vinyl alcohol and their applications.

**UNIT - IV**

**Fuels & Combustion:** Classification- solid fuels: coal – analysis of coal – proximate and ultimate analysis and their significance. Liquid fuels – petroleum and its refining, cracking – types – moving bed catalytic cracking. Knocking – octane and cetane rating, synthetic petrol - Fischer-Tropsch's process; Gaseous fuels – composition and uses of natural gas, LPG and CNG.

**Combustion:** Definition, Calorific value of fuel – HCV, LCV; Calculation of air quantity required for combustion of a fuel.

**UNIT - V**

**Cement:** Portland cement, its composition, setting and hardening of Portland cement.

**Special cements:** White cement, water proof cement, High alumina cement and Acid resistant cement.

**Refractories:** Classification, characteristics of good refractories, Refractoriness, refractoriness under load, porosity and chemical inertness – applications of refractories.

**Lubricants:** Classification of lubricants with examples-characteristics of a good lubricants - mechanism of lubrication (thick film, thin film and extreme pressure)- properties of lubricants: viscosity, cloud point, pour point, flash point and fire point.

**Composites:** Introduction- Constituents of composites – advantages, classification and constituents of composites. Applications of composites.

**Text books:**

1. Engineering Chemistry by P.C. Jain & M. Jain, Dhanpatrai Publishing Company, New Delhi (2010)
2. Engineering Chemistry by Rama Devi, Venkata Ramana Reddy and Rath, Cengage learning, New Delhi. (2016)

**Reference Books:**

1. Engineering Chemistry by Shashi Chawla,  Dhanpatrai & Company (P) Ltd. Delhi (2011)
2. Engineering Chemistry by Shikha Agarwal, Cambridge University Press, Delhi (2015)
3. Engineering Chemistry by Thirumala Chary and Laxminarayana, Scitech Publishers, Chennai (2016).

**MA203BS: Mathematics - III**
**(Statistical and Numerical Methods)**

**I Year II Sem. B.Tech.**

| L | T/P/D | C |
|---|---|---|
| 4 | 1/0/0 | 4 |

**Prerequisites:** Foundation course (No prerequisites).

**Course Objectives:** To learn

- random variables that describe randomness or an uncertainty in certain realistic situation
- binomial geometric and normal distributions
- sampling distribution of mean, variance, point estimation and interval estimation
- the testing of hypothesis and ANOVA
- the topics those deals with methods to find roots of an equation
- to fit a desired curve by the method of least squares for the given data
- solving ordinary differential equations using numerical techniques

**Course Outcomes:** After learning the contents of this course the student must be able to

- differentiate among random variables involved in the probability models which are usefull for all branches of engineering
- calculate mean, proportions and variances of sampling distributions and to make important decisions s for few samples which are taken from a large data
- solve the tests of ANOVA for classified data
- find the root of a given equation and solution of a system of equations
- fit a curve for a given data
- find the numerical solutions for a given first order initial value problem

**UNIT – I**
**Random variables and Distributions:**
Introduction, Random variables, Discrete random variable, Continuous random variable, Distribution function, Expectation, Moment generating function, Moments and properties. Discrete distributions: Binomial and geometric distributions. Continuous distribution: Normal distributions.

**UNIT – II**
**Sampling Theory:** Introduction, Population and samples, Sampling distribution of means ($\sigma$ Known)-Central limit theorem, t-distribution, Sampling distribution of means ( $\sigma$unknown)-Sampling distribution of variances – $\chi^2$and F- distributions, Point estimation, Maximum error of estimate, Interval estimation.

**UNIT – III**
**Tests of Hypothesis:** Introduction, Hypothesis, Null and Alternative Hypothesis, Type I and Type II errors, Level of significance, One tail and two-tail tests, Tests concerning one mean

and proportion, two means-proportions and their differences-ANOVA for one-way classified data.

**UNIT – IV**

**Algebraic and Transcendental Equations & Curve Fitting:** Introduction, Bisection Method, Method of False position, Iteration methods: fixed point iteration and Newton Raphson methods. Solving linear system of equations by Gauss-Jacobi and Gauss-Seidal Methods.

**Curve Fitting:** Fitting a linear, second degree, exponential, power curve by method of least squares.

**UNIT – V**

**Numerical Integration and solution of Ordinary Differential equations:** Trapezoidal rule-Simpson's $1/3^{rd}$ and $3/8^{th}$ rule- Solution of ordinary differential equations by Taylor's series, Picard's method of successive approximations, Euler's method, Runge-Kutta method (second and fourth order)

**Text Books:**

1. Probability and Statistics for Engineers by Richard Arnold Johnson, Irwin Miller and John E. Freund, New Delhi, Prentice Hall.
2. Probability and Statistics for Engineers and Sciences by Jay L. Devore, Cengage Learning.
3. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K. Iyengar and R. K. Jain, New Age International Publishers

**References:**

1. Fundamentals of Mathematical Statistics by S. C. Guptha & V. K. Kapoor, S. Chand
2. Introductory Methods of Numerical Analysis by S. S. Sastry, PHI Learning Pvt. Ltd

## EN104HS/EN204HS: PROFESSIONAL COMMUNICATION IN ENGLISH

**I Year II Sem. B.Tech.**

| L | T/P/D | C |
|---|---|---|
| 3 | 0/0/0 | 3 |

**INTRODUCTION:**

In view of the growing importance of English as a tool for global communication and the consequent emphasis on training students to acquire language skills, the syllabus of English has been designed to develop linguistic and communicative competencies of Engineering students.

In English classes, the focus should be on the skills development in the areas of vocabulary, grammar, reading and writing. For this, the teachers should use the prescribed text for detailed study. The students should be encouraged to read the texts/poems silently leading to reading comprehension. Reading comprehension passages are given for practice in the class. The time should be utilized for working out the exercises given after each excerpt, and also for supplementing the exercises with authentic materials of a similar kind. For example, from newspaper articles, advertisements, promotional material, etc. *The focus in this syllabus is on skill development, fostering ideas and practice of language skills.*

**Course Objectives:** The course will help students to:

- Improve the language proficiency of students in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
- Equip students to study academic subjects more effectively using the theoretical and Practical components of English syllabus.
- Develop study skills and communication skills in formal and informal situations.

**Course Outcomes:** Students will be able to:

- Use English Language effectively in spoken and written forms.
- Comprehend the given texts and respond appropriately.
- Communicate confidently in formal and informal contexts.

**SYLLABUS**

**Reading Skills**

**Objectives**

1. To develop an awareness in students about the significance of silent reading and comprehension.
2. To develop students' ability to guess meanings of words from the context and grasp the overall message of the text, draw inferences, etc., by way of:
    - Skimming and Scanning the text
    - Intensive and Extensive Reading
    - Reading for Pleasure

- Identifying the topic sentence
- Inferring lexical and contextual meaning
- Recognizing Coherence/Sequencing of Sentences

**NOTE:** The students will be trained in reading skills using the prescribed texts for detailed study. They will be tested in reading comprehension of different ‘unseen’ passages which may be taken from authentic texts, such as magazines/newspaper articles.

**Writing Skills**

**Objectives**

1. To develop an awareness in the students about writing as an exact and formal skill
2. To create an awareness in students about the components of different forms of writing, beginning with the lower order ones through;
    - Writing of sentences
    - Use of appropriate vocabulary
    - Paragraph writing
    - Coherence and cohesiveness
    - Narration / description
    - Note Making
    - Formal and informal letter writing
    - Describing graphs using expressions of comparison

In order to improve the proficiency of the students in the acquisition of language skills mentioned above, the following text and course contents, divided into Five Units, are prescribed:

The course content / study material is divided into **Five Units.**

**Note:** ***Listening and speaking skills are covered in the syllabus of ELCS Lab.***

**UNIT – I**

Chapter entitled ‘***Presidential Address’ by Dr. A.P.J. Kalam*** from ***“Fluency in English– A Course book for Engineering Students”*** published by Orient BlackSwan, Hyderabad.

**Vocabulary**: Word Formation -- Root Words --The Use of Prefixes and Suffixes– Collocations– Exercises for Practice.

**Grammar:** Punctuation – Parts of Speech- Articles -Exercises for Practice.

**Reading:** ***Double Angels*** by David Scott-Reading and Its Importance- Techniques for Effective Reading- Signal Words- Exercises for Practice

**Writing:** Writing Sentences- Techniques for Effective Writing-- Paragraph Writing- Types, Structure and Features of a Paragraph-Coherence and Cohesiveness: Logical, Lexical and Grammatical Devices - Exercises for Practice

**UNIT – II**

Chapter entitled ***Satya Nadella: Email to Employees on his First Day as CEO*** from ***"Fluency in English– A Course book for Engineering Students"*** Published by Orient BlackSwan, Hyderabad.

**Vocabulary**: Synonyms and Antonyms – Homonyms, Homophones, Homographs- Exercises for Practice (Chapter 17 '***Technical Communication- Principles and Practice'. Third Edition*** published by Oxford University Press may also be followed.)

**Grammar:** Verbs-Transitive, Intransitive and Non-finite Verbs – Mood and Tense—Gerund – Words with Appropriate Prepositions – Phrasal Verbs - Exercises for Practice

**Reading:** Sub-skills of Reading- Skimming, Scanning, Extensive Reading and Intensive Reading - ***The Road Not Taken*** by **Robert Frost** -- Exercises for Practice

**Writing:** Letter Writing –Format, Styles, Parts, Language to be used in Formal Letters- Letter of Apology – Letter of Complaint-Letter of Inquiry with Reply – Letter of Requisition –- Exercises for Practice

**UNIT – III**

From the book entitled '***Technical Communication- Principles and Practice'. Third Edition*** published by Oxford University Press.

**Vocabulary**: Introduction- A Brief History of Words – Using the Dictionary and Thesaurus– Changing Words from One Form to Another – Confusables (From Chapter 17 entitled '*Grammar and Vocabulary Development*')

**Grammar:** Tenses: Present Tense- Past Tense- Future Tense- Active Voice – Passive Voice- Conditional Sentences – Adjective and Degrees of Comparison. (From Chapter 17 entitled '*Grammar and Vocabulary Development*')

**Reading:** Improving Comprehension Skills – Techniques for Good Comprehension- Skimming and Scanning- Non-verbal Signals – Structure of the Text – Structure of Paragraphs – Punctuation – Author's viewpoint (Inference) – Reader Anticipation: Determining the Meaning of Words – Summarizing- Typical Reading Comprehension Questions. (From Chapter 10 entitled '*Reading Comprehension*')

**Writing:** Introduction- Letter Writing-Writing the Cover Letter- Cover Letters Accompanying Resumes- Emails. (From Chapter 15 entitled '*Formal Letters, Memos, and Email'*)

**UNIT – IV**

Chapter entitled ***'Good Manners' by J.C. Hill*** from ***Fluency in English – A Course book for Engineering Students"*** published by Orient Blackswan, Hyderabad.

**Vocabulary**: Idiomatic Expressions –One- word Substitutes --- Exercises for Practice (Chapter 17 '***Technical Communication- Principles and Practice'. Third Edition*** published by Oxford University Press may also be followed.)

**Grammar:** Sequence of Tenses- Concord (Subject in Agreement with the Verb) – Exercises for Practice

**Reading:** ***'If'*** poem by **Rudyard Kipling**--Tips for Writing a Review --- Author's Viewpoint – Reader's Anticipation-- Herein the Students will be required to Read and Submit a Review of a Book (Literary or Non-literary) of their choice – Exercises for Practice.
**Writing:** Information Transfer-Bar Charts-Flow Charts-Tree Diagrams etc., -- Exercises for Practice.

Introduction - Steps to Effective Precis Writing – Guidelines- Samples (Chapter 12 entitled '*The Art of Condensation*' from ***Technical Communication- Principles and Practice. Third Edition*** published by Oxford University Press)

**UNIT – V**

Chapter entitled ***'Father Dear Father'*** **by Raj Kinger** from ***Fluency in English – A Course book for Engineering Students"*** Published by Orient BlackSwan, Hyderabad

**Vocabulary**: Foreign Words—Words borrowed from other Languages- Exercises for Practice
**Grammar:** Direct and Indirect Speech- Question Tags- Exercises for Practice
**Reading:** Predicting the Content- Understanding the Gist – SQ3R Reading Technique- Study Skills – Note Making - Understanding Discourse Coherence – Sequencing Sentences. (From Chapter 10 entitled **'Reading Comprehension' -** ***Technical Communication- Principles and Practice. Third Edition*** published by Oxford University Press.)
**Writing:** Technical Reports- Introduction – Characteristics of a Report – Categories of Reports –Formats- Prewriting – Structure of Reports (Manuscript Format) - Types of Reports - Writing the Report. (From Chapter 13 entitled **'Technical Reports' -** ***Technical Communication- Principles and Practice. Third Edition*** published by Oxford University Press.)

- **Exercises from both the texts not prescribed shall be used for classroom tasks.**

**Text Books:**

1. ***"Fluency in English – A Course book for Engineering Students"*** by Board of Editors**: Hyderabad: Orient BlackSwan Pvt. Ltd. 2016. Print.**
2. Raman, Meenakshi & Sharma, Sangeeta***. "Technical Communication- Principles and Practice".*** **Third Edition. New Delhi: Oxford University Press. 2015. Print.**

**References:**

*1.* Green, David. *Contemporary English Grammar –Structures and Composition.* MacMillan India. 2014 (Print)
2. Rizvi, M. Ashraf. *Effective Technical Communication*. Tata Mc Graw –Hill. 2015 (Print).

**EE106ES/EE205ES: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**

| | |
|---|---|
| **I Year II Sem. B.Tech.** | **L T/P/D C** |
| | **4 0/0/0 4** |

**Pre-requisite: None**

**Course Objectives:**
- To introduce the concept of electrical circuits and its components
- To introduce the concepts of diodes & transistors, and
- To impart the knowledge of various configurations, characteristics and applications.

**Course Outcomes:** After this course, the student will be able
- To analyze and solve electrical circuits using network laws and theorems.
- To identify and characterize diodes and various types of transistors.

**UNIT - I**

**Basic Concepts of Electrical Circuits and Single Phase AC Circuits**

**Electrical Circuits:** R-L-C Parameters, Voltage and Current, Independent and Dependent Sources, Source Transformation – V-I relationship for passive elements, Kirchoff's Laws, Network reduction techniques – series, parallel, series-parallel, star-to-delta, delta-to-star transformation, Nodal Analysis,

**Single Phase AC Circuits:** R.M.S. and Average values, Form Factor, steady state analysis of series, parallel and series-parallel combinations of R, L and C with sinusoidal excitation, concept of reactance, impedance, susceptance and admittance – phase and phase difference, Concept of power factor, j-notation, complex and polar forms of representation.

**UNIT - II**

**Resonance:** Series resonance and Parallel resonance circuits, concept of bandwidth and Q factor.

**Network Theorems:** Thevenin's, Norton's, Maximum Power Transfer, Superposition and Reciprocity theorem for DC and AC excitations.

**UNIT - III**

**P-N Junction and Zener Diode:** Principle of Operation Diode equation, Volt-Ampere characteristics, Temperature dependence, Ideal versus practical, Static and dynamic resistances, Equivalent circuit, Load line analysis, Diffusion and Transition Capacitances.

**Zener Diode:** characteristics.

**Rectifiers and Filters:** P-N junction as a rectifier - Half Wave Rectifier, Ripple Factor - Full Wave Rectifier, Bridge Rectifier, Harmonic components in Rectifier Circuits, Filters – Inductor Filters, Capacitor Filters, L- section Filters, π- section Filters.

**UNIT - IV**

**Bipolar Junction Transistor (BJT):**Construction, Principle of Operation, Amplifying Action, Common Emitter, Common Base and Common Collector configurations.

Transistor Biasing And Stabilization - Operating point, DC & AC load lines, Biasing - Fixed Bias, Emitter Feedback Bias, Collector to Emitter feedback bias, Voltage divider bias, Bias stability, Stabilization against variations in $V_{BE}$ and $\beta$, Bias Compensation using Diodes and Transistors.

**Transistor Configurations:** Hybrid model, Determination of h-parameters from transistor characteristics, Analysis of CE, CB and CC configurations using h-parameters, Comparison of CE, CB and CC configurations.

**UNIT- V**

**Junction Field Effect Transistor:** Construction, Principle of Operation, Pinch-Off Voltage, Volt-Ampere Characteristic, Comparison of BJT and FET, Biasing FET.

**TEXT BOOKS:**

1. Basic Electrical and electronics Engineering –M S Sukija TK Nagasarkar Oxford University
2. Basic Electrical and electronics Engineering-D P Kothari. I J NagarathMcGraw Hill Education

**REFERENCES:**

1. Electronic Devices and Circuits – R. L. Boylestead and Louis Nashelsky, PEI/PHI, 9$^{th}$ Ed, 2006.
2. Millman’s Electronic Devices and Circuits – J. Millman and C. C. Halkias, Satyabrata Jit, TMH, 2/e, 1998.
3. Engineering circuit analysis- by William Hayt and Jack E. Kemmerly, McGraw Hill Company, 6$^{th}$ edition.
4. Linear circuit analysis (time domain phasor and Laplace transform approaches)- 2$^{nd}$ edition by Raymond A. De Carlo and Pen-Min-Lin, Oxford University Press-2004.
5. Network Theory by N. C. Jagan& C. Lakshminarayana, B.S. Publications.
6. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.

## CH206BS: ENGINEERING CHEMISTRY LAB

**I Year II Sem. B.Tech.**

| L | T/P/D | C |
|---|---|---|
| 0 | 0/3/0 | 2 |

## LIST OF EXPERIMENTS

**Volumetric Analysis:**

1. Estimation of Ferrous ion by Dichrometry.
2. Estimation of hardness of water by Complexometric method using EDTA.
3. Estimation of Ferrous and Ferric ions in a given mixture by Dichrometry.
4. Estimation Ferrous ion by Permanganometry.
5. Estimation of copper by Iodomery.
6. Estimation of percentage of purity of $MnO_2$ in pyrolusite
7. Determination of percentage of available chlorine in bleaching powder.
8. Determination of salt concentration by ion- exchange resin.

**Instrumental methods of Analysis:**

1. Estimation of HCl by Conductometry.
2. Estimation of Ferrous ion by Potentiometry.
3. Determination of Ferrous iron in cement by Colorimetric method.
4. Determination of viscosity of an oil by Redwood / Oswald's Viscometer.
5. Estimation of manganese in $KMnO_4$ by Colorimetric method.
6. Estimation o f HCl and Acetic acid in a given mixture by Conductometry.
7. Estimation of HCl by Potentiometry.

**Preparation of Polymers:**

1. Preparation of Bakelite and urea formaldehyde resin.

**Text Books:**

1. Vogel's Text Book of Quantitative Chemical Analysis, 5$^{th}$ Edition (2015) G. H. Jeffery, J. Bassett, J. Mendham and R. C. Denney.
2. A Text Book on experiments and calculations in Engineering Chemistry by S.S. Dara S. Chand & Company Ltd., Delhi (2003).

**PCE107HS/PCE207HS: ENGLISH LANGUAGE COMMUNICATION SKILLS LAB**

| | | | |
|---|---|---|---|
| **I Year II Sem. B.Tech.** | **L** | **T/P/D** | **C** |
| | **0** | **0/3/0** | **2** |

The **English Language Communication Skills (ELCS) Lab** focuses on the production and practice of sounds of language and familiarizes the students with the use of English in everyday situations both in formal and informal contexts.

**Course Objectives:**

- To facilitate computer-assisted multi-media instruction enabling individualized and independent language learning
- To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm
- To bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking
- To improve the fluency of students in spoken English and neutralize their mother tongue influence
- To train students to use language appropriately for public speaking, group discussions and interviews

**Course Outcomes**: Students will be able to attain:

- Better understanding of nuances of English language through audio- visual experience and group activities
- Neutralization of accent for intelligibility
- Speaking skills with clarity and confidence which in turn enhances their employability skills.

**Syllabus: English Language Communication Skills Lab (ELCS) shall have two parts:**

- **Computer Assisted Language Learning (CALL) Lab**
- **Interactive Communication Skills (ICS) Lab**

**Listening Skills:**
**Objectives:**

- To enable students develop their listening skills so that they may appreciate the role in the LSRW skills approach to language and improve their pronunciation
- To equip students with necessary training in listening, so that they can comprehend the speech of people of different backgrounds and regions.

*Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right intonation in sentences.*

- Listening for general content
- Listening to fill up information
- Intensive listening
- Listening for specific information

**Speaking Skills:**
Objectives
- To involve students in speaking activities in various contexts
- To enable students express themselves fluently and appropriately in social and professional contexts :
  - Oral practice
  - Describing objects/situations/people
  - Role play – Individual/Group activities
  - Just A Minute (JAM) Sessions.

The following course content is prescribed for the **English Language Communication Skills Lab**.

**Exercise – I**
**CALL Lab**:
*Understand:* Listening Skill- Its importance – Purpose- Process- Types- Barriers- Effective Listening.
*Practice*: Introduction to Phonetics – Speech Sounds – Vowels and Consonants – Minimal Pairs- Consonant Clusters- Past Tense Marker and Plural Marker.
*Testing Exercises*
**ICS Lab**:
*Understand:* Spoken vs. Written language- Formal and Informal English.
*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– Weak Forms and Strong Forms – Sentence Stress – Intonation.
*Practice:* Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms- Sentence Stress – Intonation.
*Testing Exercises*
**ICS Lab**:
*Understand:* Features of Good Conversation – Strategies for Effective Communication.
*Practice:* Situational Dialogues – Role-Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.

**Exercise - III**
**CALL Lab:**
*Understand:* Errors in Pronunciation-the Influence of Mother Tongue (MTI).
*Practice:* Common Indian Variants in Pronunciation – Differences between British and American Pronunciation.
*Testing Exercises*
**ICS Lab**:
*Understand:* Descriptions- Narrations- Giving Directions and Guidelines.
*Practice:* Giving Instructions – Seeking Clarifications – Asking for and Giving Directions – Thanking and Responding – Agreeing and Disagreeing – Seeking and Giving Advice – Making Suggestions.

**Exercise – IV**
**CALL Lab**:
*Understand:* Listening for General Details.
*Practice:* Listening Comprehension Tests.
*Testing Exercises*
**ICS Lab**:
*Understand:* Public Speaking – Exposure to Structured Talks - Non-verbal Communication- Presentation Skills.
*Practice:* Making a Short Speech – Extempore- Making a Presentation.

**Exercise – V**
**CALL Lab:**
*Understand:* Listening for Specific Details.
*Practice:* Listening Comprehension Tests.
*Testing Exercises*
**ICS Lab**:
*Understand:* Group Discussion- Interview Skills.
*Practice:* Group Discussion- Mock Interviews.

**Minimum Requirement of infrastructural facilities for ELCS Lab:**

**1. 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:*
Computers with Suitable Configuration
High Fidelity Headphones

**2. 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 T. V. or LCD, a digital stereo –audio & video system and camcorder etc.

**Prescribed Lab Manuals:**

1. A book entitled "***ELCS Lab Manual – A Workbook for CALL and ICS Lab Activities***" by Board of Editors: Hyderabad: Orient BlackSwan Pvt. Ltd. 2016. Print.
2. Hart, Steve; Nair, Aravind R.; Bhambhani, Veena. ***"EMBARK- English for undergraduates"*** Delhi: Cambridge University Press. 2016. Print.

**Suggested Software:**

1. Cambridge Advanced Learners' English Dictionary with CD.
2. Grammar Made Easy by Darling Kindersley.
3. Punctuation Made Easy by Darling Kindersley.
4. Oxford Advanced Learner's Compass, $8^{th}$ Edition.
5. English in Mind (Series 1-4), Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.
6. English Pronunciation in Use (Elementary, Intermediate, Advanced) Cambridge University Press.
7. TOEFL & GRE (KAPLAN, AARCO & BARRONS, USA, Cracking GRE by CLIFFS).

**References:**

1. Jayashree Mohanraj. *Let Us Hear Them Speak*. New Delhi: Sage Texts. 2015.Print.
2. Hancock, M. *English Pronunciation in Use. Intermediate Cambridge*: Cambridge University Press. 2009.Print.

## ME108ES/ME208ES: ENGINEERING WORKSHOP

| | |
|---|---|
| **I Year II Sem. B.Tech.** | **L T/P/D C** |
| | **0 0/3/0 2** |

**Pre-requisites**: Practical skill

**Course Objectives:**

- To Study of different hand operated power tools, uses and their demonstration.
- To gain a good basic working knowledge required for the production of various engineering products.
- To provide hands on experience about use of different engineering materials, tools, equipments and processes those are common in the engineering field.
- To develop a right attitude, team working, precision and safety at work place.
- It explains the construction, function, use and application of different working tools, equipment and machines.
- To study commonly used carpentry joints.
- To have practical exposure to various welding and joining processes.
- Identify and use marking out tools, hand tools, measuring equipment and to work to prescribed tolerances.

**Course Outcomes:** At the end of the course, the student will be able to:

- Study and practice on machine tools and their operations
- Practice on manufacturing of components using workshop trades including pluming, fitting, carpentry, foundry, house wiring and welding.
- Identify and apply suitable tools for different trades of Engineering processes including drilling, material removing, measuring, chiseling.
- Apply basic electrical engineering knowledge for house wiring practice.

**1. TRADES FOR EXERCISES:**
**At least two exercises from each trade:**

- Carpentry
- Fitting
- Tin-Smithy and Development of jobs carried out and soldering.
- Black Smithy
- House-wiring
- Foundry
- Welding
- Power tools in construction, wood working, electrical engineering and mechanical
- Engineering.

**2. TRADES FOR DEMONSTRATION & EXPOSURE:**

- Plumbing, Machine Shop, Metal Cutting (Water Plasma)

**Text Books:**

1. Workshop Practice /B. L. Juneja / Cengage
2. Workshop Manual / K.Venugopal / Anuradha.

**Reference Books:**

1. Work shop Manual - P.Kannaiah/ K.L.Narayana/ Scitech
2. Workshop Manual / Venkat Reddy/ BSP

**MA301BS: MATHEMATICS – IV**
**(Complex Variables and Fourier Analysis)**

| **B.Tech. II Year I Sem.** | **L** | **T/P/D** | **C** |
|---|---|---|---|
| | **4** | **1/0/0** | **4** |

**Prerequisites:** Foundation course (No Prerequisites).
**Course Objectives:** To learn
- differentiation and integration of complex valued functions
- evaluation of integrals using Cauchy's integral formula
- Laurent's series expansion of complex functions
- evaluation of integrals using Residue theorem
- express a periodic function by Fourier series and a non periodic function by Fourier transform
- to analyze the displacements of one dimensional wave and distribution of one dimensional heat equation

**Course Outcomes:** After learning the contents of this paper the student must be able to
- analyze the complex functions with reference to their analyticity, integration using Cauchy's integral theorem
- find the Taylor's and Laurent's series expansion of complex functions
- the bilinear transformation
- express any periodic function in term of sines and cosines
- express a non-periodic function as integral representation
- analyze one dimensional wave and heat equation

**UNIT – I**
**Functions of a complex variable:** Introduction, Continuity, Differentiability, Analyticity, properties, Cauchy, Riemann equations in Cartesian and polar coordinates**.** Harmonic and conjugate harmonic functions-Milne-Thompson method

**UNIT - II**
**Complex integration:** Line integral, Cauchy's integral theorem, Cauchy's integral formula, Generalized Cauchy's integral formula, Power series: Taylor's series- Laurent series, Singular points, Isolated singular points, pole of order m – essential singularity, Residue, Cauchy Residue theorem (Without proof).

**UNIT – III**
**Evaluation of Integrals:** Types of real integrals:

(a) Improper real integrals $\int_{-\infty}^{\infty} f(x)dx$

(b) $\int_{c}^{c+2\pi} f(\cos\theta, \sin\theta)d\theta$

Bilinear transformation- fixed point- cross ratio- properties- invariance of circles.

**UNIT – IV**

**Fourier Series and Transforms:** Introduction, Periodic functions, Fourier series of periodic function, Dirichlet's conditions, Even and odd functions, Change of interval, Half range sine and cosine series.

Fourier integral theorem (without proof), Fourier sine and cosine integrals, sine and cosine, transforms, properties, inverse transforms, Finite Fourier transforms.

**UNIT – V**

**Applications of PDE:** Classification of second order partial differential equations, method of separation of variables, Solution of one dimensional wave and heat equations.

**TEXT BOOKS:**

1. A first course in complex analysis with applications by Dennis G. Zill and Patrick Shanahan, Johns and Bartlett Publishers.
2. Higher Engineering Mathematics by Dr. B. S. Grewal, Khanna Publishers.

**REFERENCES:**

1. Fundamentals of Complex Analysis by Saff, E. B. and A. D. Snider, Pearson.
2. Advanced Engineering Mathematics by Louis C. Barrett, McGraw Hill.

# ME305ES: METALLURGY AND MATERIALS SCIENCE

**B.Tech. II Year I Sem.**

| L | T | P | C |
|---|---|---|---|
| **4** | **1** | **0** | **4** |

**Course Overview:** The subject deals with the materials and their properties, commonly used for the manufacturing various components in industry. The quantificational procedures of property estimations and the study of various phase diagrams of alloy materials .The ferrous materials and Non Ferrous materials, their properties and applications in the industries are incorporated. The importance of composite materials and ceramics are included.

The course is designed for the Second year first semester students. The course will provide an over view of the study of basic knowledge of various materials and their properties, applications.

The Study of basic alloy systems formation and their phase diagrams. The strengthening mechanisms of various alloys.

At the end of the course, the student is expected to possess knowledge in various materials and their properties.

Selection of materials based on their applications. Developing new materials and their testing methods of property evaluation. Pre- requisites: Thorough knowledge of Basic Mathematics & Physics.

**Course Objectives:**

1. To prepare students to demonstrate basic knowledge in mathematics, science and engineering.
2. To prepare students to excel their the ability to identify, formulate and solve mechanical
3. Engineering problems.
4. To prepare students should be capable of self-education and clearly understand the value of life-long learning.
5. To prepare students, will be broadly educated and will have an understanding of the impact of engineering on society and demonstrate awareness of contemporary issues.
6. To inculcate in students, the ability to design a system to meet desired needs within environmental,
7. Economic, political, ethical health and safety, manufacturability and management knowledge and techniques to estimate time, resources to complete a project.

**Course Outcomes:**

1. An ability to apply knowledge of mathematics, science and engineering, to understand different materials and their properties.
2. An ability to design a system, component or process to meet desired needs within, realistic constraints such as economic , safety, manufacturability and sustainability etc.., while selecting a material to manufacture the designed components.

3. An ability to identify the phases and their interrelationship in different alloy systems.
4. A recognition of the need for, and an ability to engage in lifelong learning with the concepts of composite, ceramic and nano materials for practical application

**UNIT – I**

**Ferrous And Non – Ferrous Metals And Alloys:** Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheriodal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Structure and properties of copper and its alloys, Aluminium and its alloys.

**UNIT – II**

**Equilibrium Diagrams:** Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of important binary phase diagrams of Cu-Ni-, Al-Cu, Bi-Cd, Cu-An, Cus-Sn and Fe-Fe3C.

**UNIT – III**

**Metals and Alloys:** Heat treatment of steels, cold, hot working of metals, recovery, and recrystallization and grain growth. Microstructure, properties and applications of ferrous and non-ferrous alloys, Effect of alloying elements on $Fe-Fe_3C$ system, Annealing, normalizing, Hardening, TTT diagrams, tempering, Hardenability, surface - hardening methods, Age hardening treatment, Cryogenic treatment of alloys.

**UNIT – IV**

**Diffusion:** Fick’s laws and application of diffusion in sintering, doping of semiconductors and surface hardening of metals.

**UNIT – V**

**Ceramics:** Structure, properties, processing and applications of traditional and advanced ceramics.

**Polymers:** Classification, polymerization, structure and properties, additives for polymer products, processing and applications. Composites: Properties and applications of various composites.

**TEXT BOOKS:**

1. Introduction to Physical Metallurgy / Sidney H. Avener.
2. Essential of Materials Science and engineering/ Donald R. Askeland/Thomson.
3. Elements of Material Science / V. Rahghavan

**REFERENCES:**

1. Material Science and Metallurgy / Kodgire.

2. Science of Engineering Materials / Agarwal
3. Materials Science and Engineering / William and Callister.
4. An introduction to materials Science / W. G. Vinas & HL Mancini
5. Material science & material / C. D. Yesudian & Harris Samuel
6. Engineering Materials and Their Applications – R. A Flinn and P K Trojan / Jaico Books.
7. Engineering materials and metallurgy / R. K. Rajput/ S. Chand.

## ME302ES: KINEMATICS OF MACHINERY

| **B.Tech. II Year I Sem.** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| | **4** | **1** | **0** | **4** |

**Prerequisites:** Basic principles of mechanics

**Course Objectives:** The objective is to study the relative motion, velocity, and accelerations of the various elements in a mechanism. In mechanical Engineering we come across number of mechanisms such as four bar/slider crank/double slider crank/straight line motion mechanism etc. Mechanism deals with only relative motions. Once we make a study considering for us also there it is called kinetics. The first course deals with mechanisms, their inversions straight line motion mechanisms steering mechanisms etc. Also study of cams/gears & gear trains & belts are also introduced.

**Course Outcomes:** The main purpose is to give an idea about the relative motions obtained in all the above type of components used in mechanical Engineering.

**UNIT – I**

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

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

**UNIT – II**

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

**Plane motion of body:** Instantaneous center of rotation- centrodes and axodes – Three centers in line theorem – Graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method.

Kliens construction - Coriolis acceleration - determination of Coriolis component of acceleration

**Analysis of Mechanisms:** Analysis of slider crank chain for displacement- velocity and acceleration of slider – Acceleration diagram for a given mechanism.

**UNIT – III**

**Straight-line motion mechanisms:** Exact and approximate copied and generated types – Peaucellier - Hart - Scott Russel – Grasshopper – Watt -Tchebicheff's and Robert Mechanism - Pantographs

**Steering gears:** Conditions for correct steering – Davis Steering gear, Ackerman's steering gear.

**Hooke's Joint:** Single and double Hooke's joint –velocity ratio – application – problems.

**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:** Tangent cam with Roller follower – circular arc cam with straight, concave and convex flanks.

**UNIT – V**

**Higher pair:** Friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion – velocity of sliding

Forms of teeth, cycloidal and involutes profiles – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference – expressions for arc of contact and path of contact of Pinion & Gear and Pinion & Rack Arrangements– Introduction to Helical – Bevel and worm gearing

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

**TEXT BOOKS:**

1. Theory of Machines and Mechanisms/Joseph E. Shigley/ Oxford
2. Theory of Machines / S. S. Rattan / Mc Graw Hill Publishers.

**REFERENCE BOOKS:**

1. Theory of Machines / Sadhu Singh / Pearson.
2. Theory of Machines / Thomas Bevan/CBS.

# ME303ES: MECHANICS OF SOLIDS

**B.Tech. II Year I Sem.**

| L | T | P | C |
|---|---|---|---|
| **3** | **0** | **0** | **3** |

**Course Overview:**

The study of Mechanics of solids often refers to various methods of calculating the stresses and strains in structural members, such as beams, columns, and shafts. The methods employed to predict the response of a structure under loading and its susceptibility to various failure modes takes into account the properties of the materials such as its yield strength, ultimate strength, Young's modulus, and Poisson's ratio. The stresses and strains that are developing within a mechanical member must be calculated in order to assess the load capacity of that member. This requires a complete description of the geometry of the member, its constraints, and the loads applied to the member and the properties of the material of which the member is composed.

**Course Objectives:** The objective is to learn the fundamental concepts of stress, strain, and deformation of solids with applications to bars, beams, and columns. Detailed study of engineering properties of materials is also of interest. Fundamentals of applying equilibrium, compatibility, and force-deformation relationships to structural elements are emphasized. The students are introduced to advanced concepts of flexibility and stiffness method of structural analysis. The course builds on the fundamental concepts of engineering mechanics course.
This course will advance the students' development of the following broad capabilities:

1. Students will be able to understand basic concepts of stress, strain and their relations based on linear elasticity. Material behaviors due to different types of loading will be discussed.
2. Students will be able to understand and know how to calculate stresses and deformation of a bar due to an axial loading under uniform and non-uniform conditions.
3. Students will understand how to develop shear-moment diagrams of a beam and find the maximum moment/shear and their locations
4. Students will understand how to calculate normal and shear stresses

**Course Outcomes:**

1. Analyze the behavior of the solid bodies subjected to various types of loading;
2. Apply knowledge of materials and structural elements to the analysis of simple structures;
3. Undertake problem identification, formulation and solution using a range of analytical methods;
4. Analyze and interpret laboratory data relating to behavior of structures and the materials they are made of, and undertake associated laboratory work individually and in teams.
5. Expectation and capacity to undertake lifelong learning

**UNIT - I**

**Simple Stresses & Strains:** Elasticity and plasticity – Types of stresses & strains–Hooke's law– stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Elastic moduli & the relationship between them – Bars of varying section – composite bars – Temperature stresses. Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

**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 a beam.

**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.

**Theories of Failure**: Introduction – Various theories of failure - Maximum Principal Stress Theory, Maximum Principal Strain Theory, Strain Energy and Shear Strain Energy Theory (Von Mises Theory).

**UNIT - V**

**Torsion of Circular Shafts :** Theory of pure torsion – Derivation of Torsion equations : T/J = q/r = Nθ/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 Cylinders:** Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and Volumetric strains – changes in dia, and volume of thin cylinders– Thin spherical shells.

**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.
6. Fundamentals of Solid Mechanics by M. L. Gambhir, PHI Learning Pvt. Ltd
7. Strength of Materials by R.K Rajput, S. Chand & Company Ltd.

## ME304ES: THERMODYNAMICS

**B.Tech. II Year II Sem.** **L T P C**
**3 0 0 3**

**Course Overview:**

Thermodynamics is the field of physics that deals with the relationship between heat and work in a substance during a thermodynamic process. Specifically, thermodynamics focuses largely on how a heat transfer is related to various energy changes within a physical system undergoing a thermodynamic process. Such processes usually result in work being done by the system and are guided by the laws of thermodynamics. viz Laws of Thermodynamics: Zeroth Law of Thermodynamics-Two systems each in thermal equilibrium with a third system are in thermal equilibrium to each other. First Law of Thermodynamics - The change in the energy of a system is the amount of energy added to the system minus the energy spent doing work. Second Law of Thermodynamics - It is impossible for a process to have as its sole result the transfer of heat from a cooler body to a hotter one. Third Law of Thermodynamics - It is impossible to reduce any system to absolute zero in a finite series of operations. This means that a perfectly efficient heat engine cannot be created. Power cycles and refrigeration cycle based on thermodynamic system is studied.

**Course Objectives:**

1. To get the basic concepts of thermodynamics, temperature measurement, first law and also ability to determine the heat, work in various flow & non-flow processes.
2. To gain the knowledge about second law of thermodynamics and determine the change in entropy, availability in various processes.
3. To get the knowledge various phases of pure substance and calculate its properties using steam tables and to determine properties of perfect gases in various processes.
4. To develop to learn the concepts of mixture of gases and to calculate the property values during a any process.
5. To get the knowledge about the working of different types of cycles and their performance.

**Course Outcomes:**

1. Demonstrate knowledge of energy transfer and work done and heat equation in different processes,
2. Power cycles and thermodynamic laws.
3. Demonstrate knowledge of ability to identify & apply fundamentals to solve problems like system
4. Properties, amount of work transfer and heat during various processes, steam properties at different temperatures and pressures using steam tables.
5. Demonstrate their knowledge & ability to design the thermal related components in various fields of
6. Energy transfer equipments.
7. An ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, and

safety manufacturability and sustainability related thermal fields like I.C engines, different types of power plants etc.

8. The ability to use modern engineering tools, software and equipment to analyze energy transfer in required applications.
9. A knowledge of impact of engineering solutions on the society and also on contemporary issues related to different types of power cycles.
10. Recognition of the need for, and an ability to engage in self education and life-long learning.

**UNIT – I**

**Introduction: Basic Concepts:** System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle – Reversibility – Quasi – static Process, 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.

**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 constants – various Non-flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy – Throttling and Free Expansion Processes – Flow processes. Deviations from perfect Gas Model – Vader 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 – Clausius – Clapeyron Equation Property tables. 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, Atmospheric air - Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation, Carrier's Equation – Psychrometric chart.

**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.

**Refrigeration Cycles:** Bell-Coleman cycle- Vapour compression cycle-performance Evaluation.

**TEXT BOOKS:**

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

**REFERENCE BOOKS:**

1. Engineering Thermodynamics/DP Mishra/ Cengage Learning/Second impression 2012
2. Thermodynamics – An Engineering Approach – Yunus Cengel & Boles /TMH
3. Thermodynamics – J. P. Holman / McGraw Hill
4. Engineering Thermodynamics – Jones & Dugan
5. Engineering Thermodynamics/P. Chattopadhyay/Oxford Higher Education/Revised First Edition
6. Thermodynamics & Heat Engines – Yadav – Central Book Depot, Allahabad.

## ME308ES: METALLURGY AND MATERIAL SCIENCE LAB

**B.Tech. II Year I Sem.**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 2 |

**Course Objective:** The purpose of this course is to make the students learn the concepts of Metallurgy and Material Science role in all manufacturing processes which convert raw materials into useful products adapted to human needs.

**Course Outcomes:** The Primary focus of the Metallurgy and Material science program is to provide undergraduates with a fundamental knowledge based associated materials properties, and their selection and application. Upon graduation, students would have acquired and developed the necessary background and skills for successful careers in the materials-related industries. Furthermore, after completing the program, the student should be well prepared for management positions in industry or continued education toward a graduate degree.

**List of Experiments:**

1. Preparation and study of crystal models for simple cubic, body centred cubic, face centred cubic and hexagonal close packed structures.
2. Preparation and study of the Microstructure of pure metals like Iron, Cu and Al.
3. Grain size measurement by different methods.
4. Preparation and study of the Microstructure of Mild steels, low carbon steels, high – C steels.
5. Study of the Microstructures of Cast Irons.
6. Study of Microstructures of different alloy steels.
7. Study of the Microstructures of Non-Ferrous alloys.
8. Study of the Microstructures of Heat treated steels.
9. Hardenability of steels by Jominy End Quench Test.
10. To find out the hardness of various heat treated and untreated plain carbon steels.

# ME307ES: MECHANICS OF SOLIDS LAB

**B.Tech. II Year I Sem.**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 2 |

**Course Overview:**

Mechanics of Solids lab deals with the experiments involving relation of externally applied loads and its internal effect on the bodies. In general study we assume bodies and objects to be rigid but in Mechanics of Solids lab we do consider the deformation/deflection. The lab involves analytical methods for determining the strength, stiffness (deformation characteristics), and stability of the various members in a structural system. The behavior of a member depends not only on the fundamental laws that govern the equilibrium of forces, but also on the mechanical characteristics of the material.

**Course Objectives:**

The objective is to learn the fundamental concepts of stress, strain, and deformation of solids with applications to bars, beams, and columns. Detailed study of engineering properties of materials is also of interest. Fundamentals of applying equilibrium, compatibility, and force-deformation relationships to structural elements are emphasized. The students are introduced to advanced concepts of flexibility and stiffness method of structural analysis. The course builds on the fundamental concepts of engineering mechanics course.

The students will advance the students' development of the following broad capabilities:

1. Students will be able to understand basic concepts of stress, strain and their relations based on linear elasticity. Material behaviors due to different types of loading will be discussed.
2. Students will be able to understand and know how to calculate stresses and deformation of a bar due to an axial loading under uniform and non-uniform conditions.
3. Students will understand how to develop shear-moment diagrams of a beam and find the maximum moment/shear and their locations
4. Students will understand how to calculate normal and shear stresses on any cross-section of a beam. Different cross-sections (including I-beam) will be discussed and applied Continuous Assessment Test 10 marks Mid Semester Test 15 marks End

**Course Outcomes**

1. Analyze the behavior of the solid bodies subjected to various types of loading.
2. Apply knowledge of materials and structural elements to the analysis of simple structures.
3. Undertake problem identification, formulation and solution using a range of analytical methods
4. Analyze and interpret laboratory data relating to behavior of structures and the materials they are made of, and undertake associated laboratory work individually and in teams.
5. Expectation and capacity to undertake lifelong learning.

**Any 10 experiments from the following**

1. Direct tension test
2. Bending test on Simple supported beam
3 Bending test on Cantilever beam
4. Torsion test
5. Brinell hardness test
6. Rockwell hardness test
7. Test on springs
8. Compression test on cube
9. Izod Impact test
10 .Charpy Impact test
11. Punch shear test

## EE308ES: ELECTRICAL AND ELECTRONICS ENGINEERING LAB

**B.Tech. II Year I Sem.**

| L | T | P | C |
|---|---|---|---|
| **0** | **0** | **3** | **2** |

**SECTION A: ELECTRICAL ENGINEERING:**

1. Verification of KCL and KVL.
2. Magnetization characteristics of D.C. Shunt generator.
3. Speed control of DC motor.
4. Swinburne's Test on DC shunt machine.
5. Brake test on DC shunt motor.
6. OC and SC tests on Single-phase transformer.
7. Brake test on 3-phase Induction motor.
8. Regulation by an alternator by synchronous impedance method.

**SECTION B: ELECTRONICS ENGINEERING:**

1. PN Junction Diode Characteristics (Forward bias, Reverse bias)
2. Transistor CE Characteristics (Input and Output)
3. Study of CRO.
4. Zener Diode Characteristics
5. Transistor CE Characteristics
6. Rectifier without Filters (Full wave & Half wave)
7. Rectifier with Filters (Full wave & half wave)

**Note:** Total 12 experiments are to be conducted.
(Six experiments from PART-A, Six experiments from PART-B)

## MC300HS: GENDER SENSITIZATION LAB

**B.Tech. II Year I Sem.**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 0 |

**Course Objectives:**

- To develop students' sensibility with regard to issues of gender in contemporary India.
- To provide a critical perspective on the socialization of men and women.
- To introduce students to information about some key biological aspects of genders.
- To expose the students to debates on the politics and economics of work.
- To help students reflect critically on gender violence.
- To expose students to more egalitarian interactions between men and women.

**Course Outcomes:**

- Students will have developed a better understanding of important issues related to gender in contemporary India.
- Students will be sensitized to basic dimensions of the biological, sociological, psychological and legal aspects of gender. This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film.
- Students will attain a finer grasp of how gender discrimination works in our society and how to counter it.
- Students will acquire insight into the gendered division of labour and its relation to politics and economics.
- Men and women students and professionals will be better equipped to work and live together as equals.
- Students will develop a sense of appreciation of women in all walks of life.
- Through providing accounts of studies and movements as well as the new laws that provide protection and relief to women, the textbook will empower students to understand and respond to gender violence.

**UNIT - I**
**UNDERSTANDING GENDER**
**Gender:** Why Should We Study It? (*Towards a World of Equals*: Unit -1)
**Socialization:** Making Women, Making Men (*Towards a World of Equals*: Unit -2)
Introduction. Preparing for Womanhood. Growing up Male. First lessons in Caste. Different Masculinities.

**UNIT - II**
**GENDER AND BIOLOGY**
**Missing Women:** Sex Selection and Its Consequences (*Towards a World of Equals*: Unit -4)
Declining Sex Ratio. Demographic Consequences.
**Gender Spectrum:** Beyond the Binary (*Towards a World of Equals*: Unit -10)

Two or Many? Struggles with Discrimination.

**UNIT - III**
**GENDER AND LABOUR**
**Housework:** the Invisible Labour (*Towards a World of Equals*: Unit -3)
"My Mother doesn't Work." "Share the Load."
**Women's Work**: Its Politics and Economics (*Towards a World of Equals*: Unit -7)
Fact and Fiction. Unrecognized and Unaccounted work. Additional Reading: Wages and Conditions of Work.

**UNIT - IV**
**ISSUES OF VIOLENCE**
**Sexual Harassment:** Say No! (*Towards a World of Equals*: Unit -6)
Sexual Harassment, not Eve-teasing- Coping with Everyday Harassment- Further Reading: "*Chupulu"*.
**Domestic Violence:** Speaking Out (*Towards a World of Equals*: Unit -8)
Is Home a Safe Place? -When Women Unite [Film]. Rebuilding Lives. Additional Reading: New Forums for Justice.
Thinking about Sexual Violence (*Towards a World of Equals*: Unit -11)
Blaming the Victim-"I Fought for my Life…." - Additional Reading: The Caste Face of Violence.

**UNIT - V**
**GENDER: CO - EXISTENCE**
**Just Relationships:** Being Together as Equals (*Towards a World of Equals*: Unit -12)
Mary Kom and Onler. Love and Acid just do not Mix. Love Letters. Mothers and Fathers. Additional Reading: Rosa Parks-The Brave Heart.

**TEXTBOOK:**
All the five Units in the Textbook**, *"Towards a World of Equals: A Bilingual Textbook on Gender"*** written by A. Suneetha, Uma Bhrugubanda, Duggirala Vasanta, Rama Melkote, Vasudha Nagaraj, Asma Rasheed, Gogu Shyamala, Deepa Sreenivas and Susie Tharu and published by **Telugu Akademi, Hyderabad**, Telangana State in the year **2015**.

**Note:** Since it is an Interdisciplinary Course, Resource Persons can be drawn from the fields of English Literature or Sociology or Political Science or any other qualified faculty who has expertise in this field from engineering departments.

**REFERENCE BOOKS:**
1. Menon, Nivedita. Seeing like a Feminist. New Delhi: Zubaan-Penguin Books, 2012
2. Abdulali Sohaila. "*I Fought For My Life…and Won*."Available online at: http://www.thealternative.in/lifestyle/i-fought-for-my-lifeand-won-sohaila-abdulal/

## NT401ES: PRODUCTION TECHNOLOGY

**B.Tech. II Year II Sem.**

| L | T | P | C |
|---|---|---|---|
| 4 | 1 | 0 | 4 |

**Course Overview:**

Production technology is a combination of manufacturing technology with management science. A production engineer typically has a wide knowledge of engineering practices and is aware of the management challenges related to production. The goal is to accomplish the production process in the smoothest, most-judicious and most-economic way.

Production technology encompasses the application of castings, machining processing, joining processes, metal cutting & tool design, metrology, machine tools, machining systems, automation, jigs and fixtures, die and mould design, material science, design of automobile parts, and machine designing and manufacturing. Production engineering also overlaps substantially with manufacturing engineering and industrial engineering.

In industry, once the design is realized, production engineering concepts regarding work-study, ergonomics, operation research, manufacturing management, materials management, production planning, etc., play important roles in efficient production processes. These deal with integrated design and efficient planning of the entire manufacturing system, which is becoming increasingly complex with the emergence of sophisticated production methods and control systems.

**Course objectives:**

1. To reorganization of Practical orientation of Manufacturing Processes
2. Understand the basic parameters in the foundry section to producing various metallic parts.
3. Knowledge on different kinds of Production Processes and practices available for Shaping or Molding several daily used parts for industries.
4. Equipment selection for various deformation Processes will be understood.
5. Understand the various methods used to producing plastic shapes.

**Course Outcomes:**

1. An ability to contrast the different types of manufacturing process and apply the Technology Systems Model to manufacturing identify, illustrate, solve, formulate, distinguish & compare different working Process
2. An Ability to understand the design a system, component or process to meet desired needs within, realistic constraints such as manufacturability, economic, environmental, safety & sustainability etc.,
3. An ability to apply knowledge of mathematics, science, and engineering, to Identify, define, and clearly state a manufacturing design problem.
4. An ability to identify, formulates, analyzes, and solves Engineering Problems in Optimum time and ability to demonstrate ability to welding and conduct experiments, analyze and interpret data.

5. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice with the concept of virtual work. Recognition of the need for, and an ability to engage in self education and life-long learning.

**UNIT – I**

**Casting:** Steps involved in making a casting - Its applications - Patterns and Types of patterns – Pattern allowances and their construction. Types of casting processes –Solidification of casting.

**UNIT – II**

**Welding:** welding Types - Oxy-fuel gas cutting – standard time and cost calculations. Arc welding, forge welding – Resistance welding, Thermit welding.

**UNIT – III**

Inert Gas Welding, TIG Welding, MIG welding, Friction welding, induction welding, explosive welding, Laser Welding, Laser Welding Soldering and Brazing, Heat affected zone in welding. Welding defects – causes and remedies – destructive and non- destructive testing of welds.

**UNIT – IV**

Hot working, cold working, strain hardening, recovery, recrystallisation 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
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 for the above operations.

**UNIT – V**

**Extrusion of Metals:** Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion and pipe making, Hydrostatic extrusion. Forces in extrusion
**Forging Processes:** Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging. **Forging hammers**: Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.

**TEXT BOOKS:**

1. Manufacturing Technology (Vol.1) / P.N. Rao/TMH/2$^{nd}$ Edition
2. Workshop Technology (Vol.1) /Hajra Chowdary/Asia Publishing House/2$^{nd}$ Edition

**REFERENCE BOOKS:**

1. Production Technology /Sarma P C /S. Chand
2. Production Technology / R.K. Jain/Khanna Publishers
3. Metal Casting / T.V Ramana Rao / New Age

4. Principles of Metal Castings / Rosenthal/TMH
5. A Course in Workshop Technology/B.S. Raghuwamshi /Dhanpat rai & Sons
6. Manufacturing Engineering and Technology/Kalpakjin S/ Pearson Edu.

## NT402ES: DESIGN OF MACHINE MEMBERS - I

**B.Tech. II Year II Sem.**

| L | T | P | C |
|---|---|---|---|
| 4 | 1 | 0 | 4 |

### Course Overview

This course deals the Systematic approach to design, standardization, Design and Manufacturing, Engineering Materials, Simple Stresses and Compound Stresses in Machine Elements, Design For Strength, strength of mechanical elements; theories of failure under static and dynamic loading situations; impact loading, Design of Fasteners, Design of joints, Design Of Keys and cotter joints, Shaft Couplings, Rivet Joints, Welded Joints, Design of Springs and Shafts.

### Course Objectives

- To enhance the ability of students to apply mathematics and fundamentals of science for design Machine elements.
- To develop good and careful problem formulation and solution skills for designing selected machine components and systems.
- To develop an ability to make proper analysis and assumptions by employing the concepts and theories.
- To develop a working knowledge in the use of various standard procedures and catalog information in the identification and selection of engineering materials.

### Course Outcomes

- Students should be able to understand design and manufacturing considerations
- Students should be able to understand Engineering materials and their properties, BIS codes for steels
- Students should be able to understand stresses in machine members
- Students should be able to understand Fatigue loading, stress concentration, endurance limit, theories of failure.
- Students should be able to understand riveted joints, bolted joints, cotter, knuckle joints, keys, couplings
- Students should be able to understand stresses and design of shaft
- Students should be able to understand deflections in springs.
- Students Can participate and succeed in competitive examinations like GATE, IES

### UNIT - I

**Introduction:** General considerations. Classification of Machine Design. Steps involved in Machine Design.

**Stresses in Machine Members:** Simple stresses, Combined stresses, Torsional and bending stresses, impact stresses, stress strain relation, various theories of failure, factor of safety, Design for strength and rigidity, preferred numbers. The concept of stiffness in tension, bending, torsion and combined situations, Static strength design based on fracture toughness.

**UNIT - II**

**Strength of Machine Elements:** Stress concentration, Theoretical stress Concentration factor, Fatigue stress concentration factor notch sensitivity, Design for fluctuating stresses, Endurance limit, Estimation of Endurance strength, Goodman's line, Soderberg's line, Modified Goodman's line.

**UNIT - III**

**Riveted and Welded Joints:** Design of joints with initial stresses, eccentric loading

**Bolted Joints**: Design of bolts with pre-stresses, Design of joints under eccentric loading, locking devices, both of uniform strength, different seals.

**UNIT - IV**

**Keys, Cotters and Knuckle Joints, Shafts:** Design of Keys, stresses in keys, cottered joints, spigot and socket, sleeve and cotter, jib and cotter joints- Knuckle joints.

**Shafts**: Design of solid and hollow shafts for strength and rigidity, Design of shafts for combined bending and axial loads, Shaft sizes, BIS code. Use of internal and external circlips, Gaskets and seals (stationary & rotary).

**UNIT - V**

**Shaft Coupling:** Rigid couplings, Muff, Split muff and Flange couplings. Flexible couplings, Flange coupling (Modified)

**Mechanical Springs:** Stresses and deflections of helical springs, Extension, compression springs, Springs for fatigue loading, natural frequency of helical springs, Energy storage capacity, helical torsion springs, Co-axial springs, leaf springs.

**TEXT BOOKS:**

1. V. Bandari (2011), A Text Book of Design of Machine Elements, 3rd edition, Tata McGraw hill education (P) ltd, New Delhi, India.
2. R. L. Norton (2006), Machine Design (An Integrated approach), 2nd edition, Pearson Publishers, Chennai, India.

**REFERENCE BOOKS:**

1. Shigley, J.E, (2011), Mechanical Engineering Design, 9th Edition, Tata McGraw-Hill, New Delhi, India.
2. S. M.D. Jalaludin, (2011), Machine Design, 3rd Edition, Anuradha Publishers, Kumbakonam, Chennai, India.
3. P. Kannaiah, (2012), Machine Design, 2nd Edition, Scitech Publications India Pvt. Ltd, New Delhi, India.

## ME401ES: FLUIDS MECHANICS AND HYDRAULIC MACHINES

**B.Tech. II Year II Sem.**

| L | T | P | C |
|---|---|---|---|
| 4 | 1 | 0 | 4 |

**Course Overview:**
The aim of this course is to introduce basic principles of fluid mechanics and it is further extended to cover the application of fluid mechanics by the inclusion of fluid machinery. Nowadays the principles of fluid mechanics find wide applications in many situations. The course deals with the fluid machinery, like turbines, pumps in general and in power stations. This course also deals with the large variety of fluids such as air, water, steam, etc; however the major emphasis is given for the study of water

**Course Objectives:** The objectives of the course are to enable the student;

1. To understand the basic principles of fluid mechanics
2. To identify various types of flows
3. To understand boundary layer concepts and flow through pipes
4. To evaluate the performance of hydraulic turbines
5. To understand the functioning and characteristic curves of pumps

**Course Outcomes:**

1. Able to explain the effect of fluid properties on a flow system.
2. Able to identify type of fluid flow patterns and describe continuity equation.
3. To analyze a variety of practical fluid flow and measuring devices and utilize fluid Mechanics principles in design.
1. To select and analyze an appropriate turbine with reference to given situation in power plants.
4. To estimate performance parameters of a given Centrifugal and Reciprocating pump.
5. Able to demonstrate boundary layer concepts.

**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- 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 & unsteady, uniform & non uniform, laminar & turbulent, rotational & 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**

**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.

**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, venturi meter, and orifice meter, Flow nozzle

**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, work done – barometric head- losses and efficiencies specific speed- performance characteristic curves, NPSH.

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

**TEXT BOOKS:**

1. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH.
2. Fluid Mechanics and Hydraulic Machines by Rajput.

**REFERENCES:**

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.
3. Hydraulic Machines by Banga & Sharma, Khanna Publishers.

## NT403ES: DYNAMICS OF MACHINES

**B.Tech. II Year II Sem.**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Overview:**

This course expands on the mechanical engineering student's background in dynamic synthesis and analysis by providing significant skills and experience in creating and modeling mechanisms. This course is intended to deal with the forces and their effects, while acting upon the machine parts in motion. The knowledge of this subject is very essential for an engineer in designing the various parts of a machine. Study of applications of gyroscopes is very helpful to learn the precession and its effect on automobiles. The study of dynamics of machinery is an applied field of mechanical engineering that is concerned with understanding the relationship between the geometry and the motions of the parts of a machine and the forces that produce this motion. This course helps to learn how to analyze the motions of mechanisms, design mechanisms to have given motions, and analyze forces in machines. Application of vibrations to the analysis and design of machines and mechanical components.

**Course Objectives:**

1. The objectives of the course are to enable the student to have;
2. An ability to derive frictional forces on bodies in motion by applying knowledge of mathematics and mechanics.
3. An ability to design and conduct experiments on gyroscopes, as well as to analyze and interpret data.
4. An ability to design, formulate, and solve engineering problems on clutches and brakes.
5. An ability to understand the purpose of dynamometers and find the power of an engine.
6. An ability to balance both the rotating and reciprocating masses.
7. An ability to study the vibrations of beams and springs when masses are attached
8. To enhance the ability of students to work in teams, establish the leadership role.
9. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.
10. Recognition of the need for, and an ability to engage in life-long learning.
11. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

**Course Outcomes:** After completing this course the student must demonstrate the knowledge and ability to:

1. Analyze Dynamics of the three-dimensional particle motion in various coordinate systems: Cartesian, natural, and cylindrical.
2. Ability to learn the concepts of gyroscopic effects and effect of precision motion on the stability of moving vehicles.

3. Ability to learn the concepts of static and dynamic force analysis of planar mechanisms.
4. Understanding of the concepts of friction-clutches, brakes and dynamometers and its importance.
5. Understanding the importance of turning moment diagrams, fly wheels and governors its analysis.
6. Ability to understand concepts of various balancing of rotary and reciprocating mass.
7. Understanding of the concepts of vibrations and simple problems on forced damped vibrations.
8. Able to communicate effectively in both verbal and written form.
9. Understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
10. Develop confidence for self education and ability for life-long learning. 11. Can participate and succeed in competitive examinations like GATE, GRE.

**UNIT – I**

**Angular Motion:** Gyroscopes – effect of precession – motion on the stability of moving vehicles such as motorcycle – motorcar – aero planes and ships. Static and Dynamic Force Analysis of planar mechanisms.

**UNIT – II**

**Friction:** Inclined plane – Friction of screw and nuts - Pivots and collars – uniform pressure, uniform wear – friction circle and friction axis: lubricated surfaces – boundary friction – film lubrication. Clutches, Single plate, multi plate, cone clutch, centrifugal clutches.

**Brakes and Dynamometers:** Simple block brake - Internal expanding brake- band brake of vehicle. Dynamometers – absorption and transmission types. General description and methods of operation.

**UNIT – III**

**Turning Moment Diagram and Flywheels:** Turning moment- Inertia torque-connecting rod angular velocity and acceleration-crank effort and torque diagrams-fluctuation of energy – flywheels and their

**Governors:** Watt, Porter and Proell governors- Spring loaded governors – Hartnell and Hartung with auxiliary springs- Sensitiveness, isochronisms and hunting– effort and power of the governors.

**UNIT – IV**

**Balancing:** Balancing of rotating masses- Primary, Secondary, and higher balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples. Examination of “V” and multi cylinder in-line and radial engines for primary and secondary balancing- locomotive balancing – Hammer blow – Swaying couple – variation of tractive effort.

**UNIT – V**

**Vibrations:** Free Vibration of mass attached to vertical spring –oscillation of pendulums-Transverse loads – vibrations of beams with concentrated and distributed loads. Dunkerly's method – Raleigh's method. Whirling of shafts – critical speed – torsional vibrations – one, two and three rotor systems.

**TEXT BOOKS:**

1. Theory of Machines/ S. S. Rattan/McGraw Hill.
2. Theory of Mechanism and Machines /Jagadish Lal/Metropolitan Book Company

**REFERENCE BOOKS:**

1. Theory of Machines/ Shigley/ Mc Graw Hill Publishers
2. Theory of Machines/ Thomas Bevan/Pearson

## SM405MS: BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

**B.Tech. II Year II Sem.**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objective:** To learn the basic Business types, impact of the Economy on Business and Firms specifically. To analyze the Business from the Financial Perspective.

**Course Outcome:** The students will understand the various Forms of Business and the impact of economic variables on the Business. The Demand, Supply, Production, Cost, Market Structure, Pricing aspects are learnt. The Students can study the firm's financial position by analysing the Financial Statements of a Company.

**UNIT – I**

**Introduction to Business and Economics:**

**Business**: Structure of Business Firm, Theory of Firm, Types of Business Entities, Limited Liability Companies, Sources of Capital for a Company, Non-Conventional Sources of Finance.

**Economics:** Significance of Economics, Micro and Macro Economic Concepts, Concepts and Importance of National Income, Inflation, Money Supply in Inflation, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

**UNIT – II**

**Demand and Supply Analysis:**

**Elasticity of Demand:** Elasticity, Types of Elasticity, Law of Demand, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of Demand, Elasticity of Demand in decision making, Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting.

**Supply Analysis:** Determinants of Supply, Supply Function & Law of Supply.

**UNIT - III**

**Production, Cost, Market Structures & Pricing:**

**Production Analysis:** Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions.

**Cost analysis**: Types of Costs, Short run and Long run Cost Functions.

**Market Structures**: Nature of Competition, Features of Perfect competition, Monopoly, Oligopoly, and Monopolistic Competition.

**Pricing:** Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis, and Cost Volume Profit Analysis.

**UNIT - IV**

**Financial Accounting:** Accounting concepts and Conventions, Accounting Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, and Preparation of Final Accounts.

**UNIT - V**

**Financial Analysis through Ratios:**

Concept of Ratio Analysis, Liquidity Ratios, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Solvency, Leverage Ratios (simple problems).

Introduction to Fund Flow and Cash Flow Analysis (simple problems).

**TEXT BOOKS:**

1. D. D. Chaturvedi, S. L. Gupta, Business Economics - Theory and Applications, International Book House Pvt. Ltd. 2013.
2. Dhanesh K Khatri, Financial Accounting, Tata McGraw Hill, 2011.
3. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, Managerial Economics, 2e, Tata McGraw Hill Education Pvt. Ltd. 2012.

**REFERENCES:**

1. Paresh Shah, Financial Accounting for Management 2e, Oxford Press, 2015.
2. S. N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, Financial Accounting, 5e, Vikas Publications, 2013.

## NT406ES: PRODUCTION TECHNOLOGY LAB

**B.Tech. II Year II Sem.**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 2 |

**Course Objectives:** To make the student to know;
- Design and manufacture of simple patterns
- Sand testing
- Arc welding, gas welding and resistance welding equipment for the fabrication of welded joints
- Pipe bending and injection molding equipment

**Course Outcomes:** The student will be able to:
- Design and manufacture simple patterns
- Control sand properties in foundry
- Operate arc welding, gas welding and resistance welding equipment
- Use pipe bending and injection moulding equipment

**Minimum of 12 Exercises need to be performed**

**I. METAL CASTING LAB:**
1. Pattern Design and making - for one casting drawing.
2. Sand properties testing - Exercise -for strengths, and permeability – 1
3. Moulding Melting and Casting - 1 Exercise

**II. WELDING LAB:**
1. ARC Welding Lap & Butt Joint - 2 Exercises
2. Spot Welding - 1 Exercise
3. TIG Welding - 1 Exercise
4. Plasma welding and Brazing - 2 Exercises
   a. (Water Plasma Device)

**III. MECHANICAL PRESS WORKING:**
1. Blanking & Piercing operation and study of simple, compound and progressive press tool.
2. Hydraulic Press: Deep drawing and extrusion operation.
3. Bending and other operations

**IV. PROCESSING OF PLASTICS**
1. Injection Moulding
2. Blow Moulding

**REFERENCE BOOK:**

1. Dictionary of Mechanical Engineering – G.H.F. Nayler, Jaico Publishing House.

## ME407ES: FLUID MECHANICS AND HYDRAULIC MACHINES LAB

**B.Tech. II Year II Sem.**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 2 |

**Course Overview:**
The aim of this course is to introduce basic principles of fluid mechanics and it is further extended to cover the application of fluid mechanics by the inclusion of fluid machinery. Nowadays the principles of fluid mechanics find wide applications in many situations. The course deals with the fluid machinery, like turbines, pumps in general and in power stations. This course also deals with the large variety of fluids such as air, water, steam, etc; however the major emphasis is given for the study of water.

**Course Objectives:**
1. To understand the basic principles of fluid mechanics.
2. To identify various types of flows.
3. To understand boundary layer concepts and flow through pipes.
4. To evaluate the performance of hydraulic turbines.
5. To understand the functioning and characteristic curves of pumps.

**Course Outcomes:**
1. Able to explain the effect of fluid properties on a flow system.
2. Able to identify type of fluid flow patterns and describe continuity equation.
3. To analyze a variety of practical fluid flow and measuring devices and utilize fluid mechanics principles in design.
4. To select and analyze an appropriate turbine with reference to given situation in power plants.
5. To estimate performance parameters of a given Centrifugal and Reciprocating pump.
6. Able to demonstrate boundary layer concepts

**List of Experiments**
1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Calibration of Venturimeter.
9. Calibration of Orifice meter.
10. Determination of friction factor for a given pipe line.
11. Determination of loss of head due to sudden contraction in a pipeline.
12. Verification of Bernoulli's Theorems

**Note:** Any 10 of the above 12 experiments are to be conducted.

## NT408ES: DYNAMICS OF MACHINES LAB

**B.Tech. II Year II Sem.**

| L | T | P | C |
|---|---|---|---|
| **0** | **0** | **3** | **2** |

**Note:** Minimum of 12 Exercises need to be performed

**Course Overview:** By the end of the course student will be able to perform vibration analysis, balancing system and Trajectory planning of a robot in joint space scheme.

**Course Objectives:** To create awareness on various vibration systems, gyroscopic couple, natural frequency and FFT analyzer.

**Course Outcomes:** At the conclusion of the course, students will have:
1. An understanding of the basic performance of steady state amplitude of a forced vibratory system
2. An understanding of the performance of Static balancing using steel balls
3. An understanding of basic Direct Kinematic analysis of a robot
4. An understanding of good laboratory practice.
5. An ability to prepare effective written reports on the performance Palletizing operation using Robot programming

**List of Experiments:**
1. Determination of damped natural frequency of vibration of the vibrating system with different viscous oils.
2. Determination of steady state amplitude of a forced vibratory system.
3. Static balancing using steel balls.
4. Determination of the magnitude and orientation of the balancing mass in dynamic balancing.
5. Field balancing of the thin rotors using vibration pickups.
6. Determination of the magnitude of gyroscopic couple, angular velocity of precession and representation of vectors.
7. Determination of natural frequency of given structure using FFT analyzer.
8. Diagnosis of a machine using FFT analyzer.
9. Direct Kinematic analysis of a robot.
10. Inverse Kinematic analysis of a robot.
11. Trajectory planning of a robot in joint space scheme.
12. Palletizing operation using Robot programming.

## MC400ES: ENVIRONMENTAL SCIENCE AND TECHNOLOGY

**B.Tech. II Year II Sem.**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 0 |

**Course Objectives:**

- Understanding the importance of ecological balance for sustainable development.
- Understanding the impacts of developmental activities and mitigation measures
- Understanding the environmental policies and regulations

**Course Outcomes:** Based on this course, the Engineering graduate will understand /evaluate / develop technologies on the basis of ecological principles and environmental regulations which in turn helps in sustainable development

**UNIT - I**

**Ecosystems:** Definition, Scope and Importance of ecosystem. Classification, structure and function of an ecosystem, Food chains, food webs and ecological pyramids. Flow of energy, Biogeochemical cycles, Bioaccumulation, Biomagnification, ecosystem value, services and carrying capacity, Field visits.

**UNIT - II**

**Natural Resources: Classification of Resources:** Living and Non-Living resources, **water resources:** use and over utilization of surface and ground water, floods and droughts, Dams: benefits and problems. **Mineral resources:** use and exploitation, environmental effects of extracting and using mineral resources, **Land resources:** Forest resources, **Energy resources:** growing energy needs, renewable and non renewable energy sources, use of alternate energy source, case studies.

**UNIT - III**

**Biodiversity And Biotic Resources:** Introduction, Definition, genetic, species and ecosystem diversity. Value of biodiversity; consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega diversity nation, Hot spots of biodiversity. Field visit. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; conservation of biodiversity: In-Situ and Ex-situ conservation. National Biodiversity act.

**UNIT - IV**

**Environmental Pollution and Control Technologies: Environmental Pollution:** Classification of pollution, **Air Pollution:** Primary and secondary pollutants, Automobile and Industrial pollution, Ambient air quality standards. **Water pollution:** Sources and types of pollution, drinking water quality standards. **Soil Pollution:** Sources and types, Impacts of modern agriculture, degradation of soil. **Noise Pollution:** Sources and Health hazards, standards, **Solid waste:** Municipal Solid Waste management, composition and characteristics of e-Waste and its management. **Pollution control technologies:** Wastewater Treatment methods: Primary, secondary and Tertiary.

Overview of air pollution control technologies, Concepts of bioremediation. **Global Environmental Problems and Global Efforts: C**limate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). Deforestation and desertification. International conventions / Protocols: Earth summit, Kyoto protocol and Montréal Protocol.

**UNIT - V**

**Environmental Policy, Legislation & EIA:** Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid waste management and handling rules, biomedical waste management and handling rules, hazardous waste management and handling rules. EIA: EIA structure, methods of baseline data acquisition. Overview on Impacts of air, water, biological and Socio-economical aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). **Towards Sustainable Future:** Concept of Sustainable Development, Population and its explosion, Crazy Consumerism, Environmental Education, Urban Sprawl, Human health, Environmental Ethics, Concept of Green Building, Ecological Foot Print, Life Cycle assessment (LCA), Low carbon life style.

**SUGGESTED TEXT BOOKS:**

1. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.
2. Environmental Studies by R. Rajagopalan, Oxford University Press.

**REFERENCE BOOKS:**

1. Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi.
2. Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.
3. Environmental Science by Daniel B. Botkin & Edward A. Keller, Wiley INDIA edition.
4. Environmental Studies by Anubha Kaushik, 4$^{th}$ Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.

## THERMAL ENGINEERING

**B.Tech. III Year I Sem.** **L T P C**
**Course Code: NT501PC** **4 1 0 4**

**Course Overview:**
This course is intended to introduce basic principles of internal combustion engines, compressors and refrigeration are widely used in automobile, agriculture, industry for transport, water pumping, electricity generation, earth moving and to supply mechanical power to grinders, crushers etc. Compressors are used for supply of gases including air at higher pressure. Compressors are used to supply compressed air to all pneumatic equipments and for gases such as cooking gas, oxygen, nitrogen, neon, argon compressors are also used. Thus there is great relevance for this course for mechanical engineers.

**Course Objectives:**
1. To introduce basic principles of operation of IC engines compressors and refrigeration systems.
2. To understand the procedures of testing and evaluating the performance of these machines.
3. To know the maintenance details and procedures.
4. Teach students to conduct experiments in laboratories and analyze the results with theoretical ones.

**Course Outcomes:** The student will be able to:
1. Understand main idea and importance behind the 2 - S and 4 - S IC engines.
2. To analyze the working of the basic components in the IC engines, Compressors and Refrigeration systems.
3. Understand the combustion process and also how it does affect the performance of the IC engines.
4. Apply the thermodynamic principles in the design of an IC engines, compressors, and refrigeration system.
5. Formulate and perform the procedures required for the maintenance and operation of IC engines, compressors, and refrigeration systems.
6. Compare different IC engines, compressors, and refrigeration systems and develop a system which meets the requirements.

**UNIT – I**
**Internal Combustion Engines:** Introduction, I.C. ENGINE Classification-Engine Systems, Fuel, Carburetor, Fuel Injection System, Ignition, Cooling and Lubrication. Comparison of Air Standard and Actual Cycles, Volumetric Efficiency.
**Combustion in S.I. & C.I. Engines:** Normal Combustion and abnormal combustion – Importance of flame speed and effect of engine variables – Types of Abnormal combustion, pre-ignition and knocking (explanation of) - anti knock additives – combustion chamber – requirements, types. Four stages of combustion in C.I. Engines– Delay period and its importance – Diesel Knock– Need for air movement, turbulence– fuel requirements, and fuel rating.

**UNIT – II**

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

**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 and rotary types.

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

**Gas Turbines:** Simple gas turbine plant – Ideal cycle, essential components – parameters of performance – actual cycle – regeneration, inter stage cooling and reheating –Closed and Semi-closed cycles – merits and demerits of, Brief concepts about compressors, combustion chambers and turbines in the context of Gas Turbine Power Plants.

**UNIT – IV**

**Steam Generators & Nozzles:** Steam Boilers (Steam Generators) Working Principle and Classification, Function of Steam nozzles – applications - types, Flow through nozzles, thermodynamic analysis – assumptions – nozzle exit velocity - Ideal (Isentropic) and actual expansion in nozzle, velocity coefficient, condition for maximum discharge, critical pressure ratio, degree of under cooling - Wilson line.

**UNIT – V**

**Steam Turbines:** Classification –Impulse turbine; Mechanical details – Velocity diagram – effect of friction – power developed, axial thrust, blade or diagram efficiency – condition for maximum efficiency. **De-Laval Turbine** - its 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. **Steam Condensers:** Classification of condensers – working principle of different types.

**TEXT BOOKS:**

1. I.C. Engines - V. GANESAN, TMH
2. Thermal Engineering / Rajput / Lakshmi Publications.

**REFERENCES:**

1. Thermal Engineering-P. L. Bellaney/ Khanna Publishers.
2. IC Engines – Mathur & Sharma – Dhanpath Rai & Sons.

# MACHINE TOOLS

**B.Tech. III Year I Sem.** **L T P C**
**Course Code: NT502PC** **4 1 0 4**

**Course Overview:**
At the very outset of engineering development materials were cut by means of simple hand tools. Gradually, with the development of civilization and engineering, work done by hand tools gives way to the work performed by special machines which are called machine tools.

Hand tools are tools which are held and used by the hands for shaping and sizing a work and there is no mechanism in them. The cutting away of the excess metal in the form of chips or small pieces is simply done by the muscular efforts of man. As a result, the process is time consuming and not gives satisfactory surface finish. It includes files, saw, chisel, scrapper, etc. which are very commonly used in bench and fitting works and assembly of machines.

**Course Objectives:**
1. Machine tools is one of the important subject in mechanical engineering faculty, not only in educational institutional, but it has very much of importance in industrial domain. Without a machine tool, there is no industry.
2. A source of power is always needed in various workshop processes particularly in cutting and forming of metal in a machine tool. In the metal-working industry work pieces of most different shapes and dimensions and of different materials are worked. In every industry we need shaping of materials.
3. This shaping of materials is done by either non-cutting process or cutting process. For example forging, pressing, drawing, etc are non- cutting shaping processes. Turning, drilling, mailing etc are comes under cutting shaping operations.
4. The process of metal cutting in which chip is formed is affected by relative motion between the work piece and the hard edge of a cutting tool held against the work piece. Such relative motion is produced by combination of rotary and translating movements either of work piece or the cutting tool or of both.
5. Machining process also include other processes like grinding, slotting, shaping, honing, planning, lapping, and broaching operations.
6. After completion of the machine tools course, students can be able to identify various applications of different tools, can be able to differentiate various tools for different machining operations, and also they can be able to solve many industrial problems regarding machine tools. And also as the kinematics of machines studied, students can be able to design various machine tools for various machines.

**Course Outcomes:**
1. An ability to understand the basic parameters in the metal cutting operation, to Calculate analytically the forces and other parameter associated with orthogonal cutting
2. An Ability To Know the various cutting fluids and their application methods, to

understand the importance of lathe, its many varieties and basic structure of center lathe

3. An ability to Understands operation of shaper, slotter , planer and drilling machine, the characteristics feature of the milling and drilling machine
4. An ability To Know the various types of milling machine ,grinding machine, boring machine s and their application and their operations, need for jigs and fixtures and Design jigs for practical application
5. An ability to Know the various types of milling machine ,grinding machine, boring machines and their applications and their operations

**UNIT – I**

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

**UNIT – II**

Engine lathe – Principle of working, specification of lathe – types of lathe – work and tool holding devices, Taper turning, Thread turning – Lathe attachments. Turret and capstan lathe – Principal features of automatic lathes – classification: Single spindle and multi-spindle automatic lathes – tool layouts.

**UNIT – III**

Shaping, slotting and planing machines – Principles of working – Principal parts – specification, classification, operations performed. Kinematic scheme of the shaping, slotting and planing machines, machining time calculations.

Drilling and Boring Machines – Principles of working, specifications, types, operations performed – tool holding devices – twist drill – Boring machines – Fine boring machines – Jig boring machine. Deep hole drilling machine. Kinematics scheme of the drilling and boring machines

**UNIT – IV**

Milling machine – Principles of working – specifications – classifications of milling machines – Principal features of horizontal, vertical and universal milling machines – machining operations Geometry of milling cutters – methods of indexing – Accessories to milling machines, kinematic scheme of milling machines.

Lapping, honing and broaching machines – comparison of grinding, lapping and honing. Kinematics scheme of Lapping, Honing and Broaching machines. Constructional features speed and feed Units, machining time calculations

**UNIT –V**

**Finishing Processes:** Grinding – fundamentals – theory of grinding – classification of grinding machines – cylindrical and surface grinding machine-Tool and cutter grinding machine – special types of grinding machines, Different types of abrasives – bonds specification of a grinding wheel and selection of a grinding wheel, Kinematic. scheme of grinding machines.

**TEXT BOOKS:**

1. Production Technology/HMT/Tata McGraw Hill
2. Production Technology / R.K. Jain and S.C. Gupta/Khanna Publishers.

**REFERENCE BOOKS:**

1. Principles of Machine Tools/ Bhattacharya A and Sen.G.C/ New Central Book Agency.
2. Workshop Technology – Vol.-II/ B.S. Raghuvamsi
3. Elements of Work Shop Technology – Vol. II/Hajra Choudry/ Media Promoters.
4. Fundamentals of Metal Machining and Machine Tools/ Geofrey Boothroyd/ McGraw Hill
5. Manufacturing Processes/JP Kaushish/Prentice Hall/2nd Edition
6. Machine Tools/C Elanchezhian & M. Vijayan/Anuradha Publications

# DESIGN OF MACHINE MEMBERS – II

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year I Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: NT503PC** | **4** | **1** | **0** | **4** |

**Note:** Design Data Book is permitted. Design of all components should include design for strength and rigidity apart from engineering performance requirements.

**Pre-requisites**: Study of engineering mechanics, design of machine members-I and theory of machines.

**Course objectives**:
- To gain knowledge about designing the commonly used important machine members such as bearings, engine parts, springs , belts, gears etc.
- To design the components using the data available in design data books.

**Course Outcomes:**
- Knowledge about journal bearing design using different empirical relations.
- Estimation of life of rolling element bearings and their selection for given service conditions.
- Acquaintance with design of the components as per the standard, recommended procedures which is essential in design and development of machinery in industry.

**UNIT – I**

**Sliding contact bearings:** Types of Journal bearings – Lubrication – Bearing Modulus – Full and partial bearings – Clearance ratio – Heat dissipation of bearings, bearing materials – journal bearing design.

**UNIT – II**

**Rolling contact bearings:** Ball and roller bearings – Static load – dynamic load – equivalent radial load – design and selection of ball & roller bearings.

**UNIT – III**

**Engine Parts:** Connecting Rod : Thrust in connecting rod – stress due to whipping action on connecting rod ends –Pistons, Forces acting on piston – Construction, Design and proportions of piston.

**UNIT – IV**

**Mechanical Springs:** Stresses and deflections of helical springs – Extension and compression springs – Design of springs for fatigue loading – natural frequency of helical springs – Energy storage capacity – helical torsion springs – Design of co-axial springs, Design of leaf springs.

**Belts & Pulleys**: Transmission of power by Belt and Rope ways, Transmission efficiencies, Belts – Flat and V types – Ropes - pulleys for belt and rope drives.

**UNIT – V**

**Gears :** Spur gears& Helical gears- Brief introduction involving important concepts – Design of gears using AGMA procedure involving Lewis and Buckingham equations. Check for wear.

**TEXT BOOKS:**

1. Design of Machine Elements / Spotts/ Pearson
2. Machine tool design / V. Bhandari / Mc Graw Hill

**REFERENCE BOOKS:**

1. Design of Machine Elements-II / Annaiah / New Age
2. Design of Machine Elements / Sharma and Purohit/PHI

# FUNDAMENTALS OF MANAGEMENT

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year I Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: SM504MS** | **3** | **0** | **0** | **3** |

**Course Objective:** To understand the Management Concepts, applications of Concepts in Practical aspects of business and development of Managerial Skills.

**Course Outcome:** The students understand the significance of Management in their Profession. The various Management Functions like Planning, Organizing, Staffing, Leading, Motivation, and Control aspects are learnt in this course. The students can explore the Management Practices in their domain area.

**UNIT-I**

**Introduction to Management:** Definition, Nature and Scope, Functions, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management; Evolution of Management- Classical Approach- Scientific and Administrative Management; The Behavioral approach; The Quantitative approach; The Systems Approach; Contingency Approach, IT Approach.

**UNIT-II**

**Planning and Decision Making:** General Framework for Planning - Planning Process, Types of Plans, Management by Objectives; Development of Business Strategy. Decision making and Problem Solving - Programmed and Non Programmed Decisions, Steps in Problem Solving and Decision Making; Bounded Rationality and Influences on Decision Making; Group Problem Solving and Decision Making, Creativity and Innovation in Managerial Work.

**UNIT-III**

**Organization and HRM:** Principles of Organization: Organizational Design & Organizational Structures; Departmentalization, Delegation; Empowerment, Centralization, Decentralization, Recentralization; Organizational Culture; Organizational Climate and Organizational Change.

Human Resource Management & Business Strategy: Talent Management, Talent Management Models and Strategic Human Resource Planning; Recruitment and Selection; Training and Development; Performance Appraisal.

**UNIT-IV**

**Leading and Motivation:** Leadership, Power and Authority, Leadership Styles; Behavioral Leadership, Situational Leadership, Leadership Skills, Leader as Mentor and Coach, Leadership during adversity and Crisis; Handling Employee and Customer Complaints, Team Leadership.

Motivation - Types of Motivation; Relationship between Motivation, Performance and Engagement, Content Motivational Theories - Needs Hierarchy Theory, Two Factor Theory, Theory X and Theory Y.

**UNIT-V**

**Controlling:** Control, Types and Strategies for Control, Steps in Control Process, Budgetary and Non- Budgetary Controls. Characteristics of Effective Controls, Establishing control systems, Control frequency, and Methods.

**TEXT BOOKS:**

1. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.
2. Fundamentals of Management, Stephen P. Robbins, Pearson Education, 2009.

**REFERENCES:**

1. Essentials of Management, Koontz Kleihrich, Tata Mc - Graw Hill.
2. Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.

# THERMAL ENGINEERING LAB

**B.Tech. III Year I Sem.** **L T P C**
**Course Code: ME505PC** **0 0 3 2**

**List of Experiments**

1. I.C. Engines Valve / Port Timing Diagrams
2. I.C. Engines Performance Test for 4 Stroke SI engines
3. I.C. Engines Performance Test for 2 Stroke SI engines
4. I.C. Engines Morse, Retardation, Motoring Tests
5. I.C. Engine Heat Balance – CI/SI Engines
6. I.C. Engines Economical speed Test on a SI engine
7. I.C. Engines effect of A/F Ratio in a SI engine
8. Performance Test on Variable Compression Ratio Engine
9. IC engine Performance Test on a 4S CI Engine at constant speed
10. Volumetric efficiency of Air – Compressor Unit
11. Dis-assembly / Assembly of Engines
12. Study of Boilers

**Note: Perform any 10 out of the 12 exercises.**

## MACHINE TOOLS LAB

**B.Tech. III Year I Sem.** **L T P C**
**Course Code: ME506PC** **0 0 3 2**

**Course Objectives:**

- To import practical exposure to the Machine tools.
- To conduct experiments and understand the working of the same.

**List of Experiments:**

1. Introduction of general purpose machines -Lathe, Drilling machine, Milling machine, Shaper
2. Planing machine, slotting machine, Cylindrical Grinder, surface grinder and tool and cutter grinder.
3. Step turning and taper turning on lathe machine.
4. Thread cutting and knurling on -lathe machine.
5. Drilling and Tapping
6. Shaping and Planning
7. Slotting
8. Milling
9. Cylindrical Surface Grinding
10. Grinding of Tool angles

# MACHINE DRAWING LAB

**B.Tech. III Year I Sem.** **L T P C**
**Course Code: NT507PC** **0 0 3 2**

**Course Overview:**
Machine Drawing gives representation of a machine component or machine by lines according to certain set rules. Machine drawing generally gives all the external and internal details of the machine components from which it can be manufactured. The machining symbols, tolerances, bill of material, etc. are specified on the drawing when it is being manufactured, then it is called production drawing.

**Course Objectives:**
1. Understand the different steps in producing drawings according to bureau of Indian standards (B.I.S.) as per SP:46 (1988)
2. Understand the application of industry standards and techniques applied in Machine Drawing
3. Comprehend general projection theory, with an emphasis on the use of orthographic projection to represent three-dimensional objects in two-dimensional views.

**Course Outcomes:**
1. After going through this course, the student shall be able to understand the drawings of mechanical components and their assemblies along with their utility for design and development of mechanical system.
2. Work effectively with engineering and science teams as well as with multidisciplinary designs.
3. Skillfully use modern engineering tools and techniques such as CAD- CAM softwares for mechanical engineering design, analysis and application

**PART - A**
**Machine drawing conventions:** Need for drawing conventions – introduction to ISI conventions - Conventional representation of materials, common machine elements such as screws, nuts, bolts, keys, gears, webs, ribs. Methods of dimensioning, general rules for sizes and placement of dimensions for holes, centers, curved and tapered features. Title boxes, their size, location and details - common abbreviations and their liberal usage. Types of Drawings – working drawings for machine parts.
**Drawing of machine element:** Simple parts - Selection of Views, additional views for the following machine elements and parts with every drawing proportions. Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws. Keys, cottered joints and knuckle joint. Riveted joints for plates. Shaft coupling, spigot and socket pipe joint. Journal, pivot and collar and foot step bearings.

**PART - B**

**Assembly drawings:** Drawings of assembled views for the part drawings of the following using conventions and easy drawing proportions. Engine parts – stuffing boxes, cross heads, Eccentrics - Connecting Rod – Piston Assembly. Machine tool parts: Tail stock, Tool Post, Machine Vices - Screws jacks- Plummer block. **Valves**: Spring loaded safety valve, feed check valve and air cock.

**NOTE:** First angle projection to be adopted. The student should be able to provide working drawings of actual parts.

**Question Paper**: Should have 25% for Part A - 3 out of 4 Questions and
75% for Part B- No choice one assembly figure

**TEXT BOOKS:**

1. Machine Drawing /K. L. Narayana/ New Age International Publishers
2. Textbook of Machine Drawing/K.C. John/PHI/Eastern Economy Edition

**REFERENCE BOOKS:**

1. Machine Drawing / P.S.Gill.
2. Machine Drawing / Junnarkar N.D./ Pearson Edu.
3. Machine Drawing/Bhattacharya/Oxford University Press
4. Machine Drawing/N.D. Bhat/ Charotar
5. A Textbook of Machine Drawing/R. K. Dhawan/ S. Chand

## PROFESSIONAL ETHICS

| | |
|---|---|
| **B.Tech. III Year I Sem.** | **L T P C** |
| **Course Code: MC500HS** | **3 0 0 0** |

**Course Objective:** To enable the students to imbibe and internalize the Values and Ethical Behaviour in the personal and Professional lives.

**Course Outcome:** The students will understand the importance of Values and Ethics in their personal lives and professional careers. The students will learn the rights and responsibilities as an employee, team member and a global citizen.

**UNIT - I**

**Introduction to Professional Ethics**: Basic Concepts, Governing Ethics, Personal & Professional Ethics, Ethical Dilemmas, Life Skills, Emotional Intelligence, Thoughts of Ethics, Value Education, Dimensions of Ethics, Profession and professionalism, Professional Associations, Professional Risks, Professional Accountabilities, Professional Success, Ethics and Profession.

**UNIT - II**

**Basic Theories:** Basic Ethical Principles, Moral Developments, Deontology, Utilitarianism, Virtue Theory, Rights Theory, Casuist Theory, Moral Absolution, Moral Rationalism, Moral Pluralism, Ethical Egoism, Feminist Consequentialism, Moral Issues, Moral Dilemmas, Moral Autonomy.

**UNIT - III**

**Professional Practices in Engineering:** Professions and Norms of Professional Conduct, Norms of Professional Conduct vs. Profession; Responsibilities, Obligations and Moral Values in Professional Ethics, Professional codes of ethics, the limits of predictability and responsibilities of the engineering profession.

Central Responsibilities of Engineers - The Centrality of Responsibilities of Professional Ethics; lessons from 1979 American Airlines DC-10 Crash and Kansas City Hyatt Regency Walk away Collapse.

**UNIT - IV**

Work Place Rights & Responsibilities, Ethics in changing domains of Research, Engineers and Managers; Organizational Complaint Procedure, difference of Professional Judgment within the Nuclear Regulatory Commission (NRC), the Hanford Nuclear Reservation.

Ethics in changing domains of research - The US government wide definition of research misconduct, research misconduct distinguished from mistakes and errors, recent history of attention to research misconduct, the emerging emphasis on understanding and fostering responsible conduct, responsible authorship, reviewing & editing.

**UNIT - V**

Global issues in Professional Ethics: Introduction – Current Scenario, Technology Globalization of MNCs, International Trade, World Summits, Issues, Business Ethics and Corporate Governance, Sustainable Development Ecosystem, Energy Concerns, Ozone Deflection, Pollution, Ethics in Manufacturing and Marketing, Media Ethics; War Ethics; Bio Ethics, Intellectual Property Rights.

**TEXT BOOKS:**

1. Professional Ethics: R. Subramanian, Oxford University Press, 2015.
2. Ethics in Engineering Practice & Research, Caroline Whitbeck, 2e, Cambridge University Press 2015.

**REFERENCES**

1. Engineering Ethics, Concepts Cases: Charles E Harris Jr., Michael S Pritchard, Michael J Rabins, 4e , Cengage learning, 2015.
2. Business Ethics concepts & Cases: Manuel G Velasquez, 6e, PHI, 2008.

## ENGINEERING METROLOGY

**B.Tech. III Year II Sem.** **L T P C**
**Course Code: NT601PC** **4 1 0 4**

**Course overview:** To provide a basic understanding of the wide range of activities encompassed by personnel working in standards and calibration laboratories. It covers the measurement process, types and correct use of measurement and test equipment, and measurement standards. It provides an opportunity for students to learn about measurement uncertainty and risk analysis. The course includes the procedures necessary to set up and to have knowledge on calibration. At the end of this subject the student is expected: It is expected to enforce, validate and verify predefined standards for traceability, accuracy, reliability, and precision. All of these are factors that would affect the validity of measurement. Although these standards vary widely, these are mandated by the government, the agencies, and some treaties. Consequently, these standards are verified and tested against a recognized quality system in calibration laboratories

**Course Objectives:**
1. To be familiar with the different instruments those are available for linear, angular, roundness and roughness measurements.
2. To be able to select and use the appropriate measuring instrument according to a specific requirement (in terms of accuracy, etc.)
3. It is the aim of this course to provide students with practical skills associated with each of these areas. Metrology activities include precision measurement of component features, form and geometry utilizing specialized measuring instruments and equipment.
4. Effectively designing product processing methods.
5. To enhance the ability of students to apply scientific methods of protection

**Course Outcomes:**
1. Graduates will demonstrate basic knowledge in mathematics, science and engineering
2. Graduates will demonstrate an understanding of their professional and ethical responsibilities
3. Graduates will demonstrate the ability to function on engineering and science laboratory teams, as well as on multidisciplinary design teams
4. Graduates will demonstrate the ability to identify, formulate and solve mechanical engineering problems
5. Graduates will have the confidence to apply engineering solutions in global and societal contexts. Graduates should be capable of self-education and clearly understand the value of life-long learning. Graduates will have ability to communicate in written, oral and graphical forms.

**UNIT - I**
Systems of limits and fits: Introduction, normal size, tolerance limits, deviations, allowance, fits and their types - unilateral and bilateral tolerance system, hole and shaft basis systems -

interchangeability and selective assembly. Indian standard Institution system - British standard system, International Standard system for plain ad screwed work.

**UNIT - II**

**Linear Measurement**: Length standard, line and end standard, slip gauges - calibration of the slip gauges, Dial indicator, micrometers. **Measurement of Angles and Tapers**: Different methods - Bevel protractor - angle slip gauges - spirit levels - sine bar - Sine plate, rollers and spheres used to determine the tapers. **Limit Gauges**: Taylor's principle - Design of go and No go gauges, plug ring, snap, gap, taper, profile and position gauges.

**UNIT - III**

**Optical Measuring Instruments**: Tool maker's microscope and its uses - collimators, optical projector - optical flats and their uses, interferometer. **Flat Surface Measurement:** Measurement of flat surfaces - instruments used - straight edges - surface plates - optical flat and auto collimator.

**UNIT - IV**

**Surface Roughness Measurement** : Differences between surface roughness and surface waviness-Numerical assessment of surface finish - CLA, R, R.M.S Values - Rz values, Rz value, Methods of measurement of surface finish-profilograph. Talysurf, ISI symbols for indication of surface finish.

**UNIT - V**

**Screw Thread Measurement**: Element of measurement - errors in screw threads - measurement of effective diameter, angle of thread and thread pitch, profile thread gauges. **Measurement Through Comparators:** Comparators - Mechanical, Electrical and Electronic Comparators, pneumatic comparators and their uses in mass production. MACHINE TOOL **Alignment Tests**: Requirements of Machine Tool Alignment Tests, Alignment tests on lathe, milling, drilling machine tools.. Preparation of acceptance charts.

**Gear Measurement**: Gear measuring instruments, Gear tooth profile measurement. Measurement of diameter, pitch pressure angle and tooth thickness. Coordinate Measuring Machines: Types of CMM, Role of CMM, and Applications of CMM.

**TEXT BOOKS**

1. Engineering Metrology / I C Gupta./ Danpath Rai
2. Engineering Metrology / R.K. Jain / Khanna Publishers

**REFERENCE BOOKS**

1. BIS standards on Limits & Fits, Surface Finish, Machine Tool Alignment etc.
2. Principles of Engineering Metrology, Rajendra
3. Metrology & Measurement, Bewoor, Anand K

# PROPERTIES OF NANOMATERIALS

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: NT602PC** | **4** | **1** | **0** | **4** |

**Course Objectives:**

1. To familiarize about the various properties of nanostructures.
2. To bring out the differences between nano and macro structures
3. To discuss applications specific properties

**Course Outcomes:** To bring out the distinct properties like electrical, magnetic, optical, thermal and other mechanical properties of nanostructures

**UNIT - I**

**Material Classes, Structure, and Properties:**

**Classes of Materials:** Metallic, Ceramic, Polymeric, Composite, Electronic, Bio and Nanomaterials, Mechanical Behavior: Stress, Strain, Stiffness and Strength, Origin of Strength. Thermal Behavior: Intrinsic Thermal Properties and the Physics of Thermal Properties, Electrical Behavior: Resistivity and Conductivity, Dielectric Behavior and the Physics of Electrical Properties. Magnetic Behavior: Magnetic Fields: Vacuum, Materials. Measuring Magnetic Properties and the physics of Magnetic Behavior. Optical Behavior: The Interaction of Materials and Radiation, Specular and Diffuse Reflection, Absorption, Transmission, Refraction and the physics of Optical Properties. Acoustic Behavior: Sound Velocity and wavelength, Sound Management, Sound Wave Impedance and Radiation.

**Nanomaterials and Nanotechnologies:** An Overview, Why Nanomaterials? Scale, Structure and behavior, Nanomaterials and Nanostructures in nature, Nano materials in Art and Cultural Heritage.

**UNIT - II**

**Nanomaterials: classes and fundamentals:** Classification of Nanomaterials, Size effects, Surface to Volume ratio versus shape, Magic Numbers, Surface Curvature, Strain Confinement, Quantum effects.

**UNIT - III**

**Nanomaterials Properties:** Mechanical Properties, Scale and Properties, Scale dependence of Material Properties of Nanostructured materials, Thermal Properties of Nanomaterials, Properties: Electrical, Magnetic, Optical, Acoustic. Special Cases: Carbon nanotubes, nanocomposites

**UNIT - IV**

**Mechanical Properties: Density And Elasticity:** Density considered as an Example Property, The Rule of Mixtures Applied to Density, The importance of Grain Morphology, Density as a function of Grain size, The Elasticity of Nanomaterials, The Physical Basis of

Elasticity, and Elasticity of discrete Nanomaterials, Elasticity of Nanodevices Materials, and Elasticity of Bulk Nanomaterials.

**UNIT - V**

**Plastic Deformation of Nanomaterials:** Continuum descriptions of Plastic Behavior, The physical basis of yield strength, Crystal and Crystal Plasticity, Strengthening Mechanisms in Single Crystal Metals, From Crystal Plasticity to Polycrystal Plasticity, the yield strength of Nanomaterials.

**TEXT BOOKS:**

1. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L. Schodek.
2. Nanomaterials - Mechanics and Mechanism by K.T. Ramesh.
3. Nanotechnology – Principles and Practices by Sulabha K. Kulkarni
4. Nanostructure and Nanomaterials by Guozhong Cao, Ying Wang.
5. Textbook of Nanoscience and Nanotechnology – B. S. Murthy, P. Shankar, Baldev Raj, B. B. Rath and James Murday, University Press-IIM Series in Metallurgy and Materials Science.
6. A Textbook of Nanoscience and Nanotechnology – T. Pradeep, Tata McGraw Hill edition.

## FINITE ELEMENT METHODS

**B.Tech. III Year II Sem.** **L T P C**
**Course Code: NT603PC/ME611PE** **4 1 0 4**

**Course Objective**: The aim of the course is to provide the participants an overview on Finite Element Method, Material models, and Applications in Civil Engineering. At the end of the course, the participants are expected to have fair understanding of:

- Basics of Finite Element Analysis.
- Available material models for structural materials, soils and interfaces/joints.
- Modeling of engineering systems and Soil–Structure Interaction (SSI).
- Importance of interfaces and joints on the behavior of engineering systems.
- Implementation of material model in finite element method and applications

**Course Outcomes**: At the end of the course, the student will be able to, Apply finite element method to solve problems in solid mechanics, fluid mechanics and heat transfer. Formulate and solve problems in one dimensional structures including trusses, beams and frames. Formulate FE characteristic equations for two dimensional elements and analyze plain stress, plain strain, axi-symmetric and plate bending problems. Implement and solve the finite element formulations using MATLAB.

**UNIT – I**

Introduction to Finite Element Method for solving field problems. Stress and Equilibrium. Boundary conditions. Strain – Displacement relations. Stress – strain relations.

**One Dimensional Problems :** Finite element modeling coordinates and shape functions. Assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

**UNIT – II**

**Analysis of Trusses:** Stiffness Matrix for Plane Truss and Space Truss Elements, Stress Calculations.

**Analysis of Beams:** Element stiffness matrix for two node, two degrees of freedom per node beam element, Load Vector, Deflection, Stresses

**UNIT – III**

Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Estimation of Load Vector, Stresses

Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. Two dimensional four noded Isoparametric elements and numerical integration.

**UNIT – IV**

**Steady State Heat Transfer Analysis**: one dimensional analysis of Slab, fin and two dimensional analysis of thin plate.

Analysis of a uniform shaft subjected to torsion.

**UNIT – V**

**Dynamic Analysis:** Formulation of finite element model, element - Mass matrices, evaluation of Eigen values and Eigen vectors for a stepped bar, truss and beam.

Finite element – formulation to 3 D problems in stress analysis, convergence requirements, Mesh generation. techniques such as semi automatic and fully Automatic use of softwares such as ANSYS, NISA, NASTRAN, etc.

**TEXT BOOKS**:

1. Finite Element Methods: Basic Concepts and applications/Alavala/PHI
2. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu/Pearson

**REFERENCE BOOKS:**

1. An Introduction to the Finite Element Method / J.N.Reddy/ Mc Graw Hill
2. Finite Element Analysis / SS Bhavikatti / New Age
3. Finite Element Method/ Dixit/Cengage

## MECHANICAL VIBRATIONS
## (Professional Elective - I)

**B.Tech. III Year II Sem.** **L T P C**
**Course Code: NT611PE** **3 0 0 3**

**Pre-requisites:** Engineering Mechanics

**Course objectives:** Understand various levels of vibrations and remedies for each of them.

**Course Outcomes:** At the end of the course, the student will be able to, Understand the causes and effects of vibration in mechanical systems. Develop schematic models for physical systems and formulate governing equations of motion. Understand the role of damping, stiffness and inertia in mechanical systems Analyze rotating and reciprocating systems and compute critical speeds. Analyze and design machine supporting structures, vibration isolators and absorbers.

**UNIT - I**

**Single degree of Freedom systems - I:** Undamped 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.

**UNIT - III**

**Two degree freedom systems:** Principal modes- undamped and damped free and forced vibrations; undamped vibration absorbers;

**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 - IV**

**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.

**Numerical Methods:** Rayleigh’s stodola's, Matrix iteration, Rayleigh- Ritz Method and Holzer's methods.

Vibration measuring instruments: Vibrometers, velocity meters & accelerometers

**UNIT - V**

**Sound level and subjective response to sound:** Subjective response to sound, frequency dependent human response to sound, sound-pressure dependent human response, the decibel scale, relationship among sound power, sound intensity and sound pressure level, relationship between sound power level and sound intensity, relationship between sound intensity level and sound pressure level, sound measuring instruments.

**TEXT BOOKS:**

1. Elements of Vibration Analysis / Meirovitch/ Mc Graw Hill
2. Principles of Vibration / Benson H. Tongue/Oxford

**REFERENCE BOOKS:**

1. Mechanical Vibrations / SS Rao / Pearson
2. Mechanical Vibration /Rao V. Dukkipati , J Srinivas/ PHI

## REFRIGERATION AND AIR CONDITIONING
## (Professional Elective – I)

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T P C** |
| **Course Code: ME612PE** | **3 0 0 3** |

**Pre-requisite**: Thermodynamics

**Course Objective**: To apply the principles of Thermodynamics to analyze different types of refrigeration and air conditioning systems and to understand the functionality of the major components.

**Course Outcomes**: At the end of the course, the student should be able to Differentiate between different types of refrigeration systems with respect to application as well as conventional and unconventional refrigeration systems. Thermodynamically analyse refrigeration and air conditioning systems and evaluate performance parameters. Apply the principles of Psychometrics to design the air conditioning loads for the industrial applications.

**UNIT – I**

**Introduction to Refrigeration:** - Necessity and applications – Unit of refrigeration and C.O.P. – Mechanical Refrigeration – Types of Ideal cycle of refrigeration.

**Air Refrigeration:** Bell Coleman cycle and Brayton Cycle, Open and Dense air systems – Actual air refrigeration system – Refrigeration needs of Air crafts- Air systems – Application of Air Refrigeration, Justification – Types of systems – Problems.

**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 – Problems.

**UNIT - III**

**System Components:** Compressors – General classification – comparison – Advantages and Disadvantages. Condensers – classification – Working Principles. Evaporators – classification – Working Principles. Expansion devices – Types – Working Principles. Refrigerants – Desirable properties – common refrigerants used – Nomenclature – Ozone Depletion – Global Warming – Azeotropes and Zeotropes.

**UNIT - IV**

Vapor Absorption System – Calculation of max COP – description and working of $NH_3$ – water system – Li – Br 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 – V**

**Introduction to Air Conditioning:** Psychometric Properties & Processes – Sensible and latent heat loads – Characterization – Need for Ventilation, Consideration of Infiltration – Load concepts of RSHF, ASHF, ESHF and ADP.
Concept of human comfort and effective temperature –Comfort Air conditioning – Industrial air conditioning and Requirements – Air conditioning Load Calculations.
Air Conditioning systems - Classification of equipment, cooling, heating humidification and dehumidification, filters, grills and registers, deodorants, fans and blowers.
Heat Pump – Heat sources – different heat pump circuits – Applications.

**TEXT BOOKS:**

1. Refrigeration and Air conditioning / CP Arora / Mc Graw Hill
2. Refrigeration and Air-Conditioning / RC Aora / PHI

**REFERENCE BOOKS:**

1. Principles of Refrigeration - Dossat / Pearson
2. Basic Refrigeration and Air-Conditioning / Ananthanarayanan / Mc Graw Hill

**OPERATIONS RESEARCH**
**(Professional elective – I)**

**B.Tech. III Year II Sem.** **L T P C**
**Course Code: NT613PE** **3 0 0 3**

**Course Objectives:** Understanding the mathematical importance of development of model in a particular optimization model for the issue and solving it.

**Course Outcome:** Understanding the problem, identifying variables & constants, formulas of optimization model and applying appropriate optimization Tech

**UNIT – I**
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-graphical model. **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 –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.

**TEXT BOOKS:**

1. Operations Research / N.V.S. Raju / SMS
2. Operations Research / ACS Kumar / Yes Dee

**REFERENCE BOOKS:**

1. Operations Research /J. K. Sharma / MacMilan.
2. Operations Research /A. M. Natarajan, P. Balasubramaniam, A. Tamilarasi / Pearson.

**MAINTENANCE AND SAFETY ENGINEERING**
**(Professional Elective - I)**

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T P C** |
| **Course Code: NT614PE** | **3 0 0 3** |

**UNIT - I**

Introduction, Need for Maintenance, Facts and Figures, Modern Maintenance, Problem and Maintenance Strategy for the 21st Century, Engineering Maintenance Objectives and Maintenance in Equipment Life Cycle, Terms and Definitions.

**Maintenance Management and Control**: Maintenance Manual, Maintenance, Facility Evaluation, Functions of Effective Maintenance Management, Maintenance Project Control Methods, Maintenance Management Control Indices.

**UNIT - II**

**Types Of Maintenance**: Preventive Maintenance, Elements of Preventive, Maintenance Program, Establishing Preventive Maintenance Program PM Program Evaluation and Improvement, PM Measures, PM Models, Corrective Maintenance, Corrective Maintenance Types, Corrective Maintenance Steps and Downtime Components, Corrective Maintenance Measures, Corrective Maintenance Models.

**Inventory Control In Maintenance**: Inventory Control Objectives and Basic Inventory Decisions, ABC Inventory Control Method, Inventory Control Models Two-Bin Inventory Control and Safety Stock, Spares Determination Factors Spares Calculation Methods

**UNIT - III**

**Quality And Safety In Maintenance**: Needs for Quality Maintenance Processes, Maintenance Work Quality, Use of Quality Control Charts in Maintenance Work Sampling, Post Maintenance Testing, Reasons for Safety Problems in Maintenance, Guidelines to Improve Safety in Maintenance Work, Safety Officer's Role in Maintenance Work, Protection of Maintenance Workers.

**Maintenance Costing:** Reasons for Maintenance Costing, Maintenance Budget Preparation Methods and Steps, Maintenance Labor Cost Estimation, Material Cost Estimation, Equipment Life Cycle Maintenance Cost Estimation, Maintenance Cost Estimation Models.

**UNIT - IV**

**Reliability, Reliability Centered Maintenance, Rcm:** Goals And Principles, RCM Process and Associated Questions, RCM Program Components Effectiveness Measurement Indicators, RCM Benefits and Reasons for Its Failures, Reliability Versus Maintenance and Reliability in Support Phase, Bathtub Hazard Rate Concept, Reliability Measures and Formulas, Reliability Networks, Reliability Analysis Techniques.

**UNIT - V**

**Maintainability**: Maintainability Importance and Objective, Maintainability in Systems Life Cycle, Maintainability Design Characteristics, Maintainability Functions and Measures, Common Maintainability Design Errors.

**TEXT BOOKS:**

1. Reliability, Maintenance and Safety Engineering/ Dr. A. K. Guptha/ Laxmi Publications.
2. Industrial Safety Management/ L.M. Deshmukh/TMH

**REFERENCES:**

1. Maintenance Engineering & Management / R. C. Mishra/ PHI
2. Reliability Engineering / Elsayed/ Pearson
3. Engineering Maintenance a modern approach/ B.S Dhallon/ C.R.R Publishers
4. A Text Book of Reliability and Maintenance Engineering/Alakesh Manna/IK International Publishing House
5. Plant Maintenance and Reliability Engineering/NVS Raju/Cengage Learning

## METROLOGY AND SURFACE ENGINEERING LAB

**B.Tech. III Year II Sem.** **L T P C**
**Course Code: NT604PC** **0 0 3 2**

**Course Overview:**
By the end of the course student will be able to perform the measurements Length, Depth, Diameter measuring using vernier calipers & micrometer. Bore measurement using bore gauge Use of gear teeth caliper for checking the chordal addendum and chordal height of spur gear. Angle and taper measurements using Bevel protractor, Sine bar and slip gauges.

**Course Objectives:**
1. To create awareness on various mechanical measuring instruments.
2. To make students familiar with various operations on machine tools.

**Course Outcomes:**
1. Hands on experience on lathe machine to perform turning, facing, threading operations.
2. Practical exposure on flat surface machining, milling and grinding operations.
3. Skill development in drilling and threading operations.
4. Linear and angular measurements exposure.

**List of Experiments:**
1. Use of gear teeth vernier calipers for checking the chordal addendum and chordal height of the spur gear.
2. Machine tool alignment of test on the lathe.
3. Tool makers microscope and its application
4. Angle and taper measurements by bevel protractor and sine bars.
5. Use of spirit level and optical flats in finding the flatness of surface plate.
6. Thread measurement by 2-wire and 3-wire methods.

## PRODUCTION DRAWING PRACTICE LAB

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: NT605PC** | **0** | **0** | **3** | **2** |

**Course Overview:** This course is an introduction to technical graphics and computer-aided design. The course includes sketching, production drawing, and a significant amount of hands-on experience on a CAD system. The production drawing portion covers topics like multi-view drawings, section views, auxiliary views and dimensioning.

**Course Objectives:** Upon completion of this course the student will be able to:

1. Draw orthographic projections and section views of objects with dimensions using standard specifications and practices
2. Learn to use CAD systems using AutoCAD and Autodesk Inventor for Parametric Solid Modeling
3. Produce engineering drawings and models using AutoCAD and Autodesk Inventor.

**UNIT – I**

Conventional representation of Materials – conventional representation of parts – screw joints, welded joints, springs, gears, electrical, hydraulic and pneumatic circuits – methods of indicating notes on drawings.

**UNIT – II**

Limits and Fits: Types of fits, exercises involving selection / interpretation of fits and estimation of limits from tables.

**UNIT – III**

Form and Positional Tolerances: Introduction and indication of the tolerances of from and position on drawings, deformation of runout and total runout and their indication.

**UNIT – IV**

Surface roughness and its indication: Definitions – finishes obtainable from various manufacturing processes, recommended surface roughness on mechanical components.
Heat treatment and surface treatment symbols used on drawings.

**UNIT – V**

Detailed and Part drawings: Drawing of parts from assembly drawings with indications of size, tolerances, roughness, form and position errors etc.
Part drawing using computer aided drafting by CAD software

**TEXT BOOKS:**

1. Production and Drawing – K.L. Narayana & P. Kannaiah/ New Age
2. machine Drawing with Auto CAD- Pohit and Ghosh, PE

**REFERENCE BOOKS:**

1. Geometric dimensioning and tolerancing- James D. Meadows/ B.S Publications
2. Engineering Metrology, R.K. Jain, Khanna Publications

# ADVANCED ENGLISH COMMUNICATION SKILLS LAB

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T P C** |
| **Course Code: EN606HS** | **0 0 3 2** |

**Introduction**

A course on *Advanced English Communication Skills (AECS) Lab* is considered essential at the third year level of B.Tech and B.Pharmacy courses. At this stage, the students need to prepare themselves for their career which requires them to listen to, read, speak and write in English both for their professional and interpersonal communication. The main purpose of this course is to prepare the students of Engineering for their placements.

**Course Objectives:** This Lab focuses on using multi-media instruction for language development to meet the following targets:

- To improve students' fluency in spoken English
- To enable them to listen to English spoken at normal conversational speed
- To help students develop their vocabulary
- To read and comprehend texts in different contexts
- To communicate their ideas relevantly and coherently in writing
- To make students industry-ready
- To help students acquire behavioral skills for their personal and professional life
- To respond appropriately in different socio-cultural and professional contexts

**Course Outcomes:** Students will be able to:

- Acquire vocabulary and use it contextually
- Listen and speak effectively
- Develop proficiency in academic reading and writing
- Increase possibilities of job prospects
- Communicate confidently in formal and informal contexts

**Syllabus**

The following course activities will be conducted as part of the Advanced English Communication Skills (AECS) Lab:

1. **Inter-personal Communication and Building Vocabulary** - Starting a Conversation – Responding Appropriately and Relevantly – Using Appropriate Body Language – Role Play in Different Situations - Synonyms and Antonyms, One-word Substitutes, Prefixes and Suffixes, Idioms and Phrases and Collocations.
2. **Reading Comprehension** –General Vs Local Comprehension, Reading for Facts, Guessing Meanings from Context, , Skimming, Scanning, Inferring Meaning.
3. **Writing Skills** – Structure and Presentation of Different Types of Writing – Letter Writing/Resume Writing/ e-correspondence/ Technical Report Writing.
4. **Presentation Skills** – Oral Presentations (individual or group) through JAM Sessions/Seminars/PPTs and Written Presentations through Posters/Projects/Reports/ e-mails/Assignments… etc.,
5. **Group Discussion and Interview Skills** – Dynamics of Group Discussion, Intervention, Summarizing, Modulation of Voice, Body Language, Relevance, Fluency and Organization of Ideas and Rubrics of Evaluation- Concept and Process,

Pre-interview Planning, Opening Strategies, Answering Strategies, Interview through Tele-conference & Video-conference and Mock Interviews.

**Minimum Hardware Requirement:** Advanced English Communication Skills (AECS) Laboratory shall have the following infrastructural facilities to accommodate at least 35 students in the lab:

- **Spacious room with appropriate acoustics**
- **Eight round tables with five movable chairs for each table.**
- **Audio-visual aids**
- **LCD Projector**
- **Public Address system**
- **Computer with suitable configuration**

**Suggested Software:** The software consisting of the prescribed topics elaborated above should be procured and used.

- **Oxford Advanced Learner's Compass**, 8$^{th}$ Edition
- **DELTA's key to the Next Generation TOEFL Test: Advanced Skill Practice.**

**REFERENCES:**

1. Kumar, Sanjay and Pushpa Lata. English for Effective Communication, Oxford University Press, 2015.
2. Konar, Nira. English Language Laboratories – A Comprehensive Manual, PHI Learning Pvt. Ltd., 2011.

## SYNTHESIS AND CHARACTERIZATION OF NANOMATERIALS

| | |
|---|---|
| **B.Tech. IV Year I Sem.** | **L T P C** |
| **Course Code: NT701PC** | **4 1 0 4** |

**Course Objectives:**

1. To provide knowledge about top-down and bottom-up approaches for the synthesis of nanomaterials.
2. To enhance the various nanosynthesis techniques and to identify and solve problems
3. To design and conduct experiments relevant to nanochemistry, as well as to analyze the results.
4. To improve usage of synthesis methods for modern technology
5. To provide an overview of contemporary spectroscopy, microscopy, diffraction and analysis tools to characterize different properties of nanomaterials
6. To develop ability to understand modern characterization techniques especially utilized to probe in nanoscopic regime
7. To elucidate on application of standard spectroscopy, microscopy techniques for element analysis, structure analysis, depth profiling, topography imaging, as well as surface and interface analysis
8. To provide overview of principles underlying the characterization methods and basic theory for analysis of the data obtained from the instrument
9. To make the students understand the principles underlying various spectroscopies and instrumentations specific to nanomaterials

**Course Outcome: T**o provide an abundant knowledge on various synthesis methods of nanomaterials.

**UNIT - I**

Introduction, Bottom-up approach: Top-down: Sol-gel method, ball milling ,Physical methods: Inert gas condensation, Arc discharge, plasma synthesis, electric explosion of wires, molecular beam epitaxy, Physical Vapour Deposition, thermal evaporation, solution combustion synthesis, Chemical vapor deposition and sputtering, approach with examples.

**UNIT - II**

Chemical methods: Nanocrystals by chemical reduction, photochemical synthesis, electrochemical synthesis, Co-precipitation method. Semiconductor nanocrystals by arrested precipitation, sonochemical routes

**UNIT - III**

**Fundamentals of Electron Microscopy:** Scanning Electron Microscopy: SEM: Theory of operation, Specimen-Beam interactions Importance of beam spot size, Machine variables, Scanning Electron Microscope (SEM).

Transmission Electron Microscopy: TEM: Theory of operation, Modes of operation, Transmission Electron Microscope (TEM),Bright field Imaging, Electron diffraction, Dark field imaging, High Resolution TEM (HRTEM), Applications of TEM.

**UNIT - IV**

**Atomic Force Microscopy:** AFM: Basic concepts – Interactive forces, Principle and instrumentation, Force curves and force measurements, Modes of imaging: Tapping, contact and non-contact, Probes, Tip functionalization,

**UNIT - V**

**X-Ray Diffraction and Spectroscopic methods:** X-ray diffraction–Powder method, Single crystal diffraction technique -Determination of crystal structures – Nanostructural analysis – Profile analysis (peak broadening and micro strain) – Crystallite size analysis using Scherer formula and Williamson – Hall equation.

**TEXT BOOKS:**

1. Nanotechnology: Principles and Practices – Sulabha K. Kulkarni – Capital Publishing Company
2. 2. Nano: The Essentials – Understanding Nanoscience and Nanotechnology by T. Pradeep. Tata McGraw Hill
3. Introduction to Nano Technology by Charles. P. Poole Jr and Frank J. Owens, Wiley India Pvt. Ltd.
4. A practical approach to X-Ray diffraction analysis by C. Suryanarayana
5. Textbook of Nanoscience and Nanotechnology – B. S. Murthy, P. Shankar, Baldev Raj, B. B. Rath and James Murday, University Press-IIM Series in Metallurgy and Materials Science.
6. A Textbook of Nanoscience and Nanotechnology – T. Pradeep, Tata McGraw Hill edition.
7. Nanostructures and Nanomaterials by Guozhong Cao
8. Inorganic Materials Synthesis and Fabrication by J.N. Lalena, D.A. Cleary, E.E. Carpenter, N.F. Dean, John Wiley & Sons Inc.
9. Introduction to Nano Technology by Charles P. Poole Jr and Frank J. Owens. Wiley India Pvt Ltd.
10. The Chemistry of nanomaterials: Synthesis, Properties and Applications, Vol-I by C.N.R. Rao, A. Muller and A.K. Cheetham
11. The Physics of Micro/Nano- Fabrication by Ivor Brodie and Julius J. Muray

**REFERENCES:**

1. Haynes, R., Woodruff, D.P. and Talchar, T.A., Optical Microscopy of Materials · Cambridge University press, 1986.
2. Flegler, S.L., Heckman, J.W. and Klomparens, K.L., Scanning and Transmission Electron Microscopy: An Introduction · WH Freeman & Co, 1993.

3. Paul E. West, Introduction to Atomic Force Microscopy Theory Practice Applications・
4. Julian ChenN, C., Introduction to Scanning Tunneling Microscopy・ Oxford University Press, Inc., 1993.
5. Magonov, S.M., and Whangbo, M-H., surface Analysis with STM and AFM: Experimental and Theoretical Aspects of Image Analysis・ VCH Publishers, Inc., New York 1996.
6. Goldstein, J., Newbury, D.E., Joy, D.C., and Lym, C.E., Scanning Electron Microscopy and X-ray Microanalysis・ 2003.
7. Encyclopedia of Nanotechnology by M. Balakrishna Rao and K. Krishna Reddy, Vol I to X, Campus books.
8. Encyclopedia of Nanotechnology by H.S. Nalwa
9. Nano: The Essentials – Understanding Nano Scinece and Nanotechnology – by T. Pradeep, Tata McGraw Hill

# HEAT TRANSFER

**B.Tech. IV Year I Sem.** **L T P C**
**Course Code: AM701PC** **4 1 0 4**

**Note:** Heat Transfer Data Book is permitted.
**Pre-requisite**: Thermodynamics

**Course Objectives**: To provide knowledge about application of conduction, convection and radiation heat transfer concepts to different practical applications

**Course Outcome**: At the end of this course, student will be able to

- Understand the basic modes of heat transfer
- Compute one dimensional steady state heat transfer with and without heat generation
- Understand and analyze heat transfer through extended surfaces
- Understand one dimensional transient conduction heat transfer
- Understand concepts of continuity, momentum and energy equations
- Interpret and analyze forced and free convective heat transfer
- Understand the principles of boiling, condensation and radiation heat transfer
- Design of heat exchangers using LMTD and NTU methods

**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
**One Dimensional Steady State Conduction Heat Transfer:** Homogeneous slabs, hollow cylinders, and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation

**UNIT – II**
**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 –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi infinite 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 Π 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 – Integral Method as approximate method -Application of Von Karman Integral Momentum Equation for flat plate with different velocity profiles.

**Forced convection: External Flows:** Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.

**UNIT – IV**

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

**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**

**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.

**Radiation Heat Transfer :** Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, 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. Heat and Mass Transfer – Dixit /Mc Graw Hill
2. Heat and Mass Transfer / Altamush Siddiqui/ Cengage

**REFERENCE BOOKS:**

1. Essential Heat Transfer - Christopher A Long / Pearson
2. Heat Transfer –Ghoshdastida / Oxford

**RENEWABLE ENERGY SOURCES**
**(Professional Elective – II)**

| | |
|---|---|
| **B.Tech. IV Year I Sem.** | **L T P C** |
| **Course Code: NT721PE** | **3 0 0 3** |

**Course Objectives:**

- To explain the concepts of Non-renewable and renewable energy systems
- To outline utilization of renewable energy sources for both domestic and industrial applications
- To analyse the environmental and cost economics of renewable energy sources in comparison with fossil fuels.

**Course Outcomes:**

- Understanding of renewable energy sources
- Knowledge of working principle of various energy systems
- Capability to carry out basic design of renewable energy systems

**UNIT-I**

**Global and National Energy Scenario:** Over view of conventional & renewable energy sources, need & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, $CO_2$ reduction potential of renewable energy- concept of Hybrid systems.

**UNIT-II**

**Solar Energy:** Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Applications Solar Photovoltaic Conversion solar photovoltaic, solar thermal, applications of solar energy systems.

**UNIT-III**

**Wind Energy:** Wind Energy Conversion, Potential, Wind energy potential measurement, Site selection, Types of wind turbines, Wind farms, wind Generation and Control. Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind energy – Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices. Wind mill component design, economics and demand side management, energy wheeling, and energy banking concepts. Safety and environmental aspects, wind energy potential and installation in India.

**UNIT-IV**

**Biogas:** Properties of biogas (Calorific value and composition), biogas plant technology and status, Bio energy system, design and constructional features. Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass, bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

**UNIT-V**

**Ocean Energy:** Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development of tidal energy.

1. **Small hydro Power Plant:** Importance of small hydro power plants and their Elements, types of turbines for small hydro, estimation of primary and secondary power.

2. **Geothermal Energy**: Geothermal power plants, various types, hot springs and steam ejection.

**REFERENCE BOOKS:**

1. Non-Conventional Energy Sources by G.D Rai
2. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986.
3. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
4. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

# MATERIAL HANDLING SYSTEMS
## (Professional Elective – II)

**B.Tech. IV Year I Sem.** **L T P C**
**Course Code: NT722PE** **3 0 0 3**

**Course Objectives:**

1. To know about the working principle of various material handling equipments
2. To understand the Material handling relates to the loading, unloading and movement of all types of materials
3. To understand the estimation of storage space and maintenance of material handling equipments

**UNTT - I**

Mechanical Handling Systems: Belt Conveyors and Desing, Bucket Elevators, Package conveyors, Chain and Flight Conveyors, Screw Conveyors, Vibratory Conveyors, Cranes and Hoists.

**UNTT - II**

Pneumatic and Hydraulic Conveying Systems: Modes of Conveying and High pressure conveying systems, Low Velocity Conveying System. Components of Pneumatic Conveying Systems: General Requirements, Fans and Blowers, Boots-Type Blowers, Sliding-Vane Rotary Compressors, Screw Compressors, Reciprocating Compressors, Vacuum Pumps.

**UNIT - III**

Bulk Solids Handling: Particle and Bulk Properties. Adhesion, Cohesion and Moisture Content. Gravity Flow of Bulk Solids: Static and Dynamic Pressure Distribution in Bulk Solids. Modes of Flow: Mass Flow, Funnel Flow and Expanded Flow from Hoppers, Bins and Silos.

**UNTT - IV**

Modern Material Handling Systems: Constructional features of (i) AGV (ii) automated storage and retrieval systems. Sensors used in AGVs and ASRS.

Bar code systems and RFID systems: Fundamentals and their integration with computer-based information systems.

**UNTT - V**

Total MH Throughput: Calculation for no. of MH systems; storage space estimation based on no of aisles.

Maintenance of MH equipment, spare parts management, cost of materials handling, cost per unit load computations.

**TEXTBOOKS:**

1. Dr. Mahesh Varma, "Construction Equipment and its Planning & Application", Metropolitan Book Co.(P) Ltd., New Delhi, India 1997.
2. James M. Apple, "Material Handling Systems Design", The Ronald Press Company, New York, USA, 1972.
3. Woodcock CR. and Mason J.S., "Bulk Solids Handling: An Introduction to Practice Technology", Leonard Hill USA, Chapman and Hall, New York.
4. M P Groover etal, "Industrial Robotics", Me Graw Hill, 1999.

**ADDITIVE MANUFACTURING**
**(Professional Elective – II)**

| | |
|---|---|
| **B.Tech. IV Year I Sem.** | **L T P C** |
| **Course Code: NT723PE** | **3 0 0 3** |

**Course Overview:**
Introduction: Need for the compression in product development, Fusion Decomposition Modeling, Concepts Modelers, LASER ENGINEERING NET SHAPING, Rapid Manufacturing Process Optimization.

**Course Objectives:** The objectives of this course are

1. Develop an understanding of the emerging technologies of rapid prototyping, rapid manufacturing, and rapid tooling.
2. Develop a degree of competency in the evaluation of various rapid manufacturing and rapid tooling technologies and their application in modern manufacturing processes.
3. To provide knowledge on advances in injection moulding process, and
4. To develop competency in plastic filling simulation software to improve the performance of injection moulding.

**Course Outcomes:** On completion of this course, students will be able to

1. Apply the basic principles of rapid prototyping (RP), rapid tooling (RT), and reverse engineering (RE) technologies to product development;
2. Decipher the limitations of RP, RT, and RE technologies for product development; realize the application of RP, RT, and RE technologies for product development.

**UNIT - I**
**Introduction**: Need for the compression in product development, History of RP system, Survey of applications, Growth of RP industry and classification of RP system.
Stereo Lithography System: Principle, Process parameter, Process details, Data preparation, Data files and machine details, Applications.

**UNIT - II**
**Fusion Decomposition Modeling**: Principle, process parameter, Path generation, Applications. Solid ground curing: Principle of operation, Machine details, Applications, Laminated Object Manufacturing: Principle of Operation, LOM materials, Process details, Applications.

**UNIT – III**
**Concepts Modelers**: Principle, Thermal jet printer, Sander's model market, 3-D printer, Genisys Xs printer HP system 5, Object Quadra system.

**UNIT – IV**

**Laser Engineering Net Shaping (Lens**): Rapid Tooling: Indirect Rapid tooling- Silicon rubber tooling- Aluminum filled epoxy tooling Spray metal tooling, Cast kriksite, 3Q keltool, etc, Direct Rapid Tooling Direct. AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft, Tooling vs. hard tooling. Software for RP: STL files, Overview of Solid view, magics, imics, magic communication, etc. Internet based software, Collaboration tools.

**UNIT - V**

**Rapid Manufacturing Process Optimization**: Factors influencing accuracy, Data preparation error, Part building error, Error in finishing, Influence of build orientation.
Allied Process: Vacuum casting, surface digitizing, and Surface generation from point cloud, Surface modification- Data transfer to solid models.

**TEXT BOOKS:**

1. " stereo lithography and other RP & M Technologies", Paul F.Jacobs, SME, NY 1996
2. " Rapid Manufacturing ", Flham D.T & Dinjoy S.S, Verlog London 2001

**REFERENCE BOOKS:**

1. Terry Wholers, "*Wholers report 2000*", Wholers Associates, 2000.
2. "Rapid automated", Lament wood, Indus Press New York.
3. Rapid prototyping principles and applications, Rafiq Noorani

## CNC TECHNOLOGY
## (Professional Elective – II)

**B.Tech. IV Year I Sem.** **L T P C**
**Course Code: NT724PE/ME734PE** **3 0 0 3**

**Course objectives**: Importance of CNC machines. Understand the fundamentals of it. Learning various methods of tooling the CNC machines. Various controlling methods, Learning the part programming

**Course outcomes:** At the end course, one should be able to select tooling method, control mechanism and do part programming for a given product.

**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 NC Machine tools, design consideration of NC machine tool, methods of improving machine accuracy.
CNC Machine elements: machine structures - Guide ways - feed drives-spindles- spindle bearings-measuring systems- tool mentoring systems.

**UNIT - II**
Tooling for CNC machines: interchangeable tooling system, preset and qualified tools, coolant fed tooling system, modular fixturing, and 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. Computer Control of Manufacturing Systems/ Yoram Koren/ Mc Graw Hill
2. CNC Programming: Principles and Applications /Mattson/ Cengage

**REFERENCE BOOKS:**

1. Machining Tools Hand Book Vol 3/ Manfred Weck , John Wiley Mechatronics-HMT/ Mc Graw Hill .
2. Machining and CNC Technology / Michael Fitzpatrick / Mc Graw Hill.

**CAD/CAM**
**(Professional Elective – III)**

**B.Tech. IV Year I Sem.** **L T P C**
**Course Code: NT731PE** **3 0 0 3**

**Pre-requisites:** To learn the importance and use of computer in design and manufacture

**Course objectives:** To provide an overview of how computers are being used in design, development of manufacturing plans and manufacture. To understand the need for integration of CAD and CAM

**Course Outcomes:** Understand geometric transformation techniques in CAD. Develop mathematical models to represent curves and surfaces .Model engineering components using solid modeling techniques. Develop programs for CNC to manufacture industrial components. To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

**UNIT – I**

Fundamentals of CAD, CAM, Automation , design process, Application of computers for design, Benefits of CAD, Computer configuration for CAD applications, Computer peripherals for CAD, Design workstation, Graphic terminal, CAD software- definition of system software and application software ,CAD database and structure.

**Geometric Modeling:** 3-D wire frame modeling, wire frame entities and their definitions, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.

**UNIT - II**

**Surface modeling:** Algebraic and geometric form, Parametric space of surface, Blending functions, parametrization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions.

**Solid Modelling:** Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

**UNIT – III**

**NC Control Production Systems:** Numerical control, Elements of NC system, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.

**UNIT – IV**

**Group Technology:** Part families, Parts classification and coding. Production flow analysis, Machine cell design.

**Computer aided process planning:** Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems.

**Computer aided manufacturing resource planning:** Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning

**UNIT – V**

**Flexible manufacturing system**: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS.

**Computer aided quality control**: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.

**Computer Integrated Manufacturing:** CIM system, Benefits of CIM

**TEXT BOOKS:**

1. CAD/CAM Concepts and Applications / Alavala / PHI
2. CAD/CAM Principles and Applications / P.N.Rao / Mc Graw Hill

**REFERENCE BOOKS:**

1. CAD/CAM/ Groover M.P/ Pearson
2. CAD/CAM/CIM/ Radhakrishnan and Subramanian / New Age

## COMPUTATIONAL FLUID DYNAMICS
## (Professional Elective – III)

**B.Tech. IV Year I Sem.** **L T P C**
**Course Code: ME732PE/AM741PE** **3 0 0 3**

**UNIT - I:**
Basic Aspects of the Governing Equations – Physical Boundary Conditions – Methods of solutions of Physical Problems – Need for Computational Fluid Dynamics – Different numerical/CFD techniques – FDM, FEM, FVM etc., - Main working principle - CFD as a research and design tool – Applications in various branches of Engineering
Mathematical behavior of Partial Differential Equations (Governing Equations): Classification of linear/ quasi linear PDE – Examples - Physical Processes: Wave Equations and Equations of Heat Transfer and Fluid Flow – Mathematical Behavior - General characteristics – Its significance in understanding the physical and numerical aspects of the PDE – One way and Two Way variables – Well posed problems – Initial and Boundary Conditions
Solution of Simultaneous Algebraic Equations: Direct Method – Gauss Elimination – LU Decomposition – Pivoting – Treatment of Banded Matrices – Thomas Algorithm
Iterative Method: Gauss Seidel and Jordan Methods - Stability Criterion

**UNIT - II:**
Finite Difference Method: Basic aspects of Discretization – Finite Difference formulae for first order and second order terms – Solution of physical problems with Elliptic type of Governing Equations for different boundary conditions - Numerical treatment of 1D and 2D problems in heat conduction, beams etc., - Solutions –Treatment of Curvelinear coordinates – Singularities – Finite Difference Discretization – Solution of 1D heat conduction problems in Heat conduction in curve linear coordinates

**UNIT - III**:
FDM: Solution of physical problems with Parabolic type of Governing Equations – Initial Condition –Explicit, implicit and semi implicit methods – Types of errors – Stability and Consistency – Von Neumann Stability criterion– Solution of simple physical problems in 1D and 2D – Transient Heat conduction problems- ADI scheme - Simple Hyperbolic type PDE - First order and Second order wave equations – Discretization using Explicit method - Stability criterion – Courant Number – CFL Condition - Its significance - Treatment of simple problems

**UNIT - IV:**
Finite Difference Solution of Unsteady Inviscid Flows: Lax – Wendroff Technique – Disadvantages – Maccormack’s Technique
Fluid Flow Equations – Finite Difference Solutions of 2D Viscous Incompressible flow problems – Vorticity and Stream Function Formulation – Finite Difference treatment of Lid

Driven Cavity Problem - Application to Cylindrical Coordinates with example of flow over infinitely long cylinder and sphere – Obtaining Elliptic Equations

**UNIT - V:**

Finite Difference Applications in Fluid flow problems: Fundamentals of fluid Flow modeling using Burger's Equation – Discretization using FTCS method with respect to Upwind Scheme and Transport Property – Upwind Scheme and Artificial Viscosity

Solutions of Navier Stokes Equations for Incompressible Fluid Flows: Staggered Grid – Marker and Cell (MAC) Formulation – Numerical Stability Considerations – Pressure correction method - SIMPLE Algorithm

**REFERENCE BOOKS:**


1. Computational Fluid Flow and Heat Transfer – K Muralidharan and T Sudarajan, Narosa Publishers
2. Computational Fluid Dynamics : The basics with applications – John D Anderson, McGraw Hill Publications

**POWER PLANT ENGINEERING**
**(Professional Elective – III)**

| | |
|---|---|
| **B.Tech. IV Year I Sem.** | **L T P C** |
| **Course Code: ME723PE/NT733PE** | **3 0 0 3** |

**Course Objective:** The goal of this course is to become prepared for professional engineering design of conventional and alternative power-generation plants. The learning objectives include

- Analysis and preliminary design of the major systems of conventional fossil-fuel steam-cycle power plants.
- A working knowledge of the basic design principles of nuclear, gas turbine, combined cycle, hydro, wind, geothermal, solar, and alternate power plants.
- Awareness of the economic, environmental, and regulatory issues related to power generation.

**Course Outcomes:** At the end of the course students are able to:

- Understand the concept of Rankine cycle.
- Understand working of boilers including water tube, fire tube and high pressure boilers and determine efficiencies.
- Analyze the flow of steam through nozzles
- Evaluate the performance of condensers and steam turbines
- Evaluate the performance of gas turbines

**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, Ash handling systems.

**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 starting equipment, 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. **Hydro Projects And Plant:** Classification – 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. Power Plant Engineering/ P. K. Nag / Mc Graw Hill
2. Power Plant Engineering / Hegde / Pearson.

**REFERENCES BOOKS:**

1. Power Plant Engineering / Gupta / PHI
2. Power Plant Engineering / A K Raja / New age

**UNCONVENTIONAL MACHINING PROCESS**
**(Professional Elective – III)**

**B.Tech. IV Year I Sem.** **L T P C**
**Course Code: NT734PE** **3 0 0 3**

**Course Overview:**
The objective of this course is to introduce the student to mole advanced topics in the machining processes. The concept of material removal by an edged tool, involving plastic deformation and formation of chips, has been known to man for several hundred years. In recent years on increasing demand for the machining of components of complex shape made hard, difficult - to - machine materials with exacting tolerances ad surface finish has resulted in the development of a number of new machining processes.

**Course Objectives:**
1. To teach the modeling technique for machining processes
2. To teach interpretation of data for process selection
3. To teach the mechanics and thermal issues associated with chip formation
4. To teach the effects of tool geometry on machining force components and surface finish
5. To teach the machining surface finish and material removal rate

**Course Outcomes:**
1. Understand the basic techniques of machining processes modeling
2. Understand the mechanical aspects of orthogonal cutting mechanics
3. Understand the thermal aspects of orthogonal cutting mechanics
4. Ability to extend, through modeling techniques, the single point, multiple point and abrasive machining processes
5. Estimate the material removal rate and cutting force, in an industrially useful manner, for practical machining processes.

**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, and 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, 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 removing mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries. Chemical machining – principle - maskants - applications.

Magnetic abrasive finishing, Abrasive flow finishing, Electro stream drilling, shaped tube electrolyte machining.

**TEXT BOOKS:**

1. Advanced Machining Processes / VK Jain / Allied publishers
2. Modern Machining Processes - P. C. Pandey, H. S. Shan

**REFERENCE BOOKS:**

1. Manufacturing Engineering And Technology By Serope Kalpakjain, Pearson Publications. 2001
2. Manufacturing Engineering & Technology, Kalpakjain
3. Unconventional Manufacturing Processes, Singh M.K

## NON-DESTRUCTIVE TESTING TECHNIQUES
## (Professional Elective – IV)

| | |
|---|---|
| **B.Tech. IV Year I Sem.** | **L T P C** |
| **Course Code: NT741PE** | **3 0 0 3** |

**Course Objectives:**

1. To understand the basic principles, techniques, equipment, applications and limitations of basic NDT methods.
2. To learn the selection of appropriate NDT methods.
3. To grasp the standards and specifications related to NDT technology.
4. To know the developments and future trends in NDT.

**UNIT - I**

Liquid Penetrant Inspection: Principles of penetrant inspection, characteristics of a penetrant, water-washable system, post-emulsification system, solvent-removable system, surface preparation and cleaning, Penetrant application, Development, Advantages limitations, and applications.

Magnetic Particle Inspection: Principle, Magnetization methods, continuous and residual methods, sensitivities, Demagnetization, Magnetic particles, Applications, Advantages and limitations.

**UNIT - II**

Eddy Current Testing: Principle, Lift-off factor, and edge effects, Skin effect, Inspection frequency, coil arrangements, inspection probes, types of circuit, reference pieces, phase analysis, display methods and applications.

**UNIT - III**

Ultrasonic Testing: Generation of ultra sound, characteristics of an ultrasonic beam, sound waves at interfaces, sound attenuation, Display systems, Probe construction, type of display, Inspection techniques, Identification of defects, Immersion testing, Sensitivity & calibration. Reference standards. Surface condition, Applications.

**UNTT - IV**

Radiography: Principle and uses of Radiography, limitations, Principle, Radiation sources, Production of X-rays, x-ray spectra, Attenuation of radiation, Radiographic equivalence, Shadow formation, enlargement and distortion, Radiographic film and paper, Xeroradiography, fluoroscopy, Exposure factors, Radiographic screens, identification markers and image quality indicators, Inspection of simple shapes, inspection of complex shapes, viewing and interpretation of radiographs, Radiation hazard, Protection against radiation, measurement of radiation received by personnel.

**UNIT - V**

Acoustic Emission: Physical Principles, Sources of emission, instrumentation and applications. Other NDT Techniques: Neutron radiography, Laser induced Ultrasonics, Surface analysis, Thermography.

**TEXTBOOKS:**

1. Barry Hull & Vernon John, "Non Destructive Testing", 1988.
2. HJ. Frissell (Editorial Coordinator) - "Non-Destructive Evaluation and Quality Control" - ASM Hand Book - International Publication, USA, 1989.
3. Dove and Adams, "Experimental stress analysis and motion measurement", Prentice Hall of India, Delhi.

## TOOL DESIGN
## (Professional Elective – IV)

**B.Tech. IV Year I Sem.** **L T P C**
**Course Code: NT742PE** **3 0 0 3**

**Course Objectives:**

1. To understand the basic knowledge of select appropriate materials for tooling applications
2. To grasp the Design, develop, and evaluate cutting tools and work holders for a manufactured product
3. To comprehend the basic knowledge of press tools for sheet metal working.

**UNIT - I**

**Cutting tool materials and single point cutting tools:** Cutting tool materials, desired properties. Types, Major Constituent, relative characteristics, latest development: ISO; classification and coding of carbides. Geometry of single point cutting tool. Influence of each geometrical parameters on the cutting tool performance. Factors involved in their selection. Tool signature and geometry in MRS, ORS, NRS. Cutting forces and design features of HSS and carbide tipped tools. Feature of high production cutting tools. Chip breakers and their types.

**UNIT - II**

**Form tools and multi point cutting tools:**

**Form tools:** Radial and tangential: flat and circular. Form correction and tool holding methods.

**Drills Geometry:** Variation of rake and clearance angles along tips, effect of geometrical parameters on thrust and torque effect of feed rate on rake and clearance, web thinning. Types of drill points, Grinding of drills.

**Milling Cutters:** Major types, geometry of peripheral, end and face milling cutters. Profile sharpened and form relieved expression for minimum number of teeth. Design features, forces and power estimation, Grinding of milling cutters.

**Reamers:** Types, geometry, Reaming allowance, design features tolerance disposition.

**Broachers:** Pull and push types. Internal and External broaches, geometry and design features. Pull force estimation. Keyway, spline, round, square broaches.

**UNIT - III**

**Press tools for sheet metal working:** Blanking and piercing. Diet set elements. Simple and progressive dies. Estimation of punch load, clearances, centre of pressure, strip layout, methods of reducing punch load.

**Bending dies:** Spring back and bending allowance estimation of punch load.

**Drawing Dies:** Punch load, blank size, number of draws, methods of retaining metal in draw dies. Metal flow during drawing.

**Metal spinning:** Configuration and design features of metal spinning, shear forming and flow forming.

**UNTT - IV**

**Jigs & Fixtures:** Design principles and construction features. Locating methods associated with flat, cylindrical internal and external surface. Types of locating pins. Requirements and choice of locating systems. Redundant location, fool proofing. Setting blocks, types of clamping devices and their basic elements. Quick action clamps and nuts. Equalizing and multiple clamping pneumatics. Hydraulic, magnetic and vacuum clamping. Types of drill jig and their classification. Types of jig bushes, jig feet. Indexing jigs. Economic analysis of Jigs and Fixtures. Economic tool life for minimum cost maximum production and max profit rate.

**UNIT - V**

**Miscellaneous tools:** Cam design for single spindle automatics for simple components. Tool layout estimation of cycle time. Gauge design: Taylor's principle, limit gauges for holes and shafts. Estimation of limits on Go and No Go gauges. Forgoing dies: Draft, parting line, filters. Allowances, sequence in multiple impression forging. Flashing, Trimming.

**Plastic Tools:** Application of plastic as a tooling material viz., for Gauges, Surface plates, jigs and fixtures. Forming dies.

**TEXTBOOKS:**

1. Surendra kenav and Umesh Chandra, "Production Engineering Design (Tool Design)", Satyaprakashan, New Delhi, 1994.
2. Donaldson, Leain and Goold, "Tool Design", Tata McGraw Hill, New Delhi, 1983.
3. Amitabha Battacharya and Inyong Ham, "Design of Cutting Tools, Use of Metal Cutting Theory", ASTME publication Michigan USA, 1969.

**ROBOTICS**
**(Professional Elective – IV)**

| | |
|---|---|
| **B.Tech. IV Year I Sem.** | **L T P C** |
| **Course Code: ME733PE/NT743PE** | **3 0 0 3** |

**Pre-requisites:** Basic principles of Kinematics and mechanics

**Course Objectives:** The goal of the course is to familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, and incorporate robotic technology in engineering systems.

- Make the students acquainted with the theoretical aspects of Robotics
- Enable the students to acquire practical experience in the field of Robotics through design projects and case studies.
- Make the students to understand the importance of robots in various fields of engineering.
- Expose the students to various robots and their operational details.

**Course Outcomes:** At the end of the course, the student will be able to understand the basic components of robots. Differentiate types of robots and robot grippers. Model forward and inverse kinematics of robot manipulators. Analyze forces in links and joints of a robot. Programme a robot to perform tasks in industrial applications. Design intelligent robots using sensors.

**UNIT – I**

**Introduction:** Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications.

**Components of the Industrial Robotics:** common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

**UNIT – II**

**Motion Analysis:** Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems.

**Manipulator Kinematics**-H notation-H method of Assignment of frames-H Transformation Matrix, joint coordinates and world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulation.

**UNIT – III**

Differential transformation of manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion – straight line motion.

**UNIT IV**

**Robot actuators and Feedback components:**

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors.

**UNIT V**

**Robot Application in Manufacturing:**

Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

**TEXT BOOKS:**

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson

**REFERENCE BOOKS:**

1. Robot Dynamics and Controls / Spony and Vidyasagar / John Wiley
2. Robot Analysis and control / Asada , Slotine / Wiley Inter-Science

# HEAT TRANSFER LAB

**B.Tech. IV Year I Sem.** **L T P C**
**Course Code: AM703PC** **0 0 3 2**

**Course Objectives**: To enable the student to apply conduction, convection and radiation heat transfer concepts to practical applications

**Course Outcome**: At the end of the lab sessions, the student will be able to

- Perform steady state conduction experiments to estimate thermal conductivity of different materials
- Perform transient heat conduction experiment
- Estimate heat transfer coefficients in forced convection, free convection , condensation and correlate with theoretical values
- Obtain variation of temperature along the length of the pin fin under forced and free convection
- Perform radiation experiments: Determine surface emissivity of a test plate and Stefan- Boltzmann's constant and compare with theoretical value

**Minimum twelve experiments from the following:**

1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of given metal rod.
5. Heat transfer through pin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.
11. Stefan Boltzmann Apparatus.
12. Critical Heat flux apparatus.
13. Study of heat pipe and its demonstration.
14. Film and Drop wise condensation apparatus

## SYNTHESIS AND CHARACTERIZATION OF NANOMATERIALS LAB

| | |
|---|---|
| **B.Tech. IV Year I Sem.** | **L T P C** |
| **Course Code: NT704PC** | **0 0 3 2** |

**Aim:**
To synthesize/ prepare the various nano-structured materials by various methods and study them using various characterizations

**Course Objective:**
The objective of this course is to be familiar with the synthesis and preparation of 0D, 1D and 2D nano-structured materials, understand the chemical background involved in the chemical reactions.

**List of experiments:**

1. Size reduction of soft and hard any ceramics – Cu metals using planetary ball milling
2. Room temperature synthesis of cobalt nanoparticles by chemical reduction method
3. Synthesis of Zinc oxide (ZnO)nanoparticles by solution combustion method
4. Synthesis of Silica ($SiO_2$) nanopowder by Sol-gel method
5. Synthesis of cadmium sulfide quantum dots by co precipitation method
6. Particle size determination of Ag nanoparticles using DLS technique
7. Zeta potential measurement of Ag nanoparticles using Zeta Potential Analyzer
8. CdS nanoparticle- Optical absorption spectra; Band gap estimation from the band edge using
    a. UV-Visible absorption Spectroscopy
9. Crystallite size determination of ZnO by scherrer formula using X-ray Diffraction
10. TG/DTA analysis
11. Atomic Force Microscope

**RERERENCES:**

Exp No 1: JNTUH, CNST lab manual
Exp No 2: Xiaoming Liang and Lijun Zhao, "Room-temperature synthesis of air-stable cobalt nanoparticles and their highly efficient adsorption ability for Congo red", RSC Advances (CNST lab experiment)
Exp No 3: JNTUH, CNST, Synthesis of nanomaterials Lab manual
Exp No 4: JNTUH, CNST, Synthesis of nanomaterials Lab manual
Exp No 5: JNTUH, CNST, Synthesis of nanomaterials Lab manual
Exp No 6: JNTUH, CNST, Characterization of nanomaterials Lab manual
Exp No 7: JNTUH, CNST, Characterization of nanomaterials Lab manual
Exp No 8: JNTUH, CNST, Characterization of nanomaterials Lab manual
Exp No 9: JNTUH, CNST, Characterization of nanomaterials Lab manual
Exp No 10: JNTUH, CNST, Characterization of nanomaterials Lab manual
Exp No 11: JNTUH, CNST, Characterization of nanomaterials Lab manual

## AUTOMATION IN MANUFACTURING
## (Professional Elective – V)

**B.Tech. IV Year II Sem.** **L T P C**
**Course Code: ME851PE** **3 0 0 3**

**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.

**UNIT – II**
**Automated flow lines:** Methods or work part transport transfer Mechanical buffer storage control function, design and fabrication consideration.
**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.
**Automated material handling:** Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems.

**UNIT - IV**
Automated storage systems, automated storage and retrieval systems, work in process storage, interfacing handling and storage with manufacturing.
**Adaptive control systems**: Introduction, adaptive control with optimization, Adaptive control with constraints, Application of A.C. in machining operations. Use of various parameters such as cutting force, Temperatures, vibration, and acoustic emission.

**UNIT – V**
**Business process Re-engineering:** Introduction to BPE logistics, ERP, Software configuration of BPE, concurrent Engineering, Techniques of Rapid Proto typing.

**TEXT BOOKS:**
1. Automation, Production Systems and Computer Integrated Manufacturing/M.P. Groover. / Pearson
2. Computer control of Manufacturing Systems by Yoram Coreom / Mc Graw Hill

**REFERENCE BOOKS:**
1. CAD / CAM/ CIM / Radhakrishnan / New Age
2. Advanced Manufacturing Technology/ K Vara Prasada Rao / Kanna Publications

# TRIBOLOGY
## (Professional Elective – V)

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T P C** |
| **Course Code: NT852PE** | **3 0 0 3** |

**Course Overview:**
The aim is to teach students in the undergraduate and postgraduate levels basic concepts about friction, lubrication and wear applicable to design and operation of mechanical systems used in engineering, industrial, and modern applications. Examples of these systems are lubrication of internal combustion engines, gearboxes, artificial hip/knee joints, and micro/nano electromechanical systems.

**Course Objectives:**
Design of surfaces in contact is a critical problem for mechanical engineering. Tribology & lubrication (ME6009) is an interdisciplinary course which deals with fundamentals of surface contact, friction, wear and lubrication. Topics in ME 6009 include description and modeling of engineering surfaces, popular surface contact theories, major modes of friction, wear, lubrication and adhesion. The tribology challenges in micro system will be discussed as well.

**UNIT - I**
**Historical Background** - Viscosity - Viscometry - Effect of temperature onviscosity - Effect of pressure in viscosity - Other physical properties of mineral oils - The generalized Reynolds equation - Flow and shear stress - The energy equation - The equation of state - Mechanism of pressure development.

**UNIT - II**
**Circumferential Flow** - Oil flow through a bearing having a circumferential oilgroove - Heat generation and lubricant temperature - Heat balance and effective temperature - Bearing design: Practical considerations - Design of journal bearings - Parallel surface bearing - Step bearing - Some situations under squeeze film lubrication - The mechanism of hydrodynamic instability - Stiffness and damping coefficients - Stability.

**UNIT - III**
**Elasto Hydrodynamic Lubrication:** Theoretical consideration - Grubin typesolution - Accurate solution - Point contact - Dimensionless parameters - Film thickness equations - Different regimes in EHL contact - Deep-groove radial bearings - Angular contact bearings - Thrust ball bearings - Geometry - Kinematics - Stress and deformations - Load capacity.

**UNIT - IV**
**SURFACE TOPOGRAPHY** - Surface characterization - Apparent and real area ofcontact - Derivation of average Reynolds equation for partially lubricated surface - Effect of surface roughness on journal bearings

**UNIT - V**

**Laws of Friction** - Friction theories - Surface contaminants - Frictional heating -Effect of sliding speed on friction - Classification of wear - Mechanisms of wear - Quantitative laws of wear - Wear resistance materials.

**TEXT BOOKS:**

1. Rowe WW & O Dionoghue, Hydrostatic and Hybrid bearing design — Butterworth's & Co. Publishers Ltd, 1983.
2. Collacott R.A, Mechanical Fault diagnosis and condition monitoring, Chapman and Hall, London 1977.

**REFERENCES BOOKS:**

1. Neale MJ, (Editor) — Tribology hand Book Neumann Butterworth's, 1975.
2. Connor and Boyd JJO (Editors) — Standard hand book of lubrication engineers — ASLE, Mc
3. Introduction to Tribology of Bearings by Majumdar, B.C

# AUTOMOBILE ENGINEERING
## (Professional Elective – V)

**B.Tech. IV Year II Sem.** **L T P C**
**Course Code: NT853PE/ME861PE** **3 0 0 3**

**UNIT - I**

**Introduction:** Layout of automobile – introduction chassis and body components. Types of Automobile engines. – Power unit – Introduction to engine lubrication – engine servicing

**Fuel System:** S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pump – filters – carburetor – types – air filters – petrol injection. Introduction to MPFI and GDI Systems.

**C.I. Engines:** Requirements of diesel injection systems, types of injection systems, DI Systems IDI systems. Fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. Introduction to CRDI and TDI Systems.

**UNIT - II**

**Cooling System:** Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporative cooling – pressure sealed cooling – antifreeze 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.

**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.

**UNIT - III**

**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, constant mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. Propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.

**Suspension System:** Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

**UNIT - IV**

**Braking System:** Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes.

**Steering System:** Steering geometry – camber, castor, king pin rake, combined angle toein, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

**UNIT - V**

Emissions from Automobiles – Pollution standards National and international – Pollution Control – Techniques – Multipoint fuel injection for SI Engines. Common rail diesel injection Energy alternatives – Solar, Photo-voltaic, hydrogen, Biomass, alcohols, LPG, CNG, liquid Fuels, and gaseous fuels, Hydrogen as a fuel for IC Engines. - Their merits and demerits. Standard Vehicle maintenance practice.

**TEXT BOOKS:**

1. Automobile Engineering / William H Crouse
2. A Text Book Automobile Engineering–Manzoor, Nawazish Mehdi & Yosuf Ali, Frontline Publications.

**REFERENCES:**

1. A Text Book of Automobile Engineering by R K Rajput. Laxmi Publications.
2. Automotive Mechanics / Heitner
3. Automotive Engineering / Newton Steeds & Garrett
4. Automotive Engines / Srinivasan
5. A Text Book of Automobile Engineering By Khalil U Siddiqui New Age International

# MECHANICS OF COMPOSITE MATERIALS
## (Professional Elective – V)

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T P C** |
| **Course Code: NT854PE** | **3 0 0 3** |

**Course Overview:**
This course is designed for building foundational knowledge in composites. It introduces the concept of: (1) Characterization and application of composite, (2) the methods of composite strengthening, and (3) production routes and performance of composites.

**Course Objectives:**
1. An ability to identify the properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.
2. An ability to predict the elastic properties of both long and short fiber composites based on the constituent properties.
3. An ability to rotate stress, strain and stiffness tensors using ideas from matrix algebra.

**UNIT - I**
**Introduction to Composite Materials:** Introduction, classification, polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon-carbon composites, fiber, reinforced composites and nature-made composites and applications.
**Reinforcements**: Fibers Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide, fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

**UNIT - II**
**Manufacturing Methods:** Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM. Macro mechanical Analysis of a "Lamina": introduction, Definitions: stress, strain, Elastic Moduli, strain Energy. Hooke's Law for different types of materials, Hooks Law for a two dimensional unidirectional lamina, plane stress assumption, reduction of Hooks Law in three dimensions to two dimensions, relationship of compliance and stiffness matrix to engineering elastic constants of a lamina.

**UNIT - III**
Hooke’s Law for a Two-Dimensional Angle Lamina, Engineering constants of an Angle Lamina. Invariant Form of Stiffness and compliance Matrices for an Angle Lamina Strength Failure. Envelops, Maximum Strain Failure Theory, Tsai-Hill Failure Theory, Tsai-Wu Failure Theory Comparison of Experimental Results with Failure Theories.
Hygrothermal Stresses and Strains in a Lamina: Hygrothermal Stress-Strain Relationships for a Unidirectional Lamina, Hygrothermal Stress-Strain Relationships for a Angle Lamina.

**UNIT - IV**

**Micromechanical Analysis of A Lamina:** Introduction, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli, Strength of Materials Approach, Semi Empirical Models Elasticity Approach, Elastic Moduli of Lamina with Transversely Isotropic Fibers, Ultimate Strengths of a Unidirectional Lamina, Coefficients of Thermal Expansion, Coefficients of Moisture Expansion .

**UNIT - V**

**Macro mechanical Analysis of Laminates:** Introduction, Laminate Code, Stress-Strain Relations for a Laminate, In-Plane and Flexural Modules of a Laminate, Hygrothermal Effects in a Laminate, Warpage of Laminates.

**Failure Analysis and Design of Laminates:** Introduction Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite, Other Mechanical Design Issues

**TEXT BOOKS:**

1. Engineering Mechanics of Composite materials by Issac and M Daniel
2. R.M Jones, Mechanics of composite Materials, McGraw Hill Company, New York, 1975

**REFERENCE BOOKS:**

1. D. Agarwal and L. Broutman, Analysis and performance of fibre Composites, Wiley-interscience.
2. L.R Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold, New York, 1969
3. Mechanics of Composite Materials, Mukhopadhyay

# CARBON NANO MATERIALS AND APPLICATIONS
## (Professional Elective – VI)

**B.Tech. IV Year II Sem.** **L T P C**
**Course Code: NT861PE** **3 0 0 3**

**Course Objectives:**
- To investigate the use of carbon nanotubes as active components
- To explore the method of synthesis and its role in obtaining SWNT /MWNT with desired characteristics
- To investigate several applications of carbon nanotubes

**UNIT - I**
**Introduction to CNT:** Introduction, History, Discovery, Carbon Nano tubes Carbon clusters and Fullerenes. Structures and types of Carbon Nano tubes: arm chair, zig-zag and chiral, structure of graphene, Defects in carbon Nanostructures.

**UNIT - II**
**Synthesis:** Synthesis of CNTs by Flame, CVD, Laser & Arc process, growth of CNTs: Growth Mechanisms involved in growth of CNTs, tip growth, basal growth.

**UNIT - III**
**Characterization of CNTs:** Characterization of Carbon Nanotubes by Raman Spectroscopy and Transmission Electron Microscopy.

**UNIT - IV**
**Properties of CNTs:** Electrical: Electron transport in CNT, field emission, Optical properties Vibrational, Mechanical Properties of CNTs. Mechanical reinforcements and their application in modern day: Polymer Nano composite an Metal Nano composite.

**UNIT - V**
**Energy storage and Sensor applications** : Application of CNTs: as an electrode material for Lithium batteries & Hydrogen & storage, Fuel cell applications and energy storage.Chemical Sensors applications of CNTs, and Glucose sensors based on CNT.

**TEXT BOOKS:**
1. Carbon Nanotubes by P. M. Ajayan, John Wiley Edition.
2. Science of Engineering Materials and Carbon Nanotubes: C.M. Srivastava and C. Srinivasan New Age Publishers.
3. Introduction to Nanotechnology by Charles P. Poole Jr and Frank J. Owens Wiley India Pvt. Ltd.
4. Nanotechnology, A gentle introduction to the next big idea by Mark Ranter, Daniel Ranter Pearson education.

**NANOCOMPOSITES**
**(Professional Elective – VI)**

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T P C** |
| **Course Code: NT862PE** | **3 0 0 3** |

**Course Objectives:**
- To synthesize and evaluate nanostructure reinforce matrix material
- To understand the importance of various nanomaterial matrix
- To discuss various application including aerospace applications

**UNIT – I**
Introduction to Nanocomposites, Composite material, Mechanical properties of Nano composite material: stress - strain relationship, toughness, strength, plasticity.

**UNIT – II**
**Bulk metal and Ceramic Nano composites:** Ceramic/Metal Nano composite, Nano composites: mechanical alloying, thermal Spray synthesis, from sol-gel synthesis Metal Matrix Nanocomposites, Thin film nanocomposite: Multilayer and Granular Films, Nanocomposite for hard coatings, Carbon nanotube-based nanocomposites, Functional Low dimensional Nanocomposite,

**UNIT – III**
Polymer-based nanocomposites, **processing of polymer nano composites:** Extrusion method, Exfoliation & intercalation, Solution casting method, impregnation techniques: Hot melt impregnation, solution impregnation.

**UNIT – IV**
Modeling of nanocomposites, modeling methods: **Continuum methods:** Analytical continuum modeling, Computational continuum modeling, **Molecular Modeling:** Molecular dynamics, Monte Carlo, Ab initio methods

**UNIT – V**
**Processing of nano composites:** Powder metallurgy method, Pressure Infiltration technique, Stir Casting, Nano composites for hard coatings, DLC coatings.

**TEXT BOOKS:**
1. Nano composite Science & Technology by P.M. Ajayan, L.S. Schadler and P.V. Braun, Wiley-VCH GmbH Co.
2. Introduction to Nano Technology by Charles. P. Poole Jr and Frank J. Owens; Wiley India Pvt Ltd.
3. Nanotechnology, A gentle introduction to the next big idea by Mark Ratner, Daniel Ratner Pearson education.
4. Polyoxometalate Chemistry for Nano- Composite Design

**REFERENCE BOOKS:**
1. Encyclopedia of Nanotechnology by H. S. Nalwa
2. Encyclopedia of Nano Technology by M. Balakrishna rao and K. Krishna Reddy, Vol I to X Campus books.

## MEMS - NEMS DESIGN AND APPLICATIONS
## (Professional Elective – VI)

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T P C** |
| **Course Code: NT863PE** | **3 0 0 3** |

**Course Objectives:**

1. To provide understanding of MEMS/NEMS applications specially sensors, Micro machining tools etc.,
2. To provide silicon micro fabrication techniques etc.,
3. To bring out scaling and packaging issues of physical system

**UNIT - I**

**Overview and Introduction:** New Trends in Engineering and Science: Micro and Nanoscale Systems: Introduction to Design of MEMS and NEMS. Biological and Biosystems Analogies. Overview of Nano and Microelectromechanical Systems. Micro and Nanoelectromechanical Systems. Synergetic Paradigms in MEMS. MEMS and NEMS Architectures

**UNIT - II**

**Fundamentals of MEMS Fabrication:** Introduction and Description of Basic Processes. Microfabrication and Micromachining of ICs, Microstructures and Microdevices. MEMS Fabrication Technologies. Bulk Micromachining, Surface Micromachining. High Aspect Ratio Technology

**UNIT - III**

**Devising and Synthesis of MEMS and NEMS:** MEMS Motion Microdevices Classifier and Synthesis. Microelectromechanical Microdevices. Synthesis and Classification Solver. Nanoelectromechanical Systems.

**UNIT - IV**

**Modeling of Micro Electromechanical Systems, Devices, and Structures:** Introduction to Modeling, Analysis and Simulation. Electromagnetics and its Application for MEMS and NEMS. Basic Foundations in Model Developments of Micro and Nanoactuators in Electromagnetic Fields. Lumped-Parameter Mathematical Models of MEMS. Direct-Current Microtransducers. Induction Micromachines: Two Phase and Three Phase. Synchronous Microtransducers: Single-Phase Reluctance Micromotors. Permanent-Magnet Synchronous Microtransducers. Microscale Permanent-Magnet Stepper Micromotors: Mathematical Model in the Machine Variables, Permanent-Magnet Stepper Micromotors in the rotor and synchronous reference frames. Piezotransducers: Steady-State Models and Characteristics, Mathematical Models of Piezoactuators: Dynamics and Nonlinear Equations of Motion. Fundamentals of Modeling of Electromagnetic Radiating Energy.

**UNIT - V**

**Modeling of Nanoscale Electromechanical Systems, Devices and Structures:** Classical Mechanics and Its Application: Newtonian Mechanics, Lagrange Equation, Hamilton Equations of Motion. Thermolysis and Heat Equation. Atomic Structures and Quantum Mechanics, Molecular and Nanostructures Dynamics: Schrodinger Equation and Wave function Theory. Density Functional Theory. Nanostructures and Molecular Dynamics. Electromagnetic Fields and their Quantization. Molecular Wires and Molecular Circuits.

**TEXT BOOKS:**

1. "MEMS and NEMS: Systems, Devices and Structures" by Sergey Edward Lyshevski, CRC press, 2002 edition.
2. An introduction to Micro electro mechanical systems Engineering" by Nadim Malut and Kirt Williams – Second edition – Artech House, Inc, Boston.
3. "Micro electro mechanical systems Design"./ by James J Allen- CRC Press – Taylor and Francis Group.

# NANO SENSORS AND ACTUATORS
## (Professional Elective – VI)

**B.Tech. IV Year II Sem.** **L T P C**
**Course Code: NT864PE** **3 0 0 3**

**Course Objectives:**
1. Demonstrate proficiency in the basic subfields of Engineering Physics as well as other areas of recent applications
2. Through critical thinking, problem solving in device designs of Micro-/Nano instruments
3. Construct and assemble experimental ideas, analyze available measurements of physical phenomena and their related things

**UNIT - I**
**Introduction to Micro- and Nanotechnology:** Introduction, Physics of Scaling – General Mechanisms for Electromechanical transduction – Sensor and Actuator Transduction Characteristics

**UNIT - II**
**Introduction to Sensors :** Sensors – Classification, Principle of operation – Linear and rotational sensors, Acceleration sensors, Force, torque and pressure sensors, Flow sensors, Temperature sensors, Proximity sensors, Light sensors, Smart material sensors, Micro and nano-sensors, Capacitive and Inductive sensors, Selection criteria of sensors – Signal conditioning and calibration.

**UNIT - III**
**Introduction to Actuators:** Classification – Principle of operation – Electrical, Electromechanical, Electromagnetic, Hydraulic and pneumatic and smart material Actuators, Micro and Nano-actuators, Selection criteria

**UNIT - IV**
**Sensor and Actuator Characteristics :** Range, Resolution, Sensitivity, Error, Repeatability, Linearity and Accuracy, Impedance, Nonlinearities, Static and Coulomb Friction, Eccentricity, Backlash, Saturation, Dead-band, System Response, First-Order System Response, Under-damped Second Order System Response, Frequency Response.

**UNIT - V**
**Nanotechnology enabled sensors:** Electromagnetic sensors, Optical Sensors, Magnetic Sensors, Physical Sensors, Chemical Sensors and biological sensors, Possibilities, Realities and applications

**TEXT BOOKS:**
1. Mechatronics – An introduction by Robert H Bishop, Taylor & Francis

2. Sensor Technology Handbook edited by Jon Wilson – Elsevier & Newnes
3. Nanotechnology – Basic Science and Emerging Technologies, Michael Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse, Chapman & Hall CRC
4. Nanotechnology – A gentle Introduction to the next big idea by Mark Ratner and Daniel Ratner
5. Nano the essentials – Understanding Nanoscience and Technology by T Pradeep

**REFERENCES:**


1. Introduction to Nanotechnology – Charles P Poole Jr, Frank J Owens, Wiley Interscience – John Wiley & sons
2. Nanotechnology for Dummies – Richard Booker, Earl Boysen, Wiley Publishing Inc.
3. Nanotechnology demystified by Linda Williams, Dr Wade Adams, Tata Mc Grawhill
4. Bionanotechnology by David Goodsell
5. Biosensing using nanomaterials edited by Arben Mercoci, Wiley Publishing Inc.
6. Engines of Creation by K Eric Drexler

**B.TECH. AERONAUTICAL ENGINEERING**
**INTRODUCTION TO SPACE TECHNOLOGY**
**(OPEN ELECTIVE - I)**

**B.Tech. III Year I Sem.** **L T P C**
**Course Code: AE511OE** **3 0 0 3**

**UNIT - I**

**Fundamentals of Rocket Propulsion and Trajectories:** Space Mission- Types-Space environment-launch vehicle selection.; Introduction to rocket propulsion-fundamentals of solid propellant rockets- Fundamentals of liquid propellant rockets-Rocket equation, Two-dimensional trajectories of rockets and missiles-Multi-stage rockets-Vehicle sizing-Two multi-stage rockets-Trade-off ratios-Single stage to orbit- Sounding rocket-Aerospace plane-Gravity turn trajectories-Impact point calculation-Injection conditions-Flight dispersions

**UNIT- II**

**Atmospheric Re-entry:** Introduction-Steep ballistic re-entry-Ballistic orbital re-entry-Skip re-entry-"Double- Dip" re-entry - Aero-braking - Lifting body re-entry

**UNIT-III**

**Fundamentals of Orbital Mechanics, Orbital Manoeuvres:** Two-body motion-circular, elliptic, hyperbolic, and parabolic orbits-Basic orbital elements-Ground trace**.** In-Plane orbit changes-Hohmann transfer-Bi-elliptical transfer-Plane changes- Combined manoeuvres-Propulsion for manoeuvres

**UNIT - IV**

**Satellite Attitude Dynamics:** Torque free axisymmetric rigid body-Attitude control for spinning spacecraft - Attitude control for non-spinning spacecraft - The Yo-Yo mechanism – Gravity – Gradient satellite-Dual spin spacecraft-Attitude determination

**UNIT-V**

**Space mission Operations:** Supporting ground system architecture and team interfaces - Mission phases and core operations- Team responsibilities – Mission diversity – Standard operations practices

**TEXT BOOK:**

1. 'Spaceflight Dynamics', W.E. Wiesel, 3rd edition, McGraw-Hill, 2010

**REFERENCES**

1. 'Rocket Propulsion and Space flight dynamics', Cornelisse JW, Schoyer HFR, and Wakker KF, Pitman, 1984
2. 'Fundamentals of Space Systems', Vincet L. Pisacane, Oxford University Press, 2005.
3. 'Understanding Space: An Introduction to Astronautics', J. Sellers, 2nd edition, McGraw- Hill, 2004

4. ‘Introduction to Space Flight’, Francis J Hale, Prentice-Hall, 1994
5. ‘Spacecraft Mission Design’, Charles D. Brown, AIAA Education Series, 1998
6. ‘Elements of Space Technology for Aerospace Engineers’, Meyer Rudolph X, Academic Press, 1999

**B.TECH. AERONAUTICAL ENGINEERING**
**INTRODUCTION TO AEROSPACE ENGINEERING**
**(OPEN ELECTIVE - II)**

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T P C** |
| **Course Code: AE621OE** | **3 0 0 3** |

**UNIT – I**

**History of Flight and Space Environment:** Balloons and dirigibles, heavier than air aircraft, commercial air transport; Introduction of jet aircraft, helicopters, missiles; Conquest of space, commercial use of space; Different types of flight vehicles, classifications exploring solar system and beyond, a permanent presence of humans in space; Earth's atmosphere, the standard atmosphere; The temperature extremes of space, laws of gravitation, low earth orbit, microgravity, benefits of microgravity; Environmental impact on spacecraft, space debris; Planetary environments.

**UNIT – II**

**Introduction to Aerodynamics:** Anatomy of the airplane, helicopter; Understanding engineering models; Aerodynamic forces on a wing, force coefficients; Generating lift, moment coefficients; Aerodynamic forces on aircraft – classification of NACA airfoils, aspect ratio, wing loading, Mach number, centre of pressure and aerodynamic centre-aerofoil characteristics-lift, drag curves; Different types of drag.

**UNIT – III**

**Flight Vehicle Performance and Stability:** Performance parameters, performance in steady flight, cruise, climb, range, endurance, accelerated flight symmetric manoeuvres, turns, sideslips, takeoff and landing; Flight vehicle Stability, static stability, dynamic stability; Longitudinal and lateral stability; Handling qualities of the airplanes.

**UNIT – IV**

**Introduction to Airplane Structures and Materials, Power Plants:** General types of construction, monocoque, semi-monocoque; Typical wing and fuselage structure; Metallic & non-metallic materials, use of aluminium alloy, titanium, stainless steel and composite materials. Basic ideas about engines, use of propeller and jets for thrust production; Principles of operation of rocket, types of rockets.

**UNIT – V**

**Satellite Systems Engineering Human Space Exploration:** Satellite missions, an operational satellite system, elements of satellite, satellite bus subsystems; Satellite structures, mechanisms and materials; Power systems; Communication and telemetry; Propulsion and station keeping; Space missions, mission objectives. Goals of human space flight missions, historical background, The Soviet and US missions; The Mercury, Gemini, Apollo (manned flight to the moon), Skylab, Apollo-Soyuz, Space Shuttle; International

Space Station, extravehicular activity; The space suit; The US and Russian designs; Life support systems, Flight safety; Indian effort in aviation, missile and space technology.

**TEXT BOOKS:**


1. Anderson J. D, “Introduction to Flight”, McGraw-Hill, 5th Edition, 1989.
2. Newman D, “Interactive Aerospace Engineering and Design”, McGraw-Hill, 1st Edition, 2002.
3. Barnard R.H and Philpot. D.R, “Aircraft Flight”, Pearson, 3rd Edition, 2004.


**REFERENCES**


1. Kermode, A. C, “Flight without Formulae”, McGraw Hill, 4th Edition, 1997.
2. Swatton P. J, “Flight Planning”, Blackwell Publisher, 6th Edition, 2002.

**B.TECH. AERONAUTICAL ENGINEERING**
**AIR TRANSPORTATION SYSTEMS**
**(OPEN ELECTIVE - III)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. IV Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: AE831OE** | **3** | **0** | **0** | **3** |

**UNIT- I**

**Aviation Industry & Its Regulatory Authorities:** Introduction, history of aviation-evolution, development, growth, challenges. Aerospace industry, air transportation industry-economic impact- types and causes. Airline Industry- structure and economic characteristics. The breadth of regulation- ICAO, IATA, national authorities (DGCA, FAA). Safety regulations- risk assessment- human factors and safety, security regulations, environmental regulations.

**UNIT-II**

**Airspace:** Categories of airspace- separation minima, airspace sectors- capacity, demand and delay. Evolution of air traffic control system- procedural ATC system, procedural ATC with radar assistance, first generation 'automated' ATC system, current generation radar and computer-based ATC systems. Aerodrome air traffic control equipment and operation - ICAO future air-navigation systems (FANS). Air-navigation service providers as businesses. Communication, navigation and surveillance systems (CNSS). Radio communications- VHF, HF, ACARS, SSR, ADS. Navigation- NDB, VOR, DME, area-navigation systems( R-Nav), ILS, MLS, GPS, INS.

**UNIT- III**

**Aircraft:** Costs- project cash-flow, aircraft price. Compatibility with the operational infrastructure. Direct and indirect operating costs. Balancing efficiency and effectiveness-payload-range, fuel efficiency, technical contribution to performance, operating speed and altitude, aircraft field length performance. typical operating costs. Effectiveness- wake-vortices, cabin dimensions, flight deck.

**UNIT- IV**

**Airports:** Setting up an airport- airport demand, airport siting, runway characteristics- length, declared distances, aerodrome areas, obstacle safeguarding. Runway capacity- evaluating runway capacity- sustainable runway capacity. Runway pavement length, Manoeuvring area-airfield lighting, aprons, Passenger terminals-terminal sizing and configuration. Airport demand, capacity and delay.

**UNIT - V**

**Airlines:** Setting up an airline- modern airline objectives. Route selection and development, airline fleet planning, annual utilization and aircraft size, seating arrangements. Indirect operating costs. Aircraft- buy or lease. Revenue generation, computerized reservation systems, yield management. Integrating service quality into the revenue-generation process.

Marketing the seats. Airline scheduling. Evaluating success- financial viability, regulatory compliance, efficient use of resources, effective service.

**TEXT BOOK:**

1. Hirst, M., *The Air Transport System*, Woodhead Publishing Ltd, Cambridge, England, 2008.

**REFERENCES:**

1. Wensven, J.G., *Air Transportation: A Management Perspective*, Eighth Edition, shgate, 2015.
2. Belobaba, P., Odoni, A. and Barnhart, C., *Global Airline Industry*, Second Edition, Wiley, 2015.
3. M. Bazargan, M., *Airline Operations and Scheduling*, Second Edition, Ashgate, 2010.
4. Nolan, M.S., *Fundamentals of Air Traffic Control*, 5th edn., Thomson Learning, 2011.
5. Wells, A. and Young, S., *Airport Planning and Management*, 6th edn., McGraw-Hill, 2011.

**B.TECH. AERONAUTICAL ENGINEERING**
**ROCKETS AND MISSILES**
**(OPEN ELECTIVE - III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T P C** |
| **Course Code: AE832OE** | **3 0 0 3** |

**UNIT- I**

**Introduction:** Space launch vehicles and military missiles- function, types, role, mission, mission profile, thrust profile, propulsion system, payload, staging, control and guidance requirements, performance measures, design, construction, operation- similarities and differences.

**UNIT – II**

**Solid and Liquid Propulsion Systems:** Solid propellant rocket motors, principal features, applications. Solid propellants- types, composition, properties, performance. Propellant grain-desirable properties, grain configurations, Liners, insulators and inhibitors-function, requirements, materials. Rocket motor casing-materials. Combustion system of solid rockets, igniters, types, construction. Nozzles-types, Liquid propellants- types, composition, properties, performance. Propellant tanks feed systems- pressurisation, turbo-pumps- valves and feed lines, injectors, starting and ignition. Engine cooling, support structure, control of engine starting and thrust build-up, liquid rocket combustion chamber

**UNIT – III**

**Aerodynamics of Rockets and Missiles:** Classification of missiles. Airframe components of rockets and missiles, Forces acting on a missile while passing through atmosphere, method of describing aerodynamic forces and moments, lateral aerodynamic moment, lateral damping moment, longitudinal moment of a rocket, lift and drag forces, drag estimation, body upwash and downwash in missiles. Rocket dispersion, re-entry body design considerations

**UNIT - IV**

**Dynamics and Control of Rockets and Missiles:** Tsiolskovsky's rocket equation- range in the absence of gravity, vertical motion in the earth's gravitational field, inclined motion, flight path at constant pitch angle, motion in the atmosphere, the gravity turn- the culmination altitude. Multi-staging. Earth launch trajectories- vertical segment, the gravity turn, constant pitch trajectory, orbital injection; Rocket thrust vector control-methods of thrust vector control for solid and liquid propulsion systems, thrust magnitude control, thrust termination

**UNIT - V**

**Rocket Testing:** Ground testing and flight testing- types of tests, test facilities and safeguards, monitoring and control of toxic materials, instrumentation and data management. Ground testing, flight testing, trajectory monitoring, post accident procedures, Description of a typical space vehicle launch procedure.

**TEXT BOOKS:**

1. Sutton, G.P., and Biblarz, O., *Rocket Propulsion Elements,* 8th edition, Wiley-Interscience, 2010.
2. Cornelisse, J.W., Schoyer H.F.R. and Wakker, K.F., *Rocket Propulsion and Space-flight Dynamics*, Pitman, 1979.
3. Turner, M.J.L., *Rocket and Spacecraft Propulsion*, 3rd edition, Springer, 2009.

**REFERENCES**

1. Chin, S.S., *Missile Configuration Design,* McGraw Hill, 1961
2. Ball, K.J., Osborne, G.F., *Space Vehicle Dynamics*, Oxford University Press, 1967.

**B.TECH. AUTOMOBILE ENGINEERING**
**DISASTER MANAGEMENT**
**(Open Elective - I)**

| | |
|---|---|
| **B.Tech. III Year I Sem.** | **L T P C** |
| **Course Code: CE511OE** | **3 0 0 3** |

**Course Objectives:** The subject provides different disasters, tools and methods for disaster management.

**Course Outcomes:** At the end of the course, the student will be able to:
- Understanding Disasters, man-made Hazards and Vulnerabilities
- Understanding disaster management mechanism
- Understanding capacity building concepts and planning of disaster managements

**UNIT - I**
**Understanding Disaster:** Concept of Disaster - Different approaches- Concept of Risk - Levels of Disasters - Disaster Phenomena and Events (Global, national and regional)
**Hazards and Vulnerabilities:** 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:** Capacity Building: Concept - Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - 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. Manual on Disaster Management, National Disaster Management, Agency Govt of India.
2. Disaster Management by Mrinalini Pandey Wiley 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015

**REFERENCES:**

1. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
2. National Disaster Management Plan, Ministry of Home affairs, Government of India (http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf)

**B.TECH. AUTOMOBILE ENGINEERING**
**INTELLECTUAL PROPERTY RIGHTS**
**(Open Elective - I)**

| | |
|---|---|
| **B.Tech. III Year I Sem.** | **L T P C** |
| **Course Code: MT512OE** | **3 0 0 3** |

**UNIT – I**

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

**UNIT – II**

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

**UNIT – III**

Law of copy rights : Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

**UNIT – IV**

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

**UNIT – V**

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

**TEXT BOOKS & REFERENCES:**


1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tata McGraw Hill Publishing company ltd.

**B.TECH. AUTOMOBILE ENGINEERING**
**DATA STRUCTURES**
**(Open Elective – II)**

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T P C** |
| **Course Code: EM614PE/MT621OE** | **3 0 0 3** |

**Course Objectives:**

- To understand the basic concepts such as Abstract Data Types, Linear, and Non Linear Data structures.
- To understand the notations used to analyze the Performance of algorithms.
- To understand the behavior of data structures such as stacks, queues, trees, hash tables, search trees, Graphs and their representations.
- To choose the appropriate data structure for a specified application.
- To understand and analyze various searching and sorting algorithms.
- To write programs in C to solve problems using data structures such as arrays, linked lists, stacks, queues, trees, graphs, hash tables, search trees.

**Course Outcomes:**

- Learn how to use data structure concepts for realistic problems.
- Ability to identify appropriate data structure for solving computing problems in respective language.
- Ability to solve problems independently and think critically.

**UNIT- I**

Basic concepts- Algorithm Specification-Introduction, Recursive algorithms, Data Abstraction Performance analysis- time complexity and space complexity, Asymptotic Notation-Big O, Omega and Theta notations, Introduction to Linear and Non Linear data structures.

Singly Linked Lists-Operations-Insertion, Deletion, Concatenating singly linked lists, Circularly linked lists-Operations for Circularly linked lists, Doubly Linked Lists-Operations- Insertion, Deletion.

Representation of single, two dimensional arrays, sparse matrices-array and linked representations.

**UNIT- II**

Stack ADT, definition, operations, array and linked implementations in C, applications-infix to postfix conversion, Postfix expression evaluation, recursion implementation, Queue ADT, definition and operations ,array and linked Implementations in C, Circular queues-Insertion and deletion operations, Deque (Double ended queue)ADT, array and linked implementations in C.

**UNIT- III**

Trees – Terminology, Representation of Trees, Binary tree ADT, Properties of Binary Trees, Binary Tree Representations-array and linked representations, Binary Tree traversals, Threaded binary trees, Max Priority Queue ADT-implementation-Max Heap-Definition, Insertion into a Max Heap, Deletion from a Max Heap.

Graphs – Introduction, Definition, Terminology, Graph ADT, Graph Representations-Adjacency matrix, Adjacency lists, Graph traversals- DFS and BFS.

**UNIT- IV**

Searching- Linear Search, Binary Search, Static Hashing-Introduction, hash tables, hash functions, Overflow Handling.

Sorting-Insertion Sort, Selection Sort, Radix Sort, Quick sort, Heap Sort, Comparison of Sorting methods.

**UNIT- V**

Search Trees-Binary Search Trees, Definition, Operations- Searching, Insertion and Deletion, AVL Trees-Definition and Examples, Insertion into an AVL Tree ,B-Trees, Definition, B-Tree of order m, operations-Insertion and Searching, Introduction to Red-Black and Splay Trees(Elementary treatment-only Definitions and Examples), Comparison of Search Trees.

Pattern matching algorithm- The Knuth-Morris-Pratt algorithm, Tries (examples only).

**TEXT BOOKS:**

1. Fundamentals of Data structures in C, 2nd Edition, E.Horowitz, S.Sahni and Susan Anderson-Freed, Universities Press.
2. Data structures A Programming Approach with C, D.S.Kushwaha and A.K.Misra, PHI.

**REFERENCE BOOKS:**

1. Data structures: A Pseudocode Approach with C, 2nd edition, R. F. Gilberg And B.A. Forouzan, Cengage Learning.
2. Data structures and Algorithm Analysis in C, 2nd edition, M.A.Weiss, Pearson.
3. Data Structures using C, A. M. Tanenbaum, Y. Langsam, M.J. Augenstein, Pearson.
4. Data structures and Program Design in C, 2nd edition, R. Kruse, C. L. Tondo and B. Leung, Pearson.
5. Data Structures and Algorithms made easy in JAVA, 2nd Edition, Narsimha Karumanchi, and Career Monk Publications.
6. Data Structures using C, R. Thareja, Oxford University Press.
7. Data Structures, S. Lipscutz, Schaum’s Outlines, TMH.
8. Data structures using C, A. K. Sharma, 2nd edition, Pearson..
9. Data Structures using C &C++, R. Shukla, Wiley India.
10. Classic Data Structures, D. Samanta, 2nd edition, PHI.
11. Advanced Data structures, Peter Brass, Cambridge.

**B.TECH. AUTOMOBILE ENGINEERING**
**ARTIFICIAL NEURAL NETWORKS**
**(Open Elective – II)**

| **B.Tech. III Year II Sem.** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| **Course Code: MT622OE** | **3** | **0** | **0** | **3** |

**Course Objectives:**

- To understand the biological neural network and to model equivalent neuron models.
- To understand the architecture, learning algorithm and issues of various feed forward and feedback neural networks.

**Course Outcomes:** By completing this course the student will be able to:

- Create different neural networks of various architectures both feed forward and feed backward.
- Perform the training of neural networks using various learning rules.
- Perform the testing of neural networks and do the perform analysis of these networks for various pattern recognition applications.

**UNIT - I**

**Introduction**: A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks

**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 - II**

**Single Layer Perceptron**: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment

**Multilayer Perceptron**: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection

**UNIT - III**

**Back Propagation:** Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues, and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning

**UNIT - IV**

**Self-Organization Maps (SOM):** Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification

**UNIT - V**

**Neuro Dynamics:** Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a Recurrent Network Paradigm

**Hopfield Models –** Hopfield Models, Computer Experiment

**TEXT BOOKS:**

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.

**REFERENCE BOOKS:**

1. Artificial Neural Networks - B. Yegnanarayana Prentice Hall of India P Ltd 2005
2. Neural Networks in Computer Inteligance, Li Min Fu TMH 2003
3. Neural Networks -James A Freeman David M S Kapura Pearson Education 2004.
4. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.

**B.TECH. AUTOMOBILE ENGINEERING**
**INTRODUCTION TO MECHATRONICS**
**(Open Elective – III)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. IV Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: AM831OE** | **3** | **0** | **0** | **3** |

**Pre-requisites:** Basic Electronics Engineering

**Course Objectives:**
- To develop an ability to identify, formulate, and solve engineering problems
- To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
- To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

**Course Outcomes:** At the end of the course, the student will be able to, Model, analyze and control engineering systems. Identify sensors, transducers and actuators to monitor and control the behavior of a process or product. Develop PLC programs for a given task. Evaluate the performance of mechatronic systems.

**UNIT – I**
**Introduction**: Definition – Trends - Control Methods: Standalone , PC Based ( Real Time Operating Systems, Graphical User Interface , Simulation ) - Applications: identification of sensors and actuators in Washing machine, Automatic Camera, Engine Management, SPM, Robot, CNC, FMS, CIM.
**Signal Conditioning : I**ntroduction – Hardware - Digital I/O , Analog input – ADC , resolution, Filtering Noise using passive components – Registors, capacitors - Amplifying signals using OP amps –Software - Digital Signal Processing – Low pass , high pass , notch filtering

**UNIT – II**
**Precision Mechanical Systems :** Modern CNC Machines – Design aspects in machine structures, guideways, feed drives, spindle and spindle bearings, measuring systems, control software and operator interface, gauging and tool monitoring.
**Electronic Interface Subsystems :** TTL, CMOS interfacing - Sensor interfacing – Actuator interfacing – solenoids , motors Isolation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers , over current sensing , resetable fuses , thermal dissipation - Power Supply - Bipolar transistors / mosfets

**UNIT – III**

**Electromechanical Drives :** Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation.

**Microcontrollers Overview** : 8051 Microcontroller , micro processor structure – Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly, C ( LED Blinking , Voltage measurement using ADC).

**UNIT – IV**

Programmable Logic Controllers : Basic Structure - Programming : Ladder diagram -Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling - Analog input / output - PLC Selection - Application.

**UNIT – V**

**Programmable Motion Controllers** : Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a control system - Feedback Devices : Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive , Capacitive , Infrared - Continuous and discrete processes - Control System Performance & tuning - Digital Controllers - P , PI , PID Control - Control modes – Position , Velocity and Torque - Velocity Profiles – Trapezoidal- S. Curve - Electronic Gearing - Controlled Velocity Profile - Multi axis Interpolation , PTP , Linear , Circular - Core functionalities – Home , Record position , GOTO Position - Applications : SPM, Robotics.

**TEXT BOOKS:**

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering/ W Bolton/ Pearson.
2. Introduction to Mechatronics / Appukuttan /Oxford

**REFERENCE BOOKS:**

1. Mechatronics Principles concepts & Applications / N.P.Mahalik/ Mc Graw Hill
2. "Designing Intelligent Machines". open University, London.

**B.TECH. AUTOMOBILE ENGINEERING**
**MICROPROCESSORS AND MICROCONTROLLERS**
**(Open Elective – III)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. IV Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: AM832OE** | **3** | **0** | **0** | **3** |

**Course Objectives:**
- To develop an understanding of the operations of microprocessors and micro controllers; machine language programming and interfacing techniques.

**Course Outcomes:**
- Understands the internal architecture and organization of 8086, 8051 and ARM processors/controllers.
- Understands the interfacing techniques to 8086 and 8051 and can develop assembly language programming to design microprocessor/ micro controller based systems.

**UNIT - I**

**8086 Architecture:** 8086 Architecture-Functional diagram, Register Organization, Memory Segmentation, Programming Model, Memory addresses, Physical Memory Organization, Architecture of 8086, Signal descriptions of 8086, interrupts of 8086.

**Instruction Set and Assembly Language Programming of 8086**: Instruction formats, Addressing modes, Instruction Set, Assembler Directives, Macros, and Simple Programs involving Logical, Branch and Call Instructions, Sorting, String Manipulations.

**UNIT - II**

**Introduction to Microcontrollers:** Overview of 8051 Microcontroller, Architecture, I/O Ports, Memory Organization, Addressing Modes and Instruction set of 8051.

**8051 Real Time Control:** Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Programming 8051 Timers and Counters

**UNIT – III**

**I/O And Memory Interface:** LCD, Keyboard, External Memory RAM, ROM Interface, ADC, DAC Interface to 8051.

**Serial Communication and Bus Interface:** Serial Communication Standards, Serial Data Transfer Scheme, On board Communication Interfaces-I2C Bus, SPI Bus, UART; External Communication Interfaces-RS232,USB.

**UNIT – IV**

**ARM Architecture:** ARM Processor fundamentals, ARM Architecture – Register, CPSR, Pipeline, exceptions and interrupts interrupt vector table, ARM instruction set – Data processing, Branch instructions, load store instructions, Software interrupt instructions, Program status register instructions, loading constants, Conditional execution, Introduction to Thumb instructions.

**UNIT – V**

**Advanced ARM Processors:** Introduction to CORTEX Processor and its architecture, OMAP Processor and its Architecture.

**TEXT BOOKS:**

1. Advanced Microprocessors and Peripherals – A. K. Ray and K.M. Bhurchandani, MHE, 2nd Edition 2006.
2. The 8051 Microcontroller, Kenneth. J. Ayala, Cengage Learning, 3rd Ed.
3. ARM System Developers guide, Andrew N SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier, 2012

**REFERENCE BOOKS:**

1. Microprocessors and Interfacing, D. V. Hall, MGH, 2nd Edition 2006.
2. Introduction to Embedded Systems, Shibu K.V, MHE, 2009
3. The 8051Microcontrollers, Architecture and Programming and Applications -K.Uma Rao, Andhe Pallavi, Pearson, 2009.

**B.TECH. BIOMEDICAL ENGINEERING**
**RELIABILITY ENGINEERING**
**(Open Elective – I)**

| | |
|---|---|
| **B.Tech. III Year I Sem.** | **L T P C** |
| **Course Code: BM511OE** | **3 0 0 3** |

**Prerequisite:** Mathematics III

**Course Objectives:**
- To introduce the basic concepts of reliability, various models of reliability
- To analyze reliability of various systems
- To introduce techniques of frequency and duration for reliability evaluation of repairable systems.

**Course Outcomes:** After completion of this course, the student will be able to
- model various systems applying reliability networks
- evaluate the reliability of simple and complex systems
- estimate the limiting state probabilities of repairable systems
- apply various mathematical models for evaluating reliability of irrepairable systems

**UNIT – I**
**Basic Probability Theory:** Elements of probability, probability distributions, Random variables, Density and Distribution functions- Binomial distribution- Expected value and standard deviation - Binomial distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution.
**Definition of Reliability:** Definition of terms used in reliability, Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Hazard models - Bath tub curve, Effect of preventive maintenance. Measures of reliability: Mean Time to Failure and Mean Time Between Failures.

**UNIT – II**
**Network Modeling and Evaluation Of Simple Systems:** Basic concepts- Evaluation of network Reliability / Unreliability - Series systems, Parallel systems- Series-Parallel systems- Partially redundant systems- Examples.
**Network Modeling and Evaluation of Complex systems**: Conditional probability method- tie set, Cutset approach- Event tree and reduced event tree methods- Relationships between tie and cutsets- Examples.

**UNIT – III**
**Time Dependent Probability:** Basic concepts- Reliability function f(t). F(t), R(t) and h(t) - Relationship between these functions.

**Network Reliability Evaluation Using Probability Distributions:** Reliability Evaluation of Series systems, Parallel systems – Partially redundant systems- determination of reliability measure- MTTF for series and parallel systems – Examples.

**UNIT – IV**

**Discrete Markov Chains:** Basic concepts- Stochastic transitional probability matrix- time dependent probability evaluation- Limiting State Probability evaluation- Absorbing states – Examples

**Continuous Markov Processes**: Modeling concepts- State space diagrams- Unreliability evaluation of single and two component repairable systems

**UNIT – V**

**Frequency and Duration Techniques:** Frequency and duration concepts, application to multi state problems, Frequency balance approach.

**Approximate System Reliability Evaluation:** Series systems – Parallel systems- Network reduction techniques- Cut set approach- Common mode failures modeling and evaluation techniques- Examples.

**TEXT BOOKS:**

1. Roy Billinton and Ronald N Allan, Reliability Evaluation of Engineering Systems, Plenum Press, 1983.
2. E. Balagurusamy, Reliability Engineering by Tata McGraw-Hill Publishing Company Limited, 2002.

**REFERENCE BOOK:**

1. K. K. Agarwal, Reliability Engineering-Kluwer Academic Publishers, 1993.

**B.TECH. BIOMEDICAL ENGINEERING**
**MEDICAL ELECTRONICS**
**(Open Elective – II)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: BM621OE** | **3** | **0** | **0** | **3** |

**Pre-requisites:** Nil.

**UNIT - I**

**Action Potential and Transducers:** Electrical activity in cells, tissues, muscles and nervous systems -transducers-types and characteristics

Physiological transducers – pressure transducers-transducers for body temperature measurement – Pulse sensors-respiratory sensors.

**UNIT - II**

**Biosignal Acquisition:** Physiological signal amplifiers-isolation amplifiers-medical pre-amplifier design-bridge amplifiers-line driving amplifier-current amplifier – chopper amplifier-biosignal analysis - signal recovery and data acquisition-drift compensation in operational amplifiers-pattern recognition-physiological assist devices.

**UNIT - III**

**Biopotential Recorders:** Characteristics of recoding system - electrocardiography (ECG) – electro encephalography (EEG) - electromyography (EMG) - electroretinography (ERG) - electrooculography (EOG) – recorders with high accuracy –recorders for OFF line analysis.

**UNIT - IV**

**Specialized Medical Equipment:** Digital thermometer-audio meter –X-ray machines-radiography and fluoroscopy - angiography – elements of bio-telemetry system-design of bio-telemetry system-radio telemetry system-pace makers-Heart lung machine-Dialysis machine.

**UNIT - V**

**Advanced Biomedical Instrumentation:** Computers in medicine - lasers in medicine – basic principles of endoscopes- nuclear imaging techniques - computer tomography (CT) Scanning –Ultrasonic imaging system-construction propagation and delay – magnetic resonance imaging (MRI).

**TEXT BOOKS:**

1. Biomedical Instrumentation and Measurements-L. Cromwell, F.J. Weibel land E. A. Pfeiffer.
2. Biomedical Instrumentation- M. Arumugam - Anuradha Publications.
3. Handbook of Biomedical Instruments- R.S. Khandpur.

**B.TECH. BIOMEDICAL ENGINEERING**
**TELEMETRY AND TELECONTROL**
**(Open Elective – III)**

| **B.Tech. IV Year II Sem.** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| **Course Code: BM831OE** | **3** | **0** | **0** | **3** |

**Pre-requisites:** Nil.

**Course Objective:** To make students understand the application of telemetry techniques to Instrumentation.

**Course Outcome:** Upon completion of this course students will appreciate t he application of different telemetry systems and control to any process.

**UNIT – I**
**Telemetry Principles:** Introduction, Functional blocks of Telemetry system, Methods of Telemetry – Non Electrical, Electrical, Pneumatic, Frequency.
**Symbols and Codes:** Bits and Symbols, Time function pulses, Line and Channel Coding, Modulation Codes. Inter symbol Interference.

**UNIT – II**
**Frequency& Time Division Multiplexed Systems:** FDM, IRIG Standard, FM and PM Circuits, Receiving end, PLL.
TDM - PAM, PAM /PM and TDM – PCM Systems. PCM reception. Differential PCM Introduction, QAM, Protocols.

**UNIT – III**
**Satellite Telemetry:** General considerations, TT & C Service, Digital Transmission systems, TT & C Subsystems, Telemetry, and Communications.
**Modern Telemetry:** Zigbee, Ethernet.

**UNIT – IV**
**Optical Telemetry:** Optical fibers Cable – Sources and detectors – Transmitter and Receiving Circuits, Coherent Optical Fiber Communication System.

**UNIT – V**
**Telecontrol Methods:** Analog and Digital techniques in Telecontrol, Telecontrol apparatus – Remote adjustment, Guidance, and regulation – Telecontrol using information theory – Example of a Telecontrol System.

**TEXT BOOKS:**
1. Telemetry Principles – D. Patranabis, TMH

2. Telecontrol Methods and Applications of Telemetry and Remote Control – by Swoboda G., Reinhold Publishing Corp., London, 1991

**REFERENCE BOOKS:**

1. Handbook of Telemetry and Remote Control – by Gruenberg L., McGraw Hill, New York, 1987.
2. Telemetry Engineering – by Young R.E., Little Books Ltd., London, 1988.
3. Data Communication and Teleprocessing System – by Housley T., PH Intl., Englewood Cliffs, New Jersey, 1987.

**B.TECH. BIOMEDICAL ENGINEERING**
**ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY**
**(Open Elective – III)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. IV Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: BM832OE** | **3** | **0** | **0** | **3** |

**Course Objectives:**

- To introduce important system concepts such as Electromagnetic interference and Electromagnetic compatibility (EMI & EMC).
- To familiarize with unavoidable and naturally happening sources of EMI and problems to ensure EMC.
- To study various techniques to reduce EMI from systems and to improve EMC of electronic systems.

**Course Outcomes:** Upon completion of this course, the student will be able to

- Gain basic knowledge of problems associated with EMI and EMC from electronic circuits and systems.
- Analyze various sources of EMI and various possibilities to provide EMC.
- Understand and analyze possible EMI prevention techniques such as grounding, shielding, filtering, and use of proper coupling mechanisms to improve compatibility of electronic circuits and systems in a given electromagnetic environment.

**UNIT – I**

**Sources of EMI:** Definition of EMI and EMC, Classification, Natural and Man-Made EMI Sources, Switching Transients, Electrostatic Discharge, Nuclear Electromagnetic Pulse and High Power Electromagnetics.

**EMI/EMC Standards:** Introduction, Standards for EMI/EMC – MIL –STD 461/462 – IEEE/ANSI Standards – CISPR/IEC, Standards – FCC Regulations.

**UNIT - II**

**EMI Coupling Modes:** Penetration: Introduction, Shielding Theory - Shielding Effectiveness, The Circuit Approach, The Wave Approach, Aperture Theory, Calculation of Effectiveness of a Conducting Box with an Aperture, Introduction to Propagation and Cross Talk – Introduction, Basic Principles, Determination of EM Field from Transmission Lines.

**UNIT - III**

**EMI Controlling Techniques - I:** Grounding, Principles and Practice of Earthing, Precautions in Earthing, Measurements of Ground Resistance, System Grounding for EMC, Cable Shielding Grounding.

Shielding, Theory and Effectiveness, Materials, Integrity at Discontinuities, Conductive Coatings, Cable Shielding, Effectiveness Measurements, Electrical Bonding.

**UNIT – IV**

**EMI Controlling Techniques - II:** Characteristics and Types of Filters – Impedance Mismatch, Lumped Element Low-Pass, High- Pass, Band-Pass and Band-Reject Filters, Power Line Filter Design - Common Mode, Differential Mode, Combined CM and DM Filters, Design Example.

EMC Gaskets – Knitted Wire-Mesh Gaskets, Wire-Screen Gaskets, Oriented Wire Mesh, Conductive Elastomer, Transparent Conductive Windows, Conductive Adhesive, Conductive Grease, Conductive Coatings, Isolation Transformers, Opto-Isolators.

**UNIT - V**

**EMI Measurements:** Introduction to Open Area Test Site Measurements – Measurement Precautions – Open Area Test Site – Terrain Roughness – NSA – Measurement of Test Site Imperfections – Antenna Factor Measurement – Measurement Errors.

Radiated Interference Measurements – Anechoic Chamber – TEM Cell – Reverberating Chamber – Ghz TEM Cell – Comparison of Test Facilities – Measurement Uncertainties

Conducted Interference Measurements – Characterization – Conducted EM Noise on Power Supply Lines – Conducted EMI from Equipment – Immunity – Detectors and Measurement – Pulsed EMI Immunity – Electrostatic Discharge.

**TEXT BOOKS:**

1. Engineering Electromagnetic Compatibility – V. Prasad Kodali – 2/e – IEEE Press – Wiley India Pvt. Ltd – 2001.

**REFERENCES:**

1. Introduction to Electromagnetic Compatibility – Clayton R. Paul – John Wiley & Sons, 1992.
2. Electromagnetic Compatibility of Integrated Circuits – Techniques for Low Emission and Susceptibility – Edited by Sonia Ben Dhia, Mohamed Ramdani and Etienne Sicard – Springer, 2006.
3. EMI reduction in Electronic Systems – Mills – J.P – Prentice Hall Inc.
4. Noise Reduction in Electronic Systems – Henry W. Ott, 2nd Edition, Wiley Interscience, 1988.

**B.TECH. CIVIL ENGINEERING**
**DISASTER MANAGEMENT**
**(Open Elective - I)**

| | |
|---|---|
| **B.Tech. III Year I Sem** | **L T/P/D C** |
| **Course Code: CE511OE** | **3 0/0/0 3** |

**Course Objectives:** The subject provide different disasters, tools and methods for disaster management

**Course Outcomes:** At the end of the course, the student will be able to:

- Understanding Disasters, man-made Hazards and Vulnerabilities
- Understanding disaster management mechanism
- Understanding capacity building concepts and planning of disaster managements

**UNIT - I**

**Understanding Disaster:** Concept of Disaster - Different approaches- Concept of Risk - Levels of Disasters - Disaster Phenomena and Events (Global, national and regional)

**Hazards and Vulnerabilities:** 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:** Capacity Building: Concept - Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - 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. Manual on Disaster Management, National Disaster Management, Agency Govt of India.
2. Disaster Management by Mrinalini Pandey Wiley 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015

**REFERENCES:**

1. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
2. National Disaster Management Plan, Ministry of Home affairs, Government of India (http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf)

**B.TECH. CIVIL ENGINEERING**
**REMOTE SENSING AND GIS**
**(Open Elective - II)**

| | |
|---|---|
| **B.Tech.IV Year II Sem** | **L T/P/D C** |
| **Course Code**: **CE621OE** | **3 0/0/0 3** |

**Pre Requisites**: Surveying

**Course Objectives:** This course will make the student to understand about the principles of GIS, Remote Sensing, Spatial Systems, and its applications to Engineering Problems.

**Course Outcomes:** At the end of the course, the student will be able to:

- Retrieve the information content of remotely sensed data
- Analyze the energy interactions in the atmosphere and earth surface features
- Interpret the images for preparation of thematic maps
- Apply problem specific remote sensing data for engineering applications
- Analyze spatial and attribute data for solving spatial problems
- Create GIS and cartographic outputs for presentation

**UNIT – I**

**Introduction to Photogrammetry:** Principles& types of aerial photograph, geometry of vertical aerial photograph, Scale & Height measurement on single vertical aerial photograph, Height measurement based on relief displacement, Fundamentals of stereoscopy, fiducial points, parallax measurement using fiducial line.

**UNIT – II**

**Remote Sensing:** Basic concept of remote sensing, Data and Information, Remote sensing data Collection, Remote sensing advantages & Limitations, Remote Sensing process.
Electro-magnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, vegetation), Indian Satellites and Sensors characteristics, Resolution, Map and Image and False color composite, introduction to digital data, elements of visual interpretation techniques.

**UNIT – III**

**Geographic Information Systems:** Introduction to GIS; Components of a GIS; Geospatial Data: Spatial Data-Attribute data – Joining Spatial and Attribute data; GIS Operations: Spatial Data Input- Attribute data Management –Data display- Data Exploration- Data Analysis. COORDINATE SYSTEMS: Geographic Coordinate System: Approximation of the Earth, Datum; Map Projections: Types of Map Projections-Map projection parameters-Commonly used Map Projections - Projected coordinate Systems

**UNIT – IV**

**Vector Data Model**: Representation of simple features- Topology and its importance; coverage and its data structure, Shape file; Data models for composite features Object Based Vector Data Model; Classes and their Relationship; The geobase data model; Geometric representation of Spatial Feature and data structure, Topology rules

**UNIT – V**

**Raster Data Model**: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, Data Conversion, Integration of Raster and Vector data.

**Data Input:** Metadata, Conversion of Existing data, creating new data; Remote Sensing data, Field data, Text data, Digitizing, Scanning, on screen digitizing, importance of source map, Data Editing

**TEXT BOOKS:**

1. Remote Sensing and GIS Lillesand and Kiefer, John Willey 2008.
2. Remote Sensing and GIS B. Bhatta by Oxford Publishers 2015.
3. Introduction to Geographic Information System – Kang-Tsung Chang, McGraw-Hill 2015

**REFERENCES:**

1. Concepts & Techniques of GIS by C. P. Lo Albert, K.W. Yonng, Prentice Hall (India) Publications.
2. Principals of Geo physical Information Systems – Peter A Burragh and Rachael A. Mc Donnell, Oxford Publishers 2004.
3. Basics of Remote sensing & GIS by S. Kumar, Laxmi Publications.

**B.TECH CIVIL ENGINEERING**
**GEOINFORMATICS**
**(Open Elective - II)**

| | |
|---|---|
| **B.Tech. III Year II Sem** | **L T/P/D C** |
| **Course Code**: **CE622OE** | **3 0/0/0 3** |

**Course Objectives:**

- To introduce the concepts of remote sensing, satellite image characteristics and its components.
- To expose the various remote sensing platforms and sensors and to introduce the concepts of GIS, GPS and GNSS.

**Course Outcomes:** At the end of the course the student will be able to understand

- The characteristics of Aerial photographic images ,Remote sensing satellites and Applications of remote sensing.
- The GIS and its Data models.
- The Global Navigation Satellite System.

**UNIT – I**

Aerial Photographs- Basic terms & Definitions, scales, relief displacements, Flight Planning, Stereoscopy, Characteristics of photographic images, Fundamentals of aerial photo-interpretation, Introduction to Digital Photogrammetry.

**UNIT - II**

Remote Sensing: Physics of remote sensing, Remote sensing satellites, and their data products, Sensors and orbital characteristics, Spectral reflectance curves, resolution and multi-concept, FCC

**UNIT – III**

Satellite Image - Characteristics and formats, Image histogram, Introduction to Image rectification, Image Enhancement, Land use and land cover classification system, Unsupervised and Supervised Classification, Applications of remote sensing

**UNIT - IV**

Basic concepts of geographic data, GIS and its components, Data models, Topology, Process in GIS: Data capture, data sources, data encoding, geospatial analysis, GIS Applications

**UNIT - V**

Global Navigation Satellite System (GNSS), GPS, GLONASS, GALILEO, GPS: Space segment, Control segment, User segment, GPS satellite signals, Datum, coordinate system and map projection, Static, Kinematic and Differential GPS, GPS Applications

**TEXT BOOKS:**

1. Remote Sensing & GIS , BS Publications
2. Higher Surveying by A M Chandra New Age International Publisher
3. Remote Sensing & GIS by B. Bhatta Oxford University Press
4. Introduction to GPS by A. E Rabbany Library of congress cataloging in Publication data

**REFERENCES:**

1. T M Lillesand et al: Remote Sensing & Image Interpretation
2. Higher Surveying by B C Punmia Ashok kr. Jain Laxmi Publications
3. N K Agarwal : Essentials of GPS , Spatial Networks: Hyderabad

**B.TECH. CIVIL ENGINEERING**
**INTELLECTUAL PROPERTY RIGHTS**
**(Open Elective - II)**

| | |
|---|---|
| **B.Tech. III Year II Sem** | **L T/P/D C** |
| **Course Code: CE623OE** | **3 0/0/0 3** |

**UNIT – I**
Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

**UNIT – II**
Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

**UNIT – III**
Law of copy rights : Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.
Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

**UNIT – IV**
Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.
Unfair competition: Misappropriation right of publicity, false advertising.

**UNIT – V**
New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.
International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

**TEXT BOOKS & REFERENCES:**
1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tate McGraw Hill Publishing company ltd.,

**B.TECH CIVIL ENGINEERING**
**ENVIRONMENTAL IMPACT ASSESSMENT**
**(Open Elective - III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem** | **L T/P/D C** |
| **Course Code: CE831OE** | **3 0/0/0 3** |

**Pre Requisites**: Environmental Engineering

**Course Objectives:** This subject will cover various aspects of Environment Impact Assessment methodologies, impact of development activities. Impact on surface water, Air and Biological Environment, Environment legislation Environment.

**Course Outcomes:**

- Identify the environmental attributes to be considered for the EIA study.
- Formulate objectives of the EIA studies.
- Identify the suitable methodology and prepare Rapid EIA.
- Indentify and incorporate mitigation measures.

**UNIT – I**

Basic concept of EIA : Initial environmental Examination, Elements of EIA, - factors affecting E-I-A Impact evaluation and analysis, preparation of Environmental Base map, Classification of environmental parameters.
E I A Methodologies: introduction, Criteria for the selection of EIA Methodology, E I A methods, Ad-hoc methods, matrix methods, Network method Environmental Media Quality Index method, overlay methods, cost/benefit Analysis.

**UNIT- II**

Assessment of Impact of development 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.

**UNIT – IV**

Environmental Audit & 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**

The Environmental Protection Act, The water Act, The Air (Prevention & Control of pollution Act.), Motor Act, Wild life Act. Case studies and preparation of Environmental Impact assessment statement for various Industries.

**TEXT BOOKS:**

1. Larry Canter – Environmental Impact Assessment, McGraw-Hill Publications
2. Environmental Impact Assessment, Barthwal, R. R. New Age International Publications

**REFERENCES:**

1. Environmental Pollution by R.K. Khitoliya S. Chand, 2014.
2. Glynn, J. and Gary, W. H. K. - Environmental Science and Engineering, Prentice Hall Publishers
3. Suresh K. Dhaneja - Environmental Science and Engineering, S.K. Kataria & Sons Publication. New Delhi.
4. Bhatia, H. S. - Environmental Pollution and Control, Galgotia Publication (P) Ltd, Delhi.
5. Wathern, P. – Environmental Impact Assessment: Theory & Practice, Publishers-Rutledge, London, 1992.

**B.TECH. CIVIL ENGINEERING**
**OPTIMIZATION TECHNIQUES IN ENGINEERING**
**(Open Elective - III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem** | **L T/P/D C** |
| **Course Code**: **CE832OE** | **3 0/0/0 3** |

**Prerequisites:** Operations Research

**Course Objectives:** After doing this subject student should know

- The various optimization techniques for single variable optimization problem
- Direct search methods and Gradient methods for multi variable un constraint Optimization problems
- Formulate a Geometric Programming model and solve it by using Arithmetic Geometric in equality theorem
- Simulate the system
- Thorough of state of art optimization techniques like Genetic Algorithms, simulated Annealing

**Course Outcomes:** For a given system, as per customer requirement it is required to

- Formulate optimization problem.
- Solve the problem by using a appropriate optimization techniques.

**UNIT - I**

**Single Variable Non-Linear Unconstrained Optimization:** Elimination methods: Uni-Model function-its importance, Fibonacci method & Golden section method. Interpolation methods: Quadratic & Cubic interpolation methods.

**UNIT - II**

**Multi variable non-linear unconstrained optimization:** Direct search methods – Univariant method, Pattern search methods – Powell's, Hook - Jeeves, Rosen brock search methods. Gradient methods: Gradient of function& its importance, Steepest descent method, Conjugate direction methods: Fletcher-Reeves method & variable metric method.

**UNIT - III**

**Linear Programming** – Formulation, Simplex method, & artificial variable optimization techniques: Big M & Two phase methods. Sensitivity analysis: Changes in the objective coefficients, constants& coefficients of the constraints. Addition and deletion of variables, constraints.

Simulation – Introduction – Types- steps – applications: inventory & queuing – Advantages and disadvantages

**UNIT - IV**

**Integer Programming**- Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method

**Stochastic Programming**: Basic concepts of probability theory, random variables-distributions-mean, variance, correlation, co variance, joint probability distribution. Stochastic linear programming: Chance constrained algorithm.

**UNIT - V**

**Geometric Programming:** Polynomials – Arithmetic - Geometric inequality – unconstrained G.P- constrained G.P ($\leq$ type only)

**Non Traditional Optimization Algorithms:** Genetics Algorithm-Working Principles, Similarities, and Differences between Genetic Algorithm & Traditional Methods. Simulated Annealing- Working Principle-Simple Problems. Introduction to Particle Swarm Optimization (PSO)(very brief)

**TEXT BOOKS:**

1. Optimization theory & Applications / S. S. Rao / New Age International.
2. Optimization for Engineering Design, Kalyanmoy Deb, PHI

**REFERENCES:**

1. Operations Research by S. D. Sharma Kedarnath & Ramnath Publisher
2. Operation Research by Hamdy A Taha Pearson Educations
3. Optimization in operations research by Ronald L. Rardin Pearson Publisher
4. Optimization Techniques by Benugundu & Chandraputla, Pearson Asia.
5. Optimization Techniques theory and practice by M. C. Joshi, K. M. Moudgalya Narosa Publications

**B.TECH. CIVIL ENGINEERING**
**ENTREPRENEURSHIP AND SMALL BUSINESS ENTERPRISES**
**(Open Elective - III)**

| | |
|---|---|
| **B.Tech. IV Year III Sem** | **L T/P/D C** |
| **Course Code: CE833OE** | **3 0/0/0 3** |

**Course Objective:** The aim of this course is to have a comprehensive perspective of inclusive learning, ability to learn and implement the Fundamentals of Entrepreneurship.

**Course Outcome:** It enables students to learn the basics of Entrepreneurship and entrepreneurial development which will help them to provide vision for their own Start-up.

**Unit – 1: Entrepreneurial Perspectives:**
Evolution, Concept of Entrepreneurship, Types of Entrepreneurs, Entrepreneurial Competencies, Capacity Building for Entrepreneurs.
Entrepreneurial Training Methods; Entrepreneurial Motivations; Models for Entrepreneurial Development, The process of Entrepreneurial Development.

**Unit – 2: New Venture Creation:**
Introduction, Mobility of Entrepreneurs, Models for Opportunity Evaluation; Business plans – Purpose, Contents, Presenting Business Plan, Procedure for setting up Enterprises, Central level - Startup and State level - T Hub, Other Institutions initiatives.

**Unit – 3: Management of MSMEs and Sick Enterprises**
Challenges of MSMEs, Preventing Sickness in Enterprises – Specific Management Problems; Industrial Sickness; Industrial Sickness in India – Symptoms, process and Rehabilitation of Sick Units.

**Units – 4: Managing Marketing and Growth of Enterprises:**
Essential Marketing Mix of Services, Key Success Factors in Service Marketing, Cost and Pricing, Branding, New Techniques in Marketing, International Trade.

**Units – 5: Strategic perspectives in Entrepreneurship:**
Strategic Growth in Entrepreneurship, The Valuation Challenge in Entrepreneurship, The Final Harvest of New Ventures, Technology, Business Incubation, India way – Entrepreneurship; Women Entrepreneurs – Strategies to develop Women Entrepreneurs, Institutions supporting Women Entrepreneurship in India.

**Text Books:**
1. Entrepreneurship Development and Small Business Enterprises, Poornima M. Charantimath, 2e, Pearson, 2014.
2. Entrepreneurship, A South – Asian Perspective, D. F. Kuratko and T.V.Rao, 3e, Cengage, 2012.

**REFERENCES:**

1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
2. The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2015.

**B.TECH. CIVIL AND ENVIRONMENTAL ENGINEERING**
**DISASTER MANAGEMENT**
**(Open Elective - I)**

| | |
|---|---|
| **B.Tech. III Year I Sem** | **L T/P/D C** |
| **Course Code**: **CE511OE** | **3 0/0/0 3** |

**Course Objectives:** The subject provide different disasters, tools and methods for disaster management

**Course Outcomes:** At the end of the course, the student will be able to:

- Understanding Disasters, man-made Hazards and Vulnerabilities
- Understanding disaster management mechanism
- Understanding capacity building concepts and planning of disaster managements

**UNIT - I**

**Understanding Disaster:** Concept of Disaster - Different approaches- Concept of Risk - Levels of Disasters - Disaster Phenomena and Events (Global, national and regional)

**Hazards and Vulnerabilities:** 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:** Capacity Building: Concept - Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - 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. Manual on Disaster Management, National Disaster Management, Agency Govt of India.
2. Disaster Management by Mrinalini Pandey Wiley 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015

**REFERENCES:**

1. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
2. National Disaster Management Plan, Ministry of Home affairs, Government of India (http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf)

**B.TECH. CIVIL AND ENVIRONMENTAL ENGINEERING**
**ENVIRONMENTAL IMPACT ASSESSMENT**
**(Open Elective - II)**

| | |
|---|---|
| **B.Tech.III Year II Sem** | **L T/P/D C** |
| **Course Code: CN621OE** | **3 0/0/0 3** |

**Pre Requisites**: Environmental Engineering

**Course Objectives:** This subject will cover various aspects of Environment Impact Assessment methodologies, impact of development activities. Impact on surface water, Air and Biological Environment, Environment legislation Environment.

**Course Outcomes:**
- Identify the environmental attributes to be considered for the EIA study.
- Formulate objectives of the EIA studies.
- Identify the suitable methodology and prepare Rapid EIA.
- Indentify and incorporate mitigation measures.

**UNIT – I**
Basic concept of EIA : Initial environmental Examination, Elements of EIA, - factors affecting E-I-A Impact evaluation and analysis, preparation of Environmental Base map, Classification of environmental parameters.
E I A Methodologies: introduction, Criteria for the selection of EIA Methodology, E I A methods, Ad-hoc methods, matrix methods, Network method Environmental Media Quality Index method, overlay methods, cost/benefit Analysis.

**UNIT- II**
Assessment of Impact of development 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.

**UNIT – IV**
Environmental Audit & 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**

The Environmental Protection Act, The water Act, The Air (Prevention & Control of pollution Act.), Motor Act, Wild life Act. Case studies and preparation of Environmental Impact assessment statement for various Industries.

**TEXT BOOKS:**

1. Larry Canter – Environmental Impact Assessment, McGraw-Hill Publications
2. Environmental Impact Assessment, Barthwal, R. R. New Age International Publications

**REFERENCES:**

1. Environmental Pollution by R.K. Khitoliya S. Chand, 2014.
2. Glynn, J. and Gary, W. H. K. - Environmental Science and Engineering, Prentice Hall Publishers
3. Suresh K. Dhaneja - Environmental Science and Engineering, S.K. Kataria & Sons Publication. New Delhi.
4. Bhatia, H. S. - Environmental Pollution and Control, Galgotia Publication (P) Ltd, Delhi.
5. Wathern, P. – Environmental Impact Assessment: Theory & Practice, Publishers-Rutledge, London, 1992.

## B.TECH. CIVIL AND ENVIRONMENTAL ENGINEERING
## INTELLECTUAL PROPERTY RIGHTS
## (Open Elective - II)

| | |
|---|---|
| **B.Tech.III Year II Sem** | **L T/P/D C** |
| **Course Code**: **CE623OE** | **3 0/0/0 3** |

**UNIT – I**

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

**UNIT – II**

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

**UNIT – III**

Law of copy rights : Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer

**UNIT – IV**

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

**UNIT – V**

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

**TEXT BOOKS & REFERENCES:**

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tate McGraw Hill Publishing company ltd.,

**B.TECH. CIVIL AND ENVIRONMENTAL ENGINEERING**
**REMOTE SENSING & GIS**
**(Open Elective - III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem** | **L T/P/D C** |
| **Course Code**: **CN831OE** | **3 0/0/0 3** |

**Pre Requisites**: Surveying

**Course Objectives:** This course will make the student to understand about the principles of GIS, Remote Sensing, Spatial Systems, and its applications to Engineering Problems.

**Course Outcomes:** At the end of the course, the student will be able to:

- Retrieve the information content of remotely sensed data
- Analyze the energy interactions in the atmosphere and earth surface features
- Interpret the images for preparation of thematic maps
- Apply problem specific remote sensing data for engineering applications
- Analyze spatial and attribute data for solving spatial problems
- Create GIS and cartographic outputs for presentation

**UNIT – I**

**Introduction to Photogrammetry:** Principles& types of aerial photograph, geometry of vertical aerial photograph, Scale & Height measurement on single vertical aerial photograph, Height measurement based on relief displacement, Fundamentals of stereoscopy, fiducial points, parallax measurement using fiducial line.

**UNIT – II**

**Remote Sensing:** Basic concept of remote sensing, Data and Information, Remote sensing data Collection, Remote sensing advantages & Limitations, Remote Sensing process.
Electro-magnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, vegetation), Indian Satellites and Sensors characteristics, Resolution, Map and Image and False color composite, introduction to digital data, elements of visual interpretation techniques.

**UNIT – III**

**Geographic Information Systems:** Introduction to GIS; Components of a GIS; Geospatial Data: Spatial Data-Attribute data – Joining Spatial and Attribute data; GIS Operations: Spatial Data Input- Attribute data Management –Data display- Data Exploration- Data Analysis. COORDINATE SYSTEMS: Geographic Coordinate System: Approximation of the Earth, Datum; Map Projections: Types of Map Projections-Map projection parameters-Commonly used Map Projections - Projected coordinate Systems

**UNIT – IV**

**Vector Data Model**: Representation of simple features- Topology and its importance; coverage and its data structure, Shape file; Data models for composite features Object Based Vector Data Model; Classes and their Relationship; The geobase data model; Geometric representation of Spatial Feature and data structure, Topology rules

**UNIT – V**

**Raster Data Model**: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, Data Conversion, Integration of Raster and Vector data.

**Data Input:** Metadata, Conversion of Existing data, creating new data; Remote Sensing data, Field data, Text data, Digitizing, Scanning, on screen digitizing, importance of source map, Data Editing

**TEXT BOOKS:**

1. Remote Sensing and GIS Lillesand and Kiefer, John Willey 2008.
2. Remote Sensing and GIS B. Bhatta by Oxford Publishers 2015.
3. Introduction to Geographic Information System – Kang-Tsung Chang, McGraw-Hill 2015

**REFERENCES:**

1. Concepts & Techniques of GIS by C. P. Lo Albert, K.W. Yonng, Prentice Hall (India) Publications.
2. Principals of Geo physical Information Systems – Peter A Burragh and Rachael A. Mc Donnell, Oxford Publishers 2004.
3. Basics of Remote sensing & GIS by S. Kumar, Laxmi Publications.

**B.TECH. CIVIL AND ENVIRONMENTAL ENGINEERING**
**ENTREPRENEURSHIP AND SMALL BUSINESS ENTERPRISES**
**(Open Elective – III)**

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T/P/D C** |
| **Course Code**: **CE833OE** | **3 0/0/0 3** |

**Course Objective:** The aim of this course is to have a comprehensive perspective of inclusive learning, ability to learn and implement the Fundamentals of Entrepreneurship.

**Course Outcome:** It enables students to learn the basics of Entrepreneurship and entrepreneurial development which will help them to provide vision for their own Start-up.

**Unit – 1: Entrepreneurial Perspectives:**
Evolution, Concept of Entrepreneurship, Types of Entrepreneurs, Entrepreneurial Competencies, Capacity Building for Entrepreneurs.
Entrepreneurial Training Methods; Entrepreneurial Motivations; Models for Entrepreneurial Development, The process of Entrepreneurial Development.

**Unit – 2: New Venture Creation:**
Introduction, Mobility of Entrepreneurs, Models for Opportunity Evaluation; Business plans – Purpose, Contents, Presenting Business Plan, Procedure for setting up Enterprises, Central level - Startup and State level - T Hub, Other Institutions initiatives.

**Unit – 3: Management of MSMEs and Sick Enterprises**
Challenges of MSMEs, Preventing Sickness in Enterprises – Specific Management Problems; Industrial Sickness; Industrial Sickness in India – Symptoms, process and Rehabilitation of Sick Units.

**Units – 4: Managing Marketing and Growth of Enterprises:**
Essential Marketing Mix of Services, Key Success Factors in Service Marketing, Cost and Pricing, Branding, New Techniques in Marketing, International Trade.

**Units – 5: Strategic perspectives in Entrepreneurship:**
Strategic Growth in Entrepreneurship, The Valuation Challenge in Entrepreneurship, The Final Harvest of New Ventures, Technology, Business Incubation, India way – Entrepreneurship; Women Entrepreneurs – Strategies to develop Women Entrepreneurs, Institutions supporting Women Entrepreneurship in India.

**TEXT BOOKS:**
1. Entrepreneurship Development and Small Business Enterprises, Poornima M. Charantimath, 2e, Pearson, 2014.
2. Entrepreneurship, A South – Asian Perspective, D. F. Kuratko and T.V. Rao, 3e, Cengage, 2012.

**REFERENCES:**

1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
2. The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2015.

## B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION TECHNOLOGY
## OPERATING SYSTEMS
## (OPEN ELECTIVE – I)

| | L | T | P | C |
|---|---|---|---|---|
| **B.Tech. III Year I Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: CS511OE** | **3** | **0** | **0** | **3** |

**Course Objectives:**

- To understand the OS role in the overall computer system
- To study the operations performed by OS as a resource manager
- To understand the scheduling policies of OS
- To understand the different memory management techniques
- To understand process concurrency and synchronization
- To understand the concepts of input/output, storage and file management
- To understand the goals and principles of protection
- Introduce system call interface for file and process management
- To study different OS and compare their features.

**Course Outcomes:**

- Apply optimization techniques for the improvement of system performance.
- Ability to design and solve synchronization problems.
- Learn about minimization of turnaround time, waiting time and response time and also maximization of throughput by keeping CPU as busy as possible.
- Ability to change access controls to protect files.
- Ability to compare the different operating systems.

**UNIT - I**

Overview-Introduction-Operating system objectives, User view, System view, Operating system definition ,Computer System Organization, Computer System Architecture, OS Structure, OS Operations, Process Management, Memory Management, Storage Management, Protection and Security, Computing Environments.

Operating System services, User and OS Interface, System Calls, Types of System Calls, System Programs, Operating System Design and Implementation, OS Structure.

**UNIT - II**

Process and CPU Scheduling - Process concepts-The Process, Process State, Process Control Block, Threads, Process Scheduling-Scheduling Queues, Schedulers, Context Switch, Operations on Processes, System calls-fork(),exec(),wait(),exit(), Interprocess communication-ordinary pipes and named pipes in Unix.

Process Scheduling-Basic concepts, Scheduling Criteria, Scheduling algorithms, Multiple-Processor Scheduling, Real-Time Scheduling, Thread scheduling, Linux scheduling and Windows scheduling.

Process Synchronization, Background, The Critical Section Problem, Peterson's solution, Synchronization Hardware, Semaphores, Classic Problems of Synchronization, Monitors, Synchronization in Linux and Windows.

**UNIT - III**

Memory Management and Virtual Memory – Memory Management Strategies- Background, Swapping, Contiguous Memory Allocation, Segmentation, Paging, Structure of Page Table, IA-32 Segmentation, IA-32 Paging.

Virtual Memory Management-Background, Demand Paging, Copy-on-Write, Page Replacement, Page Replacement Algorithms, Allocation of Frames, Thrashing, Virtual memory in Windows..

**UNIT - IV**

Storage Management-File System- Concept of a File, System calls for file operations - open (), read (), write (), close (), seek (), unlink (), Access methods, Directory and Disk Structure, File System Mounting, File Sharing, Protection.

File System Implementation - File System Structure, File System Implementation, Directory Implementation, Allocation methods, Free-space Management, Efficiency, and Performance.

Mass Storage Structure – Overview of Mass Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, Swap space Management

**UNIT - V**

Deadlocks - System Model, Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, and Recovery from Deadlock.

Protection – System Protection, 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.

**TEXT BOOKS:**

1. Operating System Concepts , Abraham Silberschatz, Peter B. Galvin, Greg Gagne, 9th Edition, Wiley, 2016 India Edition
2. Operating Systems – Internals and Design Principles, W. Stallings, 7th Edition, Pearson.

**REFERENCE BOOKS:**

1. Modern Operating Systems, Andrew S Tanenbaum, 3rd Edition, PHI
2. Operating Systems A concept-based Approach, 2nd Edition, D.M. Dhamdhere, TMH.
3. Principles of Operating Systems, B. L. Stuart, Cengage learning, India Edition.
4. An Introduction to Operating Systems, P.C.P. Bhatt, PHI.
5. Principles of Operating systems, Naresh Chauhan, Oxford University Press.

**B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION TECHNOLOGY**
**DATABASE MANAGEMENT SYSTEMS**
**(OPEN ELECTIVE – I)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year I Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: CS512OE** | **3** | **0** | **0** | **3** |

**Course Objectives:**

- To understand the basic concepts and the applications of database systems.
- To master the basics of SQL and construct queries using SQL.
- To understand the relational database design principles.
- To become familiar with the basic issues of transaction processing and concurrency control.
- To become familiar with database storage structures and access techniques.

**Course Outcomes:**

- Demonstrate the basic elements of a relational database management system.
- Ability to identify the data models for relevant problems.
- Ability to design entity relationship model and convert entity relationship diagrams into RDBMS and formulate SQL queries on the data.
- Apply normalization for the development of application software.

**UNIT - I**

**Introduction:** Database System Applications, Purpose of Database Systems, View of Data, Database Languages – DDL, DML, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Data Mining and Information Retrieval, Specialty Databases, Database Users and Administrators, History of Database Systems.

**Introduction to Data base design:** Database Design and ER diagrams, Entities, Attributes and Entity sets, Relationships and Relationship sets, Additional features of ER Model, Conceptual Design with the ER Model, Conceptual Design for Large enterprises.

**Relational Model:** Introduction to the Relational Model, Integrity Constraints over Relations, Enforcing Integrity constraints, Querying relational data, Logical data base Design: ER to Relational, Introduction to Views, Destroying /Altering Tables and Views.

**UNIT - II**

**Relational Algebra and Calculus**: Preliminaries, Relational Algebra, Relational calculus – Tuple relational Calculus, Domain relational calculus, Expressive Power of Algebra and calculus.

**SQL:** Queries, Constraints, Triggers: Form of Basic SQL Query, UNION,INTERSECT, and EXCEPT, Nested Queries, Aggregate Operators, NULL values Complex Integrity Constraints in SQL, Triggers and Active Data bases, Designing Active Databases..

**UNIT - III**

**Schema Refinement and Normal Forms**: Introduction to Schema Refinement, Functional Dependencies - Reasoning about FDs, Normal Forms, Properties of Decompositions, Normalization, Schema Refinement in Database Design, Other Kinds of Dependencies.

**UNIT - IV**

**Transaction Management:** Transactions, Transaction Concept, A Simple Transaction Model, Storage Structure, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Transaction Isolation and Atomicity Transaction Isolation Levels, Implementation of Isolation Levels.

**Concurrency Control:** Lock–Based Protocols, Multiple Granularity, Timestamp-Based Protocols, Validation-Based Protocols, Multiversion Schemes.

Recovery System-Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management, Failure with loss of nonvolatile storage, Early Lock Release and Logical Undo Operations, Remote Backup systems.

**UNIT - V**

**Storage and Indexing:** Overview of Storage and Indexing: Data on External Storage, File Organization and Indexing, Index Data Structures, Comparison of File Organizations.

Tree-Structured Indexing: Intuition for tree Indexes, Indexed Sequential Access Method (ISAM), B+ Trees: A Dynamic Index Structure, Search, Insert, Delete.

**Hash- Based Indexing:** Static Hashing, Extendible hashing, Linear Hashing, Extendible vs. Linear Hashing.

**TEXT BOOKS:**

1. Data base Management Systems, Raghu Ramakrishnan, Johannes Gehrke, McGraw Hill Education (India) Private Limited, 3$^{rd}$ Edition. **(Part of UNIT-I, UNIT-II, UNIT-III, UNIT-V)**
2. Data base System Concepts, A. Silberschatz, Henry. F. Korth, S. Sudarshan, McGraw Hill Education(India) Private Limited l, 6$^{th}$ edition.**( Part of UNIT-I, UNIT-IV)**

**REFERENCE BOOKS:**

1. Database Systems, 6$^{th}$ edition, R Elmasri, Shamkant B.Navathe, Pearson Education.
2. Database System Concepts, Peter Rob & Carlos Coronel, Cengage Learning.
3. Introduction to Database Management, M. L. Gillenson and others, Wiley Student Edition.
4. Database Development and Management, Lee Chao, Auerbach publications, Taylor & Francis Group.
5. Introduction to Database Systems, C. J. Date, Pearson Education.

# B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION TECHNOLOGY
# JAVA PROGRAMMING
# (OPEN ELECTIVE – II)

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: CS621OE** | **3** | **0** | **0** | **3** |

**Course Objectives:**

- To understand object oriented programming concepts, and apply them in problem solving.
- To learn the basics of java Console and GUI based programming.

**Course Outcomes:**

- Understanding of OOP concepts and basics of java programming (Console and GUI based).
- The skills to apply OOP and Java programming in problem solving.
- Should have the ability to extend his/her knowledge of Java programming further on his/her own.

**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, building strings, exploring string class.

**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**

**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.

**UNIT- V**

**GUI Programming with Java** - The AWT class hierarchy, Introduction to Swing, Swing vs. AWT, Hierarchy for Swing components, Containers – JFrame, JApplet, JDialog, JPanel, Overview of some swing components- Jbutton, JLabel, JTextField, JTextArea, simple swing applications, Layout management - Layout manager types – border, grid and flow

**Event** h**andling -** 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.

**TEXT BOOK:**

1. Java Fundamentals – A comprehensive Introduction, Herbert Schildt and Dale Skrien, 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.

**B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION TECHNOLOGY**

# SOFTWARE TESTING METHODOLOGIES
## (OPEN ELECTIVE – II)

| | L | T | P | C |
|---|---|---|---|---|
| **B.Tech. III Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: CS622OE** | **3** | **0** | **0** | **3** |

**Course Objectives:**
To understand the software testing methodologies such as flow graphs and path testing, transaction flows testing, data flow testing, domain testing and logic base testing.

**Course Outcomes:**
- Ability to apply the process of testing and various methodologies in testing for developed software.
- Ability to write test cases for given software to test it before delivery to the customer.

**UNIT - I**
Introduction:- Purpose of testing, Dichotomies, model for testing, consequences of bugs, taxonomy of bugs.
Flow graphs and Path testing:- Basics concepts of path testing, predicates, path predicates and achievable paths, path sensitizing, path instrumentation, application of path testing.

**UNIT - II**
Transaction Flow Testing:-transaction flows, transaction flow testing techniques.
Dataflow testing:- Basics of dataflow testing, strategies in dataflow testing, application of dataflow testing.

**UNIT - III**
Domain Testing:-domains and paths, Nice & ugly domains, domain testing, domains and interfaces testing, domain and interface testing, domains and testability.

**UNIT-IV**
Paths, Path products and Regular expressions:- path products & path expression, reduction procedure, applications, regular expressions & flow anomaly detection.
Logic Based Testing:- overview, decision tables, path expressions, kv charts, specifications.

**UNIT - V**
State, State Graphs and Transition testing:- state graphs, good & bad state graphs, state testing, Testability tips.
Graph Matrices and Application:-Motivational overview, matrix of graph, relations, power of a matrix, node reduction algorithm, building tools. (Student should be given an exposure to a tool like JMeter or Win-runner).

**TEXT BOOKS:**

1. Software Testing techniques – Boris Beizer, Dreamtech, second edition.
2. Software Testing Tools – Dr.K.V.K.K.Prasad, Dreamtech.

**REFERENCE BOOKS:**

1. The craft of software testing - Brian Marick, Pearson Education.
2. Software Testing,3rd edition,P.C. Jorgensen, Aurbach Publications (Dist.by SPD).
3. Software Testing, N.Chauhan, Oxford University Press.
4. Introduction to Software Testing, P.Ammann&J.Offutt, Cambridge Univ.Press.
5. Effective methods of Software Testing, Perry, John Wiley, 2nd Edition, 1999.
6. Software Testing Concepts and Tools, P.Nageswara Rao, dreamtech Press.
7. Software Testing, M.G.Limaye, TMH.
8. Software Testing, S.Desikan, G.Ramesh, Pearson.
9. Foundations of Software Testing, D.Graham & Others, Cengage Learning.
10. Foundations of Software Testing, A.P.Mathur, Pearson.

**B.TECH COMPUTER SCIENCE AND ENGINEERING / B.TECH INFORMATION TECHNOLOGY**

**CYBER SECURITY**

**(OPEN ELECTIVE – II)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: CS623OE** | **3** | **0** | **0** | **3** |

**UNIT- I**

**Introduction to Cybercrime:** Introduction, Cybercrime, and Information Security, Who are Cybercriminals, Classifications of Cybercrimes, And Cybercrime: The legal Perspectives and Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes.

**UNIT - II**

**Cyber Offenses: How Criminals Plan Them:** Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector, Cloud Computing.

**UNIT - III**

**Cybercrime: Mobile and Wireless Devices:** Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies an Measures in Mobile Computing Era, Laptops.

**UNIT IV**

**Tools and Methods Used in Cybercrime:** Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

**UNIT V**

**Cyber Security:** Organizational Implications

Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

**TEXT BOOK:**

1. **Cyber Security:** *Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, Nina Godbole and Sunil Belapure, Wiley INDIA.

**REFERENCE BOOK:**

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security , Chwan-Hwa(john) Wu,J.David Irwin.CRC Press T&F Group

**B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION TECHNOLOGY**
**LINUX PROGRAMMING**
**(OPEN ELECTIVE – III)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. IV Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: CS831OE** | **3** | **0** | **0** | **3** |

**Course Objectives:**

- To understand and make effective use of Linux utilities and Shell scripting language (bash) to solve Problems.
- To implement in C some standard Linux utilities such as ls, mv, cp etc. using system calls.
- To develop the skills necessary for systems programming including file system programming, process and signal management, and interprocess communication.
- To develop the basic skills required to write network programs using Sockets.

**Course Outcomes:**

- Work confidently in Linux environment.
- Work with shell script to automate different tasks as Linux administration.

**UNIT- I**

**Linux Utilities** - File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking commands, Filters, Text processing utilities and Backup utilities.
Sed-Scripts, Operation, Addresses, Commands, Applications, awk-Execution, Fields and Records, Scripts, Operation, Patterns, Actions, Associative Arrays, String and Mathematical functions, System commands in awk, Applications.
**Shell programming with Bourne again shell (bash)** - Introduction, shell responsibilities, pipes and Redirection, here documents, running a shell script, the shell as a programming language, shell meta characters, file name substitution, shell variables, command substitution, shell commands, the environment, quoting, test command, control structures, arithmetic in shell, shell script examples, interrupt processing, functions, debugging shell scripts.

**UNIT- II**

**Files and Directories** - File Concept, File types, File System Structure, file metadata-Inodes, kernel support for files, system calls for file I/O operations- open, creat, read, write, close, lseek, dup2, file status information-stat family, file and record locking- fcntl function, file permissions - chmod, fchmod, file ownership-chown, lchown, fchown, links-soft links and hard links – symlink, link, unlink. **Directories** - Creating, removing and changing Directories-mkdir, rmdir, chdir, obtaining current working directory-getcwd, Directory contents, Scanning Directories-opendir, readdir, closedir, rewinddir functions.

**UNIT- III**

**Process** – Process concept, Layout of a C program image in main memory, Process environment-environment list, environment variables, getenv, setenv, Kernel support for process, process identification, process control - process creation, replacing a process image, waiting for a process, process termination, zombie process, orphan process, system call interface for process management-fork, vfork, exit, wait, waitpid, exec family, Process Groups, Sessions and Controlling Terminal, Differences between threads and processes.

**Signals –** Introduction to signals, Signal generation and handling, Kernel support for signals, Signal function, unreliable signals, reliable signals, kill, raise, alarm, pause, abort, sleep functions.

**UNIT- IV**

**Interprocess Communication** - Introduction to IPC, IPC between processes on a single computer system, IPC between processes on different systems, pipes-creation, IPC between related processes using unnamed pipes, FIFOs-creation, IPC between unrelated processes using FIFOs (Named pipes), differences between unnamed and named pipes, popen and pclose library functions. **Message Queues** - Kernel support for messages, APIs for message queues, client/server example. **Semaphores** - Kernel support for semaphores, APIs for semaphores, file locking with semaphores.

**UNIT- V**

**Shared Memory** - Kernel support for shared memory, APIs for shared memory, shared memory example. **Sockets** - Introduction to Berkeley Sockets, IPC over a network, Client-Server model, Socket address structures (Unix domain and Internet domain),Socket system calls for connection oriented protocol and connectionless protocol, example-client/server programs-Single Server-Client connection, Multiple simultaneous clients, Socket options-setsockopt and fcntl system calls, Comparison of IPC mechanisms.

**TEXT BOOKS:**

1. Unix System Programming using C++, T. Chan, PHI.
2. Unix Concepts and Applications, 4th Edition, Sumitabha Das, TMH.
3. Unix Network Programming, W. R. Stevens, PHI.

**REFERENCE BOOKS:**

1. Beginning Linux Programming, 4th Edition, N. Matthew, R. Stones, Wrox, Wiley India Edition.
2. Unix for programmers and users, 3rd Edition, Graham Glass, King Ables, Pearson.
3. System Programming with C and Unix, A. Hoover, Pearson.
4. Unix System Programming, Communication, Concurrency and Threads, K. A. Robbins and S. Robbins, Pearson Education.
5. Unix shell Programming, S. G. Kochan and P. Wood, 3rd edition, Pearson Education.
6. Shell Scripting, S. Parker, Wiley India Pvt. Ltd.

7. Advanced Programming in the Unix Environment, 2nd edition, W. R. Stevens and S. A. Rago, Pearson Education.
8. Unix and Shell programming, B. A. Forouzan and R. F. Gilberg, Cengage Learning.
9. Linux System Programming, Robert Love, O'Reilly, SPD.
10. C Programming Language, Kernighan and Ritchie, PHI

**B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION TECHNOLOGY**
**R PROGRAMMING**
**(OPEN ELECTIVE – III)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. IV Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: CS832OE** | **3** | **0** | **0** | **3** |

**Course Objectives:**

- Understanding and being able to use basic programming concepts
- Automate data analysis
- Working collaboratively and openly on code
- Knowing how to generate dynamic documents
- Being able to use a continuous test-driven development approach

**Course Outcomes:**

- be able to use and program in the programming language R
- be able to use R to solve statistical problems
- be able to implement and describe Monte Carlo the technology
- be able to minimize and maximize functions using R

**UNIT – I**

**Introduction**: Overview of R, R data types and objects, reading and writing data, sub setting R Objects, Essentials of the R Language, Installing R, Running R, Packages in R, Calculations, Complex numbers in R, Rounding, Arithmetic, Modulo and integer quotients, Variable names and assignment, Operators, Integers, Factors, Logical operations

**UNIT – II**

Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes

**Vectors:** Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations

**UNIT – III**

**Lists:** Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, DATA FRAMES, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations

**UNIT - IV**

FACTORS AND TABLES, Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables , Extracting a Subtable, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions

**UNIT - V**

**OBJECT-ORIENTED PROGRAMMING:** S Classes, S Generic Functions, Writing S Classes, Using Inheritance, S Classes, Writing S Classes, Implementing a Generic Function on an S Class, visualization, Simulation, code profiling, Statistical Analysis with R, data manipulation

**TEXT BOOKS:**

1. R Programming for Data Science by Roger D. Peng
2. The Art of R Programming by Prashanth singh, Vivek Mourya, Cengage Learning India**.**

**B.TECH COMPUTER SCIENCE AND ENGINEERING/B.TECH INFORMATION TECHNOLOGY**
**PHP PROGRAMMING**
**(OPEN ELECTIVE – III)**

| | L | T | P | C |
|---|---|---|---|---|
| **B.Tech. IV Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: CS833OE** | **3** | **0** | **0** | **3** |

**Course Objectives:**

- Gain the PHP programming skills needed to successfully build interactive, data-driven sites
- Use the MVC pattern to organize code
- Test and debug a PHP application
- Work with form data
- Use cookies and sessions
- Work with regular expressions, handle exceptions, and validate data

**Course Outcomes:**

- Be able to develop a form containing several fields and be able to process the data provided on the form by a user in a PHP-based script.
- Understand basic PHP syntax for variable use and standard language constructs, such as conditionals and loops.
- Understand the syntax and use of PHP object-oriented classes.
- Understand the syntax and functions available to deal with file processing for files on the server as well as processing web URLs.
- Understand the paradigm for dealing with form-based data, both from the syntax of HTML forms, and how they are accessed inside a PHP-based script.

**Unit - I:**

**INTRODUCTION TO PHP:** History of PHP, Apache Web Server, MySQL and Open Source, Relationship between Apache, MySQL and PHP (AMP Module), PHP configuration in IIS, Apache Web server

**BASICS OF PHP:** PHP structure and syntax, Creating the PHP pages, Rules of PHP syntax, Integrating HTML with PHP, Constants, Variables : static and global variable, Conditional Structure & Looping, PHP Operators, Arrays, for each constructs, User defined function, argument function, Variable function, Return Function, default argument, variable length argument.

**Unit - II:**

**WORKING WITH FUNCTIONS:** Variable Function, String Function, Math Function, Date Function, Array Function, and File Function. User defined function, Systems defined function, Parameterized function, Non parameterized function, Dynamic parameter in function, Variable scope, Passing Argument in function, Static function.

**Unit - III:**

**WORKING WITH DATA:** FORM element, INPUT elements, Processing the form, User Input, Adding items, Validating the user input, Passing variables between pages. Files, Creating and deleting file, Reading and writing file, Working with file, Creating and deleting folder, Working with regular Expression Basic regular expression, Matching patterns, Finding match, Replace match,

**Unit - IV:**

**ERROR HANDLING:** Error types in PHP, Generating PHP errors, Exceptions, Parse errors, State Management: - Cookies Session, Destroying cookies and session Http management, Sent mail

**Images with PHP:** Working with GD Library, File types with GD and PHP, Compiling PHP with GD, Creating the image table, uploading the image.

**Unit - V:**

**INTRODUCTION TO MYSQL:** MySQL structure and syntax, Types of MySQL tables and storages engines, MySQL commands, Integration of PHP with MySQL, Connection to the MySQL server, Working with PHP and arrays of data, Referencing two tables, Joining two tables.

**WORKING WITH DATABASE:** Creating a table, manipulating the table, editing the database, inserting a record, deleting a record, editing data

**Understand process of executing a PHP-based script on a webserver.**

**TEXT BOOKS:**

1. **Beginning PHP, Apache, MySQL Web Development -** Elizabeth Naramore, Jason Gerner, Yann Le, Scouarnec, Jeremy Stolz, Michael K. Glass, Gary Mailer - By Wrox Publication.
2. **PHP, MySQL and Apache** - Julie C. Melone By Pearson Education

**REFERENCE BOOKS:**

1. **Beginning PHP 5.3,** by Matt Doyle - By Wrox Publication
2. **PHP and MySQL Bible** – Tim Converse and Joyce Park with Clark Morgam By Wiley INDIA

**B.TECH. ELECTRONICS AND COMMUNICATION ENGINEERING / B.TECH ELECTRONICS AND TELEMATICS ENGINEERING**
**PRINCIPLES OF ELECTRONIC COMMUNICATIONS**
**(OPEN ELECTIVE - I)**

| | L | T | P | C |
|---|---|---|---|---|
| **B.Tech. III Year I Sem.** | | | | |
| **Course Code: EC511OE** | **3** | **0** | **0** | **3** |

**Course Objectives:** The objective of this subject is to:

- Introduce the students to modulation and various analog and digital modulation schemes.
- They can have a broad understanding of satellite, optical, cellular, mobile, wireless and telecom concepts.

**Course Outcomes:** By completing this subject, the student can

- Work on various types of modulations.
- Should be able to use these communication modules in implementation.
- Will have a basic understanding of various wireless and cellular, mobile and telephone communication systems.

**UNIT - I**

**Introduction:** Need for Modulation, Frequency translation, Electromagnetic spectrum, Gain, Attenuation and decibels.

**UNIT - II**

**Simple description on Modulation:** Analog Modulation-AM, FM, Pulse Modulation-PAM, PWM, PCM, Digital Modulation Techniques-ASK, FSK, PSK, QPSK modulation and demodulation schemes.

**UNIT - III**

**Telecommunication Systems:** Telephones Telephone system, Paging systems, Internet Telephony.

**Networking and Local Area Networks:** Network fundamentals, LAN hardware, Ethernet LANs, Token Ring LAN.

**UNIT - IV**

**Satellite Communication:** Satellite Orbits, satellite communication systems, satellite subsystems, Ground Stations Satellite Applications, Global Positioning systems.

**Optical Communication:** Optical Principles, Optical Communication Systems, Fiber –Optic Cables, Optical Transmitters & Receivers, Wavelength Division Multiplexing.

**UNIT - V**

**Cellular and Mobile Communications:** Cellular telephone systems, AMPS, GSM, CDMA, and WCDMA.

**Wireless Technologies:** Wireless LAN, PANs and Bluetooth, Zig Bee and Mesh Wireless networks, Wimax and MANs, Infrared wireless, RFID communication, UWB.

**Text Books:**

1. Principles of Electronic Communication Systems, Louis E. Frenzel, 3e, McGraw Hill publications, 2008.
2. Electronic Communications systems, Kennedy, Davis 4e, MC GRAW HILL EDUCATION, 1999

**Reference Books:**

1. Theodore Rapp port, Wireless Communications - Principles and practice, Prentice Hall, 2002.
2. Roger L. Freeman, Fundamentals of Telecommunications, 2e, Wiley publications.
3. Introduction to data communications and networking, Wayne Tomasi, Pearson Education, 2005.

**B.TECH. ELECTRONICS AND COMMUNICATION ENGINEERING / B.TECH ELECTRONICS AND TELEMATICS ENGINEERING**

**PRINCIPLES OF COMPUTER COMMUNICATIONS AND NETWORKS (OPEN ELECTIVE - II)**

| | L | T | P | C |
|---|---|---|---|---|
| **B.Tech. III Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: EC621OE** | **3** | **0** | **0** | **3** |

**Course Objectives:**
- To understand the concept of computer communication.
- To learn about the networking concept, layered protocols.
- To understand various communications concepts.
- To get the knowledge of various networking equipment.

**Course Outcomes:**
- The student can get the knowledge of networking of computers, data transmission between computers.
- Will have the exposure about the various communication concepts.
- Will get awareness about the structure and equipment of computer network structures.

**UNIT - I**

**Overview of Computer Communications and Networking:** Introduction to Computer Communications and Networking, Introduction to Computer Network, Types of Computer Networks, Network Addressing, Routing, Reliability, Interoperability and Security, Network Standards, The Telephone System and Data Communications.

**UNIT - II**

**Essential Terms and Concepts:** Computer Applications and application protocols, Computer Communications and Networking models, Communication Service Methods and data transmission modes, analog and Digital Communications , Speed and capacity of a Communication Channel, Multiplexing and switching, Network architecture and the OSI reference model.

**UNIT - III**

**Analog and Digital Communication Concepts:** Representing data as analog signals, representing data as digital signals, data rate and bandwidth reduction, Digital Carrier Systems.

**UNIT - IV**

**Physical and data link layer Concepts:** The Physical and Electrical Characteristics of wire, Copper media, fiber optic media, wireless Communications. Introduction to data link Layer , the logical link control and medium access control sub-layers.

**UNIT - V**

**Network Hardware Components:** Introduction to Connectors, Transreceivers and media convertors, repeaters, network interference cards and PC cards, bridges, switches, switches Vs Routers.

**TEXT BOOKS**:

1. Computer Communications and Networking Technologies, Michel A. Gallo and William H. Hancock, Thomson Brooks / Cole.
2. Data Communications and Networking – Behrouz A. Forouzan, Fourth Edition MC GRAW HILL EDUCATION, 2006.

**REFERENCE BOOK**S:

1. Principles of Computer Networks and Communications, M. Barry Dumas, Morris Schwartz, Pearson.
2. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 3rd Edition, Pearson Education.

**B.TECH. ELECTRONICS AND COMMUNICATION ENGINEERING / B.TECH ELECTRONICS AND TELEMATICS ENGINEERING**

# ELECTRONIC MEASURING INSTRUMENTS
## (OPEN ELECTIVE - III)

| | L | T | P | C |
|---|---|---|---|---|
| **B.Tech. IV Year II Sem.** | | | | |
| **Course Code: EC831OE** | **3** | **0** | **0** | **3** |

**Note: No detailed mathematical treatment is required.**

**Course Objectives:**
- It provides an understanding of various measuring systems functioning and metrics for performance analysis.
- Provides understanding of principle of operation, working of different electronic instruments viz. signal generators, signal analyzers, recorders and measuring equipment.
- Provides understanding of use of various measuring techniques for measurement of different physical parameters using different classes of transducers.

**Course Outcomes:** On completion of this course student can be able to
- Identify the various electronic instruments based on their specifications for carrying out a particular task of measurement.
- Measure various physical parameters by appropriately selecting the transducers.
- Use various types of signal generators, signal analyzers for generating and analyzing various real-time signals.

**UNIT - I**

**Block Schematics of Measuring Systems and Performance Metrics:** Performance Characteristics, Static Characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag.

**UNIT - II**

**Signal Generators:** AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary Waveform Generator, and Specifications.

**UNIT - III**

**Measuring Instruments:** DC Voltmeters, D’ Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments. CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes.

**UNIT - IV**

**Recorders:** X-Y Plotter, Curve tracer, Galvanometric Recorders, Servo transducers, pen driving mechanisms, Magnetic Recording, Magnetic recording techniques.

**UNIT - V**

**Transducers:** Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Digital Temperature sensing system, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers.

**TEXT BOOKS:**

1. Electronic Measurements and Instrumentation: B.M. Oliver, J.M. Cage TMH Reprint 2009.
2. Electronic Instrumentation: H.S.Kalsi – TMH, 2$^{nd}$ Edition 2004.

**REFERENCES:**

1. Electronic Instrumentation and Measurements – David A. Bell, Oxford Univ. Press, 1997.
2. Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbincs, W.D. Cooper: PHI 5$^{th}$ Edition 2003.
3. Electronic Measurements and Instrumentation – K. Lal Kishore, Pearson Education 2010.
4. Industrial Instrumentation: T.R. Padmanabham Springer 2009.

**B.TECH. ELECTRONICS AND COMPUTER ENGINEERING**
**SCRIPTING LANGUAGES**
**(Open Elective – I)**

| | |
|---|---|
| **B.Tech. III Year I Sem.** | **L T P C** |
| **Course Code: EM511OE** | **3 0 0 3** |

**Course Objectives:** The goal of the course is to study:

- The principles of scripting languages.
- Motivation for and applications of scripting.
- Difference between scripting languages and non- scripting languages.
- Types of scripting languages.
- Scripting languages such as PERL, TCL/TK, python and BASH.
- Creation of programs in the Linux environment.
- Usage of scripting languages in IC design flow.

**Course Outcomes:**
Upon learning the course, the student will have the:

- Ability to create and run scripts using PERL/TCl/Python in IC design flow.
- Ability to use Linux environment and write programs for automation of scripts in VLSI tool design flow.

**UNIT –I:**
**Linux Basics:**
Introduction to Linux , File System of the Linux, General usage of Linux kernel & basic commands, Linux users and group, Permissions for file, directory and users, searching a file & directory, zipping and unzipping concepts.

**UNIT –II :**
**Linux Networking:**
Introduction to Networking in Linux, Network basics & Tools, File Transfer Protocol in Linux, Network file system, Domain Naming Services, Dynamic hosting configuration Protocol & Network information Services.

**UNIT –III :**
**Perl Scripting**:
Introduction to Perl Scripting, working with simple values, Lists and Hashes, Loops and Decisions, Regular Expressions, Files and Data in Perl Scripting, References & Subroutines, Running and Debugging Perl, Modules, Object – Oriented Perl.

**UNIT –IV:**

**Tcl / Tk Scripting:**

Tcl Fundamentals, String and Pattern Matching, Tcl Data Structures, Control Flow Commands, Procedures and Scope, Evel, Working with Unix, Reflection and Debugging, Script Libraries, Tk Fundamentals, Tk by examples, The Pack Geometry Manager, Binding Commands to X Events, Buttons and Menus, Simple Tk Widgets, Entry and List box Widgets Focus, Grabs and Dialogs.

**UNIT –V :**

**Python Scripting**:

Introduction to Python, using the Python Interpreter, More Control Flow Tools, Data Structures, Modules, Input and Output, Errors and Exceptions, Classes, Brief Tour of the Standard Library.

**TEXT BOOKS**:

1. Python Tutorial by Guido Van Rossum, Fred L. Drake Jr. editor , Release 2.6.4
2. Practical Programming in Tcl and Tk by Brent Welch, Updated for Tcl 7.4 and Tk 4.0.
3. Teach Yorself Perl in 21 days by David Till.
4. Red Hat Enterprise Linux 4 : System Administration Guide Copyright, 2005 Red Hat Inc.

**REFERENCE BOOKS**:

1. Learning Python – 2nd Ed., Mark Lutz and David Ascher, 2003, O'Reilly.
2. Perl in 24 Hours – 3rd Ed., Clinton Pierce, 2005, Sams Publishing.
3. Learning Perl – 4th Ed. Randal Schwartz, Tom Phoenix and Brain d foy. 2005.
4. Jython Essentials – Samuele Pedroni and Noel Pappin.2002. O'Reilly.
5. Programming Perl – Larry Wall, Tom Christiansen and John Orwant, 3rd Edition, O'Reilly, 2000. (ISBN 0596000278)

**B.TECH. ELECTRONICS AND COMPUTER ENGINEERING**
**SOFT COMPUTING TECHNIQUES**
**(Open Elective – II)**

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T P C** |
| **Course Code: EM621OE** | **3 0 0 3** |

**Prerequisite**: Nil.

**Course Objectives:** This course makes the students to Understand

- Fundamentals of Neural Networks & Feed Forward Networks.
- Associative Memories & ART Neural Networks.
- Fuzzy Logic & Systems.
- Genetic Algorithms and Hybrid Systems.

**Course Outcomes:** On completion of this course the students will be able to

- Identify and employ suitable soft computing techniques in classification and optimization problems.
- Design hybrid systems to suit a given real – life problem.

**UNIT –I:**
**Fundamentals of Neural Networks & Feed Forward Networks:**
Basic Concept of Neural Networks, Human Brain, Models of an Artificial Neuron, Learning Methods, Neural Networks Architectures, Single Layer Feed Forward Neural Network :The Perceptron Model, Multilayer Feed Forward Neural Network :Architecture of a Back Propagation Network (BPN), The Solution, Back propagation Learning, Selection of various Parameters in BPN. Application of Back propagation Networks in Pattern Recognition & Image Processing.

**UNIT –II:**
**Associative Memories & ART Neural Networks:**
Basic concepts of Linear Associator, Basic concepts of Dynamical systems, Mathematical Foundation of Discrete-Time Hop field Networks(HPF), Mathematical Foundation of Gradient-Type Hopfield Networks, Transient response of Continuous Time Networks, Applications of HPF in Solution of Optimization Problem: Minimization of the Traveling salesman tour length, Summing networks with digital outputs, Solving Simultaneous Linear Equations, Bidirectional Associative Memory Networks; Cluster Structure, Vector Quantization, Classical ART Networks, Simplified ART Architecture.

**UNIT –III:**

**Fuzzy Logic & Systems:**

Fuzzy sets, Crisp Relations, Fuzzy Relations, Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Rule based system, Defuzzification Methods, Applications: Greg Viot's Fuzzy Cruise Controller, Air Conditioner Controller.

**UNIT –IV:**

**Genetic Algorithms:**

Basic Concepts of Genetic Algorithms (GA), Biological background, Creation of Offsprings, Working Principle, Encoding, Fitness Function, Reproduction, Inheritance Operators, Cross Over, Inversion and Deletion, Mutation Operator, Bit-wise Operators used in GA, Generational Cycle, Convergence of Genetic Algorithm.

**UNIT –V:**

**Hybrid Systems:**

Types of Hybrid Systems, Neural Networks, Fuzzy Logic, and Genetic Algorithms Hybrid, Genetic Algorithm based BPN: GA Based weight Determination, Fuzzy Back Propagation Dept. of ECE, JNTUHCEH M.Tech. (SSP) (FT) w.e.f. 2015-16 56 Networks: LR-type fuzzy numbers, Fuzzy Neuron, Fuzzy BP Architecture, Learning in Fuzzy BPN, Inference by fuzzy BPN.

**TEXT BOOKS:**

1. Introduction to Artificial Neural Systems - J.M.Zurada, Jaico Publishers
2. Neural Networks, Fuzzy Logic & Genetic Algorithms: Synthesis & Applications - S.Rajasekaran, G.A. Vijayalakshmi Pai, July 2011, PHI, New Delhi.
3. Genetic Algorithms by David E. Gold Berg, Pearson Education India, 2006.
4. Neural Networks & Fuzzy Sytems- Kosko.B., PHI, Delhi,1994.

**REFERENCE BOOKS:**

1. Artificial Neural Networks - Dr. B. Yagananarayana, 1999, PHI, New Delhi.
2. An introduction to Genetic Algorithms - Mitchell Melanie, MIT Press, 1998
3. Fuzzy Sets, Uncertainty and Information- Klir G.J. & Folger. T. A., PHI, Delhi, 1993

**B.TECH. ELECTRONICS AND COMPUTER ENGINEERING**
**DATA ANALYTICS**
**(Open Elective – III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T P C** |
| **Course Code: EM831OE** | **3 0 0 3** |

**Prerequisite:** Nil

**Course Objectives**: The student should be made to :
- Be exposed to conceptual frame work of big data.
- Understand different techniques of Data Analysis.
- Be familiar with concepts of data streams.
- Be exposed to item sets, Clustering, frame works and Visualization.

**Course Outcomes:** Upon completion of this course the students will be able to
- Understand Big data fundamentals.
- Learn various Data Analysis Techniques
- Implement various Data streams.
- Understand item sets, Clustering, frame works & Visualizations.

**UNIT – I**
**Introduction to Big Data:** Introduction to Big Data Platform – Challenges of Conventional systems – Web data – Evolution of Analytic scalability , analytic process and tools , Analysis vs Reporting – Modern data analytic tools, stastical concepts : Sampling distributions, resampling , statistical inference, prediction error.

**UNIT – II**
**Data Analysis:** Regression modeling , Multivariate analysis, Bayesian modeling , inference and Bayesian networks , Support vector and Kernel methods, Analysis of time series : Linear systems analysis , nonlinear dynamics – Rule induction – Neural networks : Learning and and Generalisation, competitive learning, Principal component analysis and neural networks ; Fuzzy Logic : extracting fuzzy models from data , fuzzy decision trees, Stochastic search methods.

**UNIT – III**
**Mining Data Streams:** Introduction to Streams Concepts – Stream data model and architecture – Stream Computing , Sampling data in a stream – Filtering streams – Counting distinct elements in a stream – Estimating moments – Counting oneness in a Window – Decaying window – Real time Analytics Platform ( RTAP) applications – case studies – real time sentiment analysis, stock market predictions.

**UNIT – IV**

**Frequent Itemsets and clustering:** Mining Frequent itemsets – Market based Modeling – Apriori Algorithm – Handling large data sets in Main Memory – Limited Pass Algorithm – Counting frequent itemsets in a Stream – Clustering Techniques – Hierarchical – K-Means – Clustering high dimensional data – CLIQUE and ProCLUS – Frequent pattern based clustering methods – Clustering in non-euclidean space – Clustering for streams and Parallelism.

**UNIT – V**

**Frame Works and Visualization:** MapReduce – Hadoop, Hive , MapR – Sharding – NoSQL Databases – S3 – Hadoop Distributed file systems – Visualizations – Visual data analysis techniques, interaction techniques : systems and Applications .

**TEXT BOOKS:**

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.

**REFERENCE BOOKS:**

1. Bill Franks, Taming the Big Data Tidal wave: Finding Opportunities in Huge Data Streams with advanced analytics, John Wiley & sons, 2012.
2. Glenn J. Myatt, Making Sense of Data, John Wiley & sons, 2007 Pete Warden, Big Data Glossary, O'Reilly, 2011.
3. Jiawei Han, Micheline Kamber "Data Mining Concepts and Techniques", Second Edition, Elsevier, Reprinted 2008.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING**
**NON-CONVENTIONAL POWER GENERATION**
**(OPEN ELECTIVE – I)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year I Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: EE511OE** | **3** | **0** | **0** | **3** |

**Prerequisite:** Nil.

**Course Objectives:**
- To introduce various types of renewable energy technologies
- To understand the technologies of energy conversion from the resources and their quantitative analysis.

**Course Outcomes:** After completion of this course, the student will be able to
- Analyze solar thermal and photovoltaic systems and related technologies for energy conversion.
- Understand Wind energy conversion and devices available for it.
- Understand Biomass conversion technologies, Geo thermal resources and energy conversion principles and technologies.
- Realize Power from oceans (thermal, wave, tidal) and conversion devices.
- Understand fundamentals of fuel cells and commercial batteries.

**UNIT - I**
Fundamentals of Solar Energy-Solar spectrum- Solar Radiation on Earth's surface-Solar radiation geometry-Solar radiation measurements- Solar radiation data- Solar radiation on horizontal and tilted surfaces. Solar Thermal conversion- Flat plate collectors- concentrated collectors- construction and thermal analysis- Solar applications- Solar ponds- Heliostat systems-water heater-air heater-solar still.

**UNIT - II**
Solar-Electric Power generation- Photovoltaic cells- Equivalent circuit- V-I Characteristics- Photovoltaic modules – constructional details- design considerations- Tracking- Maximum power point tracking - Solar Thermo electric conversion.

**UNIT - III**
Wind Energy- Fundamentals of wind energy-power available in wind- Betz Limit- Aerodynamics of wind turbine- Wind turbines- Horizontal and vertical axis turbines –their configurations- Wind Energy conversion systems.

**UNIT - IV**
Energy from Bio Mass- Various fuels- Sources-Conversion technologies-Wet Processes – Dry Processes- Bio Gas generation – Aerobic and anaerobic digestion - Factors affecting

generation of bio gas - Classification of bio gas plants-Different Indian digesters- Digester design considerations - Gasification process - Gasifiers – Applications. Geothermal Energy - sources- Hydrothermal convective - Geo-pressure resources - Petro-thermal systems (HDR) - Magma Resources-Prime Movers.

**UNIT - V**

OTEC Systems- Principle of operation - Open and closed cycles, Energy from Tides - Principle of Tidal Power - Components of tidal Power plants - Operation Methods - Estimation of Energy in Single and double basin systems - Energy and Power from Waves-Wave energy conversion devices - Fuel Cells - Design and Principle of operation - Types of Fuel Cells - Advantages and disadvantages - Types of Electrodes – Applications - Basics of Batteries - Constructional details of Lead acid batteries - Ni-Cd Batteries.

**TEXT BOOKS:**

1. “John Twidell & Wier”, “Renewable Energy Resources”, CRC Press, 2009.
2. “G. D. Rai”, “Non Conventional Energy sources”, Khanna publishers, 2004

**REFERENCE BOOKS:**

1. “D. P .Kothari, Singal, Rakesh and Ranjan”, “Renewable Energy sources and Emerging Technologies”, PHI, 2009.
2. “F. C. Treble”, Generating Electricity from Sun, Pergamon Press, 1st Edition 1991
3. “C. S. Solanki”, “Solar Photovoltaics - Fundamentals- Principles and Applications”, PHI, 2009
4. “S. P. Sukhatme”, “Solar Energy Principles and Application”, TMH, 2009.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING**
**ELECTRICAL ENGINEERING MATERIALS**
**(OPEN ELECTIVE – I)**

| | |
|---|---|
| **B.Tech. III Year I Sem.** | **L T P C** |
| **Course Code: EE512OE** | **3 0 0 3** |

**Prerequisite:** Engineering chemistry and Engineering Physics - II

**Course Objective:**

- To understand the importance of various materials used in electrical engineering and obtain a qualitative analysis of their behavior and applications.

**Course Outcomes:** After completion of this course, the student will be able to

- Understand various types of dielectric materials, their properties in various conditions.
- Evaluate magnetic materials and their behavior.
- Evaluate semiconductor materials and technologies.
- Acquire Knowledge on Materials used in electrical engineering and applications.

**UNIT- I**

**Dielectric Materials:** Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

**UNIT – II**

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

**UNIT – III**

**Semiconductor Materials:** Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale integration techniques (VLSI)

**UNIT – IV**

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

**UNIT – V**

**Special Purpose Materials:** Refractory Materials, Structural Materials, Radioactive Materials, Galvanization and Impregnation of materials, Processing of electronic materials, Insulating varnishes and coolants, Properties and applications of mineral oils, Testing of Transformer oil as per ISI

**Text Books:**

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

**Reference Books:**

1. TTTI Madras, "Electrical Engineering Materials", McGraw Hill Education, 2004.
2. "AdrianusJ.Dekker", Electrical Engineering Materials, PHI Publication, 2006.
3. S. P. Seth, P. V. Gupta "A course in Electrical Engineering Materials", Dhanpat Rai & Sons, 2011.

**B.TECH. ELECTRICAL AND ELECTRONICS ENGINEERING**
**NANOTECHNOLOGY**
**(OPEN ELECTIVE – I)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year I Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: EE513OE** | **3** | **0** | **0** | **3** |

**Course Objectives:** Nano Technology is one of the core subjects of multidisciplinary nature. This has extensive applications in the field of energy, electronics, Biomedical Engg. Etc. Built to specifications by manufacturing matter on the atomic scale, the Nano products would exhibit an order of magnitude improvement in strength, toughness, and efficiency. The objective here is imparting the basic knowledge in Nano Science and Technology.

**Course Outcomes:** The present syllabus of "Introduction to Nano Technology" will give insight into many aspects of Nanoscience, technology and their applications in the prospective of materials science.

**UNIT - I**
**Introduction:** History and Scope, Can Small Things Make a Big Difference? Classification of Nanostructured Materials, Fascinating Nanostructures, Applications of Nanomaterials, Nature: The Best of Nanotechnologist, Challenges, and Future Prospects.

**UNIT - II**
**Unique Properties of Nanomaterials: Microstructure and Defects in Nanocrystalline Materials**: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and disclinations,
**Effect of Nano-dimensions on Materials Behavior:** Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility.
**Magnetic Properties**: Soft magnetic nanocrystalline alloy, Permanent magnetic nanocrystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties, and Mechanical Properties.

**UNIT- III**
**Synthesis Routes: Bottom up approaches:** Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Sol-gel method ,Self-assembly, **Top down approaches:** Mechanical alloying, Nano-lithography, **Consolidation of Nanopowders**: Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing Spark plasma sintering.

**UNIT - IV**
**Tools to Characterize nanomaterials:** X-Ray Diffraction (XRD), Small Angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope

(STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nanoindentation.

**UNIT - V**

**Applications of Nanomaterials:** Nano-electronics, Micro- and Nano-electromechanical systems (MEMS/NEMS), Nanosensors, Nanocatalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water-Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Defense and Space Applications, Concerns and challenges of Nanotechnology.

**TEXT BOOKS:**

1. Text Book of Nano Science and Nano Technology – B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rath and James Munday, University Press-IIM.
2. Introduction to Nanotechnology – Charles P. Poole, Jr., and Frank J. Owens, Wley India Edition, 2012.

**REFERENCES BOOKS:**

1. Nano: The Essentials by T. Pradeep, Mc Graw- Hill Education.
2. Nanomaterials, Nanotechnologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L. Schodek.
3. Transport in Nano structures- David Ferry, Cambridge University press 2000
4. Nanofabrication towards biomedical application: Techniques, tools, Application and impact – Ed. Challa S., S. R. Kumar, J. H. Carola.
5. Carbon Nanotubes: Properties and Applications- Michael J. O'Connell.
6. Electron Transport in Mesoscopic systems - S. Dutta, Cambridge University press.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING**
**DESIGN ESTIMATION AND COSTING OF ELECTRICAL SYSTEMS**
**(OPEN ELECTIVE – II)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: EE621OE** | **3** | **0** | **0** | **3** |

**Prerequisite:** Power systems - I & Power Systems - II

**Course Objectives:**

- To emphasize the estimation and costing aspects of all electrical equipment, installation and designs on the cost viability.
- To design and estimation of wiring
- To design overhead and underground distribution lines, substations and illumination

**Course Outcomes:** After Completion of this course, student will be able to

- Understand the design considerations of electrical installations.
- Design electrical installation for buildings and small industries.
- Identify and design the various types of light sources for different applications.

**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, Indian Electricity rules, 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", New Age International Publisher, 2010.
2. "Er. V. K. Jain, Er. Amitabh Bajaj", "Design of Electrical Installations", University Science Press.


**Reference Books:**


1. Code of practice for Electrical wiring installations,(System voltage not exceeding 650 volts), 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 not exceeding 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, Indian Standard Institution, IS: 900-1965.
7. Code of Practice for electrical wiring, Installations (system voltage not exceeding 650 Volts), Indian Standard Institution, IS: 2274-1963.
8. "Gupta J. B., Katson, Ludhiana", "Electrical Installation, estimating and costing", S. K. Kataria and sons, 2013.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING**
**ENERGY STORAGE SYSTEMS**
**(OPEN ELECTIVE – II)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: EE622OE** | **3** | **0** | **0** | **3** |

**Prerequisite:** Electro chemistry
**Course Objective:**

- To enable the student to understand the need for energy storage, devices and technologies available and their applications

**Course Outcomes:** After completion of this course, the student will be able to

- analyze the characteristics of energy from various sources and need for storage
- classify various types of energy storage and various devices used for the purpose
- Identify various real time applications.

**UNIT - I**
**Electrical Energy Storage Technologies:** Characteristics of electricity, Electricity and the roles of EES, 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 EES, More renewable energy, less fossil fuel, Smart Grid uses, The roles of electrical energy storage technologies, The roles from the viewpoint of a utility, The roles from the viewpoint of consumers, The roles from the viewpoint of generators of renewable energy.

**UNIT - III**
**Features of Energy Storage Systems:** Classification of EES 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 EES, 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. "James M. Eyer, Joseph J. Iannucci and Garth P. Corey ", "Energy Storage Benefits and Market Analysis", Sandia National Laboratories, 2004.
2. The Electrical Energy Storage by IEC Market Strategy Board.

**Reference Book:**

1. "Jim Eyer, Garth Corey", Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report, Sandia National Laboratories, Feb 2010.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING**
**INTRODUCTION TO MECHATRONICS**
**(OPEN ELECTIVE – II)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: EE623OE** | **3** | **0** | **0** | **3** |

**Pre-requisites:** Basic Electronics Engineering

**Course Objectives:**
- To develop an ability to identify, formulate, and solve engineering problems
- To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
- To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

**Course Outcomes:** At the end of the course, the student will be able to, Model, analyze and control engineering systems. Identify sensors, transducers and actuators to monitor and control the behavior of a process or product. Develop PLC programs for a given task. Evaluate the performance of mechatronic systems.

**UNIT – I**
**Introduction**: Definition – Trends - Control Methods: Standalone , PC Based ( Real Time Operating Systems, Graphical User Interface , Simulation ) - Applications: identification of sensors and actuators in Washing machine, Automatic Camera, Engine Management, SPM, Robot, CNC, FMS, CIM.
**Signal Conditioning : I**ntroduction – Hardware - Digital I/O , Analog input – ADC , resolution, Filtering Noise using passive components – Registors, capacitors - Amplifying signals using OP amps –Software - Digital Signal Processing – Low pass , high pass , notch filtering

**UNIT – II**
**Precision Mechanical Systems :** Modern CNC Machines – Design aspects in machine structures, guideways, feed drives, spindle and spindle bearings, measuring systems, control software and operator interface, gauging and tool monitoring.
**Electronic Interface Subsystems :** TTL, CMOS interfacing - Sensor interfacing – Actuator interfacing – solenoids , motors Isolation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers , over current sensing , resetable fuses , thermal dissipation - Power Supply - Bipolar transistors / mosfets

**UNIT – III**

**Electromechanical Drives :** Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation.

**Microcontrollers Overview** : 8051 Microcontroller , micro processor structure – Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly, C (LED Blinking, Voltage measurement using ADC).

**UNIT – IV**

Programmable Logic Controllers : Basic Structure - Programming : Ladder diagram -Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling - Analog input / output - PLC Selection - Application.

**UNIT – V**

**Programmable Motion Controllers** : Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a control system - Feedback Devices : Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive , Capacitive , Infrared - Continuous and discrete processes - Control System Performance & tuning - Digital Controllers - P , PI , PID Control - Control modes – Position , Velocity and Torque - Velocity Profiles – Trapezoidal- S. Curve - Electronic Gearing - Controlled Velocity Profile - Multi axis Interpolation , PTP , Linear , Circular - Core functionalities – Home , Record position , GOTO Position - Applications : SPM, Robotics.

**TEXT BOOKS:**

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering/ W Bolton/ Pearson.
2. Introduction to Mechatronics / Appukuttan /Oxford

**REFERENCE BOOKS:**

1. Mechatronics Principles concepts & Applications / N.P.Mahalik/ Mc Graw Hill
2. "Designing Intelligent Machines". open University, London.

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING**
**ENTREPRENEUR RESOURCE PLANNING**
**(OPEN ELECTIVE – III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T P C** |
| **Course Code: EE831OE** | **3 0 0 3** |

**(Students must read text book. Faculty is free to choose any other cases)**

**Course Objectives:** It enables the student to understand the foundations of Enterprise planning and ERP System Options.

**Course Outcome:** The student understands the challenges in implementation of ERP system, ERP System Implementation options, and functional modules of ERP.

1. Introduction to ERP- Foundation for Understanding ERP systems-Business benefits of ERP-The challenges of implementing ERP system-ERP modules and Historical Development.

Case: Response top RFP for ban ERP system (Mary Sumner).

2. ERP system options & Selection methods-Measurement of project Inpact-information Technology Selection-ERP proposal evaluation-Project Evaluation Technique.(David L. olson).

Case: Atlantic Manufacturing (Mary Sumner).

3. ERP system Installation Options- IS/IT Management results-Risk Identification analysis-System Projects- Demonstration of the system-Failure method-system Architecture & ERP (David L. Olson)

Case: Data Solutions & Technology Knowledge (Mary Sumner).

4. ERP - sales and Marketing- Management control process in sales and marketing - ERP customer relationship management - ERP systems- Accounting & Finance control processes. Financial modules in ERP systems.

Case: Atlantic manufacturing (Mary Sumner).

5. ERP – Production and Material Management-Control process on production and manufacturing - Production module in ERP- supply chain Management & e-market place-e-business & ERP-e supply chain & ERP- Future directions for ERP.

Case: HR in Atlantic manufacturing. (Mary Sumner).

**UNIT - I**

**ERP and Technology:** Introduction – Related Technologies – Business Intelligence – E-Commerce and E Business – Business Process Reengineering – Data Warehousing – Data Mining – OLAP – Product life Cycle management – SCM – CRM

**UNIT - II**

**ERP Implementation:** Implementation Challenges – Strategies – Life Cycle – Pre-implementation Tasks –Requirements Definition – Methodologies – Package selection –

Project Teams –Process Definitions – Vendors and Consultants – Data Migration – Project management – Post Implementation Activities.

**UNIT - III**

**ERP In Action & Business Modules:** Operation and Maintenance – Performance – Maximizing the ERP System – Business Modules – Finance – Manufacturing – Human Resources – Plant maintenance –Materials Management – Quality management – Marketing – Sales, Distribution and service.

**UNIT - IV**

**ERP Market:** Marketplace – Dynamics – SAP AG – Oracle – PeopleSoft – JD Edwards – QAD Inc –SSA Global – Lawson Software – Epicor – Intutive.

**UNIT - V**

Enterprise Application Integration – ERP and E-Business – ERP II – Total quality management – Future Directions – Trends in ERP.

**TEXT BOOKS:**

1. Alexis Leon, “ERP DEMYSTIFIED”, Tata McGraw Hill, Second Edition, 2008.
2. Mary Sumner, “Enterprise Resource Planning”, Pearson Education, 2007.

**REFERENCE BOOKS:**

1. Jim Mazzullo, “SAP R/3 for Everyone”, Pearson, 2007.
2. Jose Antonio Fernandz, “The SAP R /3 Handbook”, Tata McGraw Hill, 1998.
3. Biao Fu, “SAP BW: A Step-by-Step Guide”, First Edition, Pearson Education, 2003.

## B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING
## MANAGEMENT INFORMATION SYSTEM (MIS)
## (OPEN ELECTIVE – III)

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T P C** |
| **Course Code: EE832OE** | **3 0 0 3** |

**Course Objective:**

- To provide the basic concepts of Enterprise Resource Planning and Management of Information System.
- Explain to students why information systems are so important today for business and management;
- Evaluate the role of the major types of information systems in a business
- Assess the impact of the Internet and Internet technology on business-electronic commerce and electronic business;
- Identify the major management challenges to building and using information systems and learn how to find appropriate solutions to those challenges

**Course Outcomes:** The completion of the subject, the student will be able to

- Understand the usage of MIS in organizations and the constituents of the MIS
- Understand the classifications of MIS, understanding of functional MIS and the different functionalities of these MIS. This would be followed by case study on Knowledge management.
- Assess the requirement and stage in which the organization is placed. Nolan model is expected to aid such decisions
- Learn the functions and issues at each stage of system development. Further different ways in which systems can be developed are also learnt.

**UNIT – I**

**Introduction to IS Models and Types of Information systems: –** Nolan Stage Hypothesis, IS Strategic Grid, Wards Model, Earl's Multiple Methodology, Critical Success Factors, Soft Systems Methodology, Socio-Technical Systems Approach (Mumford), System Develop Life Cycle, Prototype and End User Computing, Application Packages, Outsourcing, Deciding Combination of Methods. Types of Information Systems

**UNIT – II**

**IS Security, Control and Audit–** System Vulnerability and Abuse, business value of security and control, Need for Security, Methods of minimizing risks IS Audit, ensuring system quality.

**UNIT – III**

**Induction to ERP:** Overview of ERP, MRP, MRPII and Evolution of ERP, Integrated Management Systems, Reasons for the growth of ERP, Business Modeling, Integrated Data

Model, Foundations of IS in Business, Obstacles of applying IT, ERP Market- ERP Modules: Finance, Accounting Systems, Manufacturing and Production Systems, Sales and Distribution Systems, , Human Resource Systems, Plant Maintenance System, Materials Management System, Quality Management System, ERP System Options and Selection, ERP proposal Evaluation.

**UNIT – IV**

**Benefits of ERP:** Reduction of Lead Time, On-Time Shipment, Reduction in Cycle Time, Improved Resource Utilisation, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Design Making Capabilities.

**UNIT – V**

**ERP Implementation and Maintenance**: Implementation Strategy Options, Features of Successful ERP Implementation, Strategies to Attain Success, User Training, Maintaining ERP & IS**.** Case Studies.

**TEXT BOOKS:**

1. Gordon B. Davis & Margrethe H. Olson: Management Information Systems, TMH, 2009.
2. C Laudon and Jane P. Laudon, et al: Management Information Systems, Pearson Education, 2009.
3. Alexis Leon: ERP (Demystified), 5/E, Tata McGraw-Hill, 2009.
4. C. S. V. Murthy: Management Information System, Himalaya, 2009
5. James A. Obrein: Management Information Systems, TMH, 2009
6. David L Olson: Managerial Issues of Enterprise Resource Planning Systems, McGraw Hill, International Edition-2009.
7. Rainer, Turban, Potter: Introduction to Information Systems, WILEY-India, 2009.
8. Vaman, ERP in Practice, TMH, 2009

**REFERENCE BOOKS:**

1. Dharminder and Sangeetha: Management Information Systems, Excel, 2009
2. Gerald V. Post, David L Anderson: Management Information Systems, Irvin McGraw Hill, 2009.
3. Monk: Concepts in ERP, Cengage, 2009
4. Olson: Managerial Issues of ERO, TMH, 2009
5. Motiwala: Enterprise Resource Planning, Pearson 2009
6. Miller: MIS—Cases, Pearson, 2009

**B.TECH ELECTRICAL AND ELECTRONICS ENGINEERING**
**ORGANIZATIONAL BEHAVIOUR**
**(OPEN ELECTIVE – III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T P C** |
| **Course Code: EE833OE** | **3 0 0 3** |

**Course Objective:**

- To provide the students with the conceptual framework and the theories underlying Organisational Behaviour.

**Course Outcomes:** Upon the completion of the subject, the student will be able to

- Analyse the behaviour of individuals and groups in organizations in terms of the key factors that influence organizational behaviour.
- Assess the potential effects of organizational level factors (such as structure, culture and change) on organizational behaviour.
- Critically evaluate the potential effects of important developments in the external environment (such as globalization and advances in technology) on organizational behaviour.
- Analyse organizational behavioural issues in the context of organizational behaviour theories, models and concepts.

**UNIT – I**

Introduction to OB - Definition, Nature and Scope –Environmental and organizational context – Impact of IT, globalization, Diversity, Ethics, culture, reward systems and organizational design on Organisational Behaviour. Cognitive Processes-I : Perception and Attribution: Nature and importance of Perception – Perceptual selectivity and organization - Social perception – Attribution Theories – Locus of control –Attribution Errors –Impression Management.

**UNIT – II**

Cognitive Processes-II: Personality and Attitudes - Personality as a continuum – Meaning of personality - Johari Window and Transactional Analysis - Nature and Dimension of Attitudes – Job satisfaction and organisational commitment-Motivational needs and processes- Work-Motivation Approaches Theories of Motivation- Motivation across cultures - Positive organizational behaviour: Optimism – Emotional intelligence – Self-Efficacy.

**UNIT – III**

Dynamics of OB-I: Communication – types - interactive communication in organizations – barriers to communication and strategies to improve the follow of communication - Decision Making: Participative decision making techniques – creativity and group decision making . Dynamics of OB –II Stress and Conflict: Meaning and types of stress –Meaning and types of conflict - Effect of stress and intra-individual conflict - strategies to cope with stress and conflict.

**UNIT – IV**

Dynamics of OB –III Power and Politics: Meaning and types of power – empowerment - Groups Vs. Teams – Nature of groups –dynamics of informal groups – dysfunctions of groups and teams – teams in modern work place.

**UNIT – V**

Leading High performance: Job design and Goal setting for High performance- Quality of Work Life- Socio technical Design and High performance work practices - Behavioural performance management: reinforcement and punishment as principles of Learning –Process of Behavioural modification - Leadership theories - Styles, Activities and skills of Great leaders.

**TEXT BOOKS:**

1. Luthans, Fred: Organizational Behaviour 10/e, McGraw-Hill, 2009
2. Mc Shane: Organizational Behaviour, 3e, TMH, 2008
3. Nelson: Organizational Behaviour, 3/e, Thomson, 2008.
4. New strom W. John& Davis Keith, Organisational Behaviour-- Human Behaviour at Work, 12/e, TMH, New Delhi, 2009.
5. Pierce and Gardner: Management and Organisational Behaviour: An Integrated perspective, Thomson, 2009.
6. Robbins, P. Stephen, Timothy A. Judge: Organisational Behaviour, 12/e, PHI/Pearson, New Delhi, 2009.
7. Pareek Udai: Behavioural Process at Work:, Oxford & IBH, New Delhi, 2009.

**REFERENCE BOOKS:**

1. Schermerhorn: Organizational Behaviour 9/e, Wiley, 2008.
2. Hitt: Organizational Behaviour, Wiley, 2008
3. Aswathappa: Organisational Behaviour, Himalaya, 2009
4. Mullins: Management and Organisational Behaviour, Pearson, 2008.
5. McShane, Glinow: Organisational Behaviour--Essentials, TMH, 2009.
6. Ivancevich: Organisational Behaviour and Management, 7/e, TMH, 2008.

**B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING**
**ELECTRONIC MEASUREMENTS AND INSTRUMENTATION**
**(Open Elective – I)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year I Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: EI511OE** | **3** | **0** | **0** | **3** |

**Prerequisite: Nil**

**Course Objectives:**

- It provides an understanding of various measuring systems functioning and metrics for performance analysis.
- Provides understanding of principle of operation, working of different electronic instruments viz. signal generators, signal analyzers, recorders and measuring equipment.
- Provides understanding of use of various measuring techniques for measurement of different physical parameters using different classes of transducers.

**Course Outcomes:** On completion of this course student can be able to

- Identify the various electronic instruments based on their specifications for carrying out a particular task of measurement.
- Measure various physical parameters by appropriately selecting the transducers.
- Use various types of signal generators, signal analyzers for generating and analyzing various real-time signals.

**UNIT - I**

**Block Schematics of Measuring Systems:** Performance Characteristics, Static Characteristics, Accuracy, Precision, Resolution, Types of Errors, Gaussian Error, Root Sum Squares formula, Dynamic Characteristics, Repeatability, Reproducibility, Fidelity, Lag ;Measuring Instruments: DC Voltmeters, D’ Arsonval Movement, DC Current Meters, AC Voltmeters and Current Meters, Ohmmeters, Multimeters, Meter Protection, Extension of Range, True RMS Responding Voltmeters, Specifications of Instruments.

**UNIT - II**

**Signal Analyzers:** AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage Meters, Oscillators. Signal Generators: AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary Waveform Generator, Video Signal Generators, and Specifications

**UNIT - III**

**Oscilloscopes:** CRT, Block Schematic of CRO, Time Base Circuits, Lissajous Figures, CRO Probes, High Frequency CRO Considerations, Delay lines, Applications: Measurement of Time, Period and Frequency Specifications.

**Special Purpose Oscilloscopes:** Dual Trace, Dual Beam CROs, Sampling Oscilloscopes, Storage Oscilloscopes, Digital Storage CROs.

**UNIT - IV**

**Transducers:** Classification, Strain Gauges, Bounded, unbounded; Force and Displacement Transducers, Resistance Thermometers, Hotwire Anemometers, LVDT, Thermocouples, Synchros, Special Resistance Thermometers, Digital Temperature sensing system, Piezoelectric Transducers, Variable Capacitance Transducers, Magneto Strictive Transducers.

**UNIT - V**

**Bridges:** Wheat Stone Bridge, Kelvin Bridge, and Maxwell Bridge.

**Measurement of Physical Parameters**: Flow Measurement, Displacement Meters, Liquid level Measurement, Measurement of Humidity and Moisture, Velocity, Force, Pressure – High Pressure, Vacuum level, Temperature -Measurements, Data Acquisition Systems.

**TEXT BOOKS:**

1. Electronic Measurements and Instrumentation – K. Lal Kishore, Pearson Education 2010.
2. Electronic Instrumentation: H.S.Kalsi – TMH, 2nd Edition 2004.

**REFERENCE BOOKS:**

1. Electronic Instrumentation and Measurements – David A. Bell, Oxford Univ. Press, 1997.
2. Modern Electronic Instrumentation and Measurement Techniques: A.D. Helbincs, W.D. Cooper: PHI 5th Edition 2003.
3. Electronic Measurements and Instrumentation: B.M. Oliver, J.M. Cage TMH Reprint 2009.
4. Industrial Instrumentation: T.R. Padmanabham Springer 2009.

**B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING**
**INDUSTRIAL ELECTRONICS**
**(Open Elective – II)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: EI621OE** | **3** | **0** | **0** | **3** |

**Pre-requisites:** Basic Electrical and Electronics Engineering or Electronic Devices and Circuits.

**UNIT - I**
**DC Amplifiers:** Need for DC amplifiers, DC amplifiers - Drift, Causes, Darlington Emitter Follower, Cascode amplifier, Stabilization, Differential amplifiers - Chopper stabilization, Operational Amplifiers, Ideal specifications of Operational Amplifiers, Instrumentation Amplifiers.

**UNIT - II**
**Regulated Power Supplies:** Block diagram, Principle of voltage regulation, Series and Shunt type Linear Voltage Regulators, Protection Techniques - Short Circuit, Over voltage and Thermal Protection.
**Switched Mode & IC Regulators:** Switched Mode voltage regulator, Comparison of Linear and Switched Mode Voltage Regulators, Servo Voltage Stabilizer, monolithic voltage regulators Fixed and Adjustable IC Voltage regulators, 3-terminal Voltage regulators - Current boosting .

**UNIT - III**
**SCR and Thyristor:** Principles of operation and characteristics of SCR, Triggering of Thyristors, Commutation Techniques of Thyristors - Classes A, B, C, D, E and F, Ratings of SCR.

**UNIT - IV**
**Applications of SCR in Power Control:** Static circuit breaker, Protection of SCR, Inverters - Classification, Single Phase inverters, Converters –single phase Half wave and Full wave.
**DIAC, TRIAC and Thyristor Applications:** Chopper circuits – Principle, methods and Configurations, DIAC AND TRIAC, TRIACS – Triggering modes, Firing Circuits, Commutation.

**UNIT - V**
**Industrial Applications - I:** Industrial timers -Classification, types, Electronic Timers – Classification, RC and Digital timers, Time base Generators.
Electric Welding Classification, types and methods of Resistance and ARC wielding, Electronic DC Motor Control.
**Industrial Applications - II:** High Frequency heating – principle, merits, applications, High frequency Source for Induction heating. Dielectric Heating – principle, material properties,

Electrodes and their Coupling to RF generator, Thermal losses and Applications. Ultrasonics – Generation and Applications.

**TEXTBOOKS:**

1. Industrial and Power Electronics – G. K. Mithal and Maneesha Gupta, Khanna Publishers, 19th Ed., 2003.
2. Integrated Electronics – J. Millman and C.C Halkias, McGraw Hill, 1972.

**REFERENCE BOOKS:**

1. Electronic Devices and circuits – Theodore. H. Bogart, Pearson Education, 6th Edn., 2003.
2. Thyristors and applications – M. Rammurthy, East-West Press, 1977.3.
3. Integrated Circuits and Semiconductor Devices – Deboo and Burroughs, ISE

**B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING**
**SENSORS AND TRANSDUCERS**
**(Open Elective – III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T P C** |
| **Course Code: EI831OE** | **3 0 0 3** |

**Pre-requisites:** Nil

**Course Objectives:** To enable the students to select and design suitable instruments to meet the requirements of industrial applications and various transducers used for the measurement of various physical quantities and the following:

- Various types of Sensors & Transducers and their working principle
- Resistive, Capacitive and Inductive transducers
- Some of the miscellaneous transducers
- Characteristics of transducers

**Course Outcomes:** Upon completion of this course the student shall be able to understand the working of basic sensors and transducers used in any industries.

**UNIT – I**

**Measurements and Instrumentation of Transducers:** Measurements – Basic method of measurement – Generalized scheme for measurement systems – Units and standards – Errors – Classification of errors, error analysis – Statistical methods – Sensor – Transducer – Classification of transducers – Basic requirement of transducers.

**UNIT – II**

**Characteristics of Transducers:** Static characteristics – Dynamic characteristics – Mathematical model of transducer – Zero, first order and second order transducers – Response to impulse, step, ramp and sinusoidal inputs

**UNIT – III**

**Resistive Transducers:** Potentiometer –Loading effect – Strain gauge – Theory, types, temperature compensation – Applications – Torque measurement – Proving Ring – Load Cell – Resistance thermometer – Thermistors materials – Constructions, Characteristics – Hot wire anemometer

**UNIT – IV**

**Inductive and Capacitive Transducer:** Self inductive transducer – Mutual inductive transducers – Linear Variable Differential Transformer – LVDT Accelerometer – RVDT – Synchros – Microsyn – Capacitive transducer – Variable Area Type – Variable Air Gap type – Variable Permittivity type – Capacitor microphone.

**UNIT – V**

**Miscellaneous Transducers:** Piezoelectric transducer – Hall Effect transducers – Smart sensors – Fiber optic sensors – Film sensors – MEMS – Nano sensors, Digital transducers

**TEXT BOOKS:**

1. Sawhney. A.K, “A Course in Electrical and Electronics Measurements and Instrumentation”, 18th Edition, Dhanpat Rai & Company Private Limited, 2007.
2. Patranabis. D, “Sensors and Transducers”, Prentice Hall of India, 2003.

**REFERENCE BOOKS:**

1. Renganathan. S, “Transducer Engineering”, Allied Publishers, Chennai, 2003.
2. Doebelin. E.A, “Measurement Systems – Applications and Design”, Tata McGraw Hill, New York, 2000.
3. John. P, Bentley, “Principles of Measurement Systems”, III Edition, Pearson Education, 2000.
4. Murthy. D. V. S, “Transducers and Instrumentation”, Prentice Hall of India, 2001.
5. Sensor Technology Hand Book – Jon Wilson, Newne 2004.
6. Instrument Transducers – An Introduction to their Performance and design – by Herman K. P. Neubrat, Oxford University Press.

**B.TECH. ELECTRONICS AND INSTRUMENTATION ENGINEERING**
**PC BASED INSTRUMENTATION**
**(Open Elective – III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T P C** |
| **Course Code: EI832OE** | **3 0 0 3** |

**Course Objective:** To introduce interfacing data acquisition systems to PC and introducing PLCs with their classification, operation, and programming.

**UNIT – I**
**Introduction to Computer Instrument Communication:** Personal Computer, overview of operating System, I/O Ports, Plug-in-slots, PCI bus, Operators Interface. Computer Interfacing for Data Acquisition and Control – Interfacing Input Signals, Output system with continuous actuators. Data Acquisition and Control using Standard Cards: PC expansion systems, Plug-in Data Acquisition Boards; Transducer to Control room, Backplane bus – VXI.

**UNIT – II**
**Programmable logic controller (PLC) basics:** Definition, overview of PLC systems, input/output modules, power supplies, and isolators.
**Basic PLC programming:** Programming On-Off inputs/ outputs. Creating Ladder diagrams Basic PLC functions PLC Basic Functions, register basics, timer functions, counter functions.

**UNIT – III**
**PLC intermediate and advanced functions:** Arithmetic functions, number comparison functions, Skip and MCR functions, data move systems. Utilizing digital bits, sequencer functions, matrix functions. PLC Advanced functions: Analog PLC operation, networking of PLC.

**UNIT – IV**
**Application of PLC:** Controlling of Robot using PLC, PID control of continuous processes, Continuous Bottle-filling system, Batch mixing system, 3-stage air conditioning system, Automatic frequency control of Induction heating

**UNIT – V**
**Related Topics:** Alternate programming languages. Auxiliary commands and functions. PLC installation, troubleshooting, and maintenance. Field bus: Introduction, concept. HART protocol: Method of operation, structure, and applications. Smart transmitters, smart valves, and smart actuators.

**TEXT BOOKS**

1. Programmable Logic Controllers – Principles and Applications, John. W .Webb Ronald A Reis , Fourth edition, Prentice Hall Inc., New Jersey, 1998.
2. Computer Control of Processes – M.Chidambaram. Narosa 2003.

**REFERENCES**

1. PC Based Instrumentation and Control Third Edition by Mike Tooley ; Elsevier.
2. PC Interfacing and Data Acquisition Techniques for Measurement, Instrumentation, and Control. By Kevin James; Elsevier.
3. Practical Data Acquisition for Instrumentation and Control Systems by John Park and Steve Mackay.
4. Distributed Control Systems, Lukcas M.P, Van Nostrand Reinhold Co., New York, 1986.
5. 5. Programmable Logic Controllers, Second edition, Frank D. Petruzella, Mc Graw Hill, New York, 1997.
6. Programmable Logic Controllers Programming methods and applications-Prentice Hall by John R. Hackworth and Frederick D. Hackworth, Jr.

**B.TECH. MECHANICAL ENGINEERING**
**OPTIMIZATION TECHNIQUES**
**(Open Elective – I)**

| | |
|---|---|
| **B.Tech. III Year I Sem.** | **L T/P/D C** |
| **Course Code**: **ME511OE** | **3 0/0/0 3** |

**Prerequisite:** Mathematics –I & Mathematics –II

**Course Objectives:**

- To introduce various optimization techniques i.e classical, linear programming, transportation problem, simplex algorithm, dynamic programming
- Constrained and unconstrained optimization techniques for solving and optimizing an electrical and electronic engineering circuits design problems in real world situations.
- To explain the concept of Dynamic programming and its applications to project implementation.

**Course Outcomes:** After completion of this course, the student will be able to

- explain the need of optimization of engineering systems
- understand optimization of electrical and electronics engineering problems
- apply classical optimization techniques, linear programming, simplex algorithm, transportation problem
- apply unconstrained optimization and constrained non-linear programming and dynamic programming
- Formulate optimization problems.

**UNIT – I**

**Introduction and Classical Optimization Techniques:** Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

**Classical Optimization Techniques:** Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints.

Solution by method of Lagrange multipliers – Multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

**UNIT – II**

**Linear Programming:** Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

**Transportation Problem:** Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel’s approximation method – testing for optimality of balanced transportation problems.

**UNIT – III**

**Unconstrained Nonlinear Programming:** One dimensional minimization methods, Classification, Fibonacci method and Quadratic interpolation method

**Unconstrained Optimization Techniques:** Univariant method, Powell's method and steepest descent method.

U**NIT – IV**

**Constrained Nonlinear Programming:** Characteristics of a constrained problem - classification - Basic approach of Penalty Function method - Basic approach of Penalty Function method - Basic approaches of Interior and Exterior penalty function methods - Introduction to convex programming problem.

**UNIT – V**

**Dynamic Programming:** Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

**TEXT BOOKS:**

1. Singiresu S. Rao, Engineering Optimization: Theory and Practice by John Wiley and Sons, 4th edition, 2009.
2. H. S. Kasene & K. D. Kumar, Introductory Operations Research, Springer (India), Pvt. Ltd., 2004

**REFERENCE BOOKS:**

1. George Bernard Dantzig, Mukund Narain Thapa, "Linear programming", Springer series in operations research 3rd edition, 2003.
2. H.A. Taha, "Operations Research: An Introduction", 8th Edition, Pearson/Prentice Hall, 2007.
3. Kalyanmoy Deb, "Optimization for Engineering Design – Algorithms and Examples", PHI Learning Pvt. Ltd, New Delhi, 2005.

**B.TECH. MECHANICAL ENGINEERING**
**COMPUTER GRAPHICS**
**(Open Elective - I)**

| | | | |
|---|---|---|---|
| **B.Tech. III Year I Sem.** | **L** | **T/P/D** | **C** |
| **Course Code**: **ME512OE** | **3** | **0/0/0** | **3** |

**Course Objectives:**
- To make students understand about fundamentals of Graphics to enable them to design animated scenes for virtual object creations.
- To make the student present the content graphically.

**Course Outcomes:**
- Students can animate scenes entertainment.
- Will be able work in computer aided design for content presentation..
- Better analogy data with pictorial representation.

**UNIT - I**

**Introduction:** Application areas of Computer Graphics, overview of graphics systems, video-display devices, raster-scan systems, random scan systems, graphics monitors and work stations and input devices

**Output primitives:** Points and lines, line drawing algorithms, mid-point circle and ellipse algorithms. Filled area primitives: Scan line polygon fill algorithm, boundary-fill and flood-fill algorithms.

**UNIT - II**

**2-D Geometrical transforms:** Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transforms, transformations between coordinate systems.

**2-D Viewing:** The viewing pipeline, viewing coordinate reference frame, window to view-port coordinate transformation, viewing functions, Cohen-Sutherland and Cyrus-beck line clipping algorithms, Sutherland –Hodgeman polygon clipping algorithm.

**UNIT - III**

3**-D Object representation**: Polygon surfaces, quadric surfaces, spline representation, Hermite curve, Bezier curve and B-spline curves, Bezier and B-spline surfaces, sweep representations, octrees BSP Trees,

**3-D Geometric transformations**: Translation, rotation, scaling, reflection and shear transformations, composite transformations, 3-D viewing: Viewing pipeline, viewing coordinates, view volume and general projection transforms and clipping.

**UNIT - IV**

**Visible surface detection methods:** Classification, back-face detection, depth-buffer, scan-line, depth sorting, BSP-tree methods, area sub-division and octree methods

**Illumination Models and Surface rendering Methods:** Basic illumination models, polygon rendering methods

**UNIT- V**

**Computer animation:** Design of animation sequence, general computer animation functions, raster animation, computer animation languages, key frame systems, motion specifications

**TEXT BOOKS:**

1. "Computer Graphics C version", Donald Hearn and M. Pauline Baker, Pearson education.
2. "Computer Graphics Second edition", Zhigand xiang, Roy Plastock, Schaum's outlines, Tata Mc Graw hill edition.

**REFERENCE BOOKS:**

1. "Computer Graphics Principles & practice", second edition in C, Foley, Van Dam, Feiner and Hughes, Pearson Education.
2. "Procedural elements for Computer Graphics", David F Rogers, Tata Mc Graw hill, 2nd edition.
3. "Principles of Interactive Computer Graphics", Neuman and Sproul, TMH.
4. "Principles of Computer Graphics", Shalini, Govil-Pai, Springer.
5. "Computer Graphics", Steven Harrington, TMH
6. Computer Graphics, F. S. Hill, S. M. Kelley, PHI.
7. Computer Graphics, P. Shirley, Steve Marschner & Others, Cengage Learning.
8. Computer Graphics & Animation, M. C. Trivedi, Jaico Publishing House.
9. An Integrated Introduction to Computer Graphics and Geometric Modelling, R. Goldman, CRC Press, Taylor&Francis Group.
10. Computer Graphics, Rajesh K.Maurya, Wiley India.

**B.TECH. MECHANICAL ENGINEERING**
**INTRODUCTION TO MECHATRONICS**
**(Open Elective - I)**

| | |
|---|---|
| **B.Tech. III Year I Sem.** | **L T/P/D C** |
| **Course Code**: **ME513OE** | **3 0/0/0 3** |

**Pre-requisites:** Basic Electronics Engineering

**Course Objectives:**

- To develop an ability to identify, formulate, and solve engineering problems
- To develop an ability to design a system, component, or process to meet desired needs within realistic constraints.
- To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

**Course Outcomes:** At the end of the course, the student will be able to, Model, analyze and control engineering systems. Identify sensors, transducers and actuators to monitor and control the behavior of a process or product. Develop PLC programs for a given task. Evaluate the performance of mechatronic systems.

**UNIT – I**

**Introduction**: Definition – Trends - Control Methods: Standalone , PC Based ( Real Time Operating Systems, Graphical User Interface , Simulation ) - Applications: identification of sensors and actuators in Washing machine, Automatic Camera, Engine Management, SPM, Robot, CNC, FMS, CIM.

**Signal Conditioning : I**ntroduction – Hardware - Digital I/O , Analog input – ADC , resolution, Filtering Noise using passive components – Registors, capacitors - Amplifying signals using OP amps –Software - Digital Signal Processing – Low pass , high pass , notch filtering

**UNIT – II**

**Precision Mechanical Systems :** Modern CNC Machines – Design aspects in machine structures, guideways, feed drives, spindle and spindle bearings, measuring systems, control software and operator interface, gauging and tool monitoring.

**Electronic Interface Subsystems :** TTL, CMOS interfacing - Sensor interfacing – Actuator interfacing – solenoids , motors Isolation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers , over current sensing , resetable fuses , thermal dissipation - Power Supply - Bipolar transistors / mosfets

**UNIT – III**

**Electromechanical Drives :** Relays and Solenoids - Stepper Motors - DC brushed motors – DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation.

**Microcontrollers Overview** : 8051 Microcontroller , micro processor structure – Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly, C (LED Blinking, Voltage measurement using ADC).

**UNIT – IV**

Programmable Logic Controllers : Basic Structure - Programming : Ladder diagram -Timers, Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling - Analog input / output - PLC Selection - Application.

**UNIT – V**

**Programmable Motion Controllers** : Introduction - System Transfer Function – Laplace transform and its application in analysing differential equation of a control system - Feedback Devices : Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors : Inductive , Capacitive , Infrared - Continuous and discrete processes - Control System Performance & tuning - Digital Controllers - P , PI , PID Control - Control modes – Position , Velocity and Torque - Velocity Profiles – Trapezoidal- S. Curve - Electronic Gearing - Controlled Velocity Profile - Multi axis Interpolation , PTP , Linear , Circular - Core functionalities – Home , Record position , GOTO Position - Applications : SPM, Robotics.

**TEXT BOOKS:**

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering/ W Bolton/ Pearson.
2. Introduction to Mechatronics / Appukuttan /Oxford

**REFERENCE BOOKS:**

1. Mechatronics Principles concepts & Applications / N.P.Mahalik/ Mc Graw Hill
2. "Designing Intelligent Machines". open University, London.

**B.TECH. MECHANICAL ENGINEERING**
**FUNDAMENTALS OF MECHANICAL ENGINEERING**
**(Open Elective - I)**

| | |
|---|---|
| **B.Tech. III Year I Sem.** | **L T/P/D C** |
| **Course Code**: **ME514OE** | **3 0/0/0 3** |

**Pre-Requisites:** None
**Course Objectives:** Understanding of basic principles of Mechanical Engineering is required in various field of engineering.

**Course Outcomes:** After learning the course the students should be able to
- To understand the fundamentals of mechanical systems.
- To understand and appreciate significance of mechanical engineering in different Fields of engineering.

**UNIT - I**
**Introduction:** Prime movers and its types, Concept of Force, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific heat capacity, Change of state, Path, Process, Cycle, Internal energy, Enthalpy, Statements of Zeroth Law and First law.
**Energy:** Introduction and applications of Energy sources like Fossil fuels, Nuclear fuels, Hydel, Solar, wind, and bio-fuels, Environmental issues like Global warming and Ozone depletion.

**UNIT - II**
**Properties of gases:** Gas laws, Boyle's law, Charle's law, Combined gas law, Gas constant, Relation between Cp and Cv, Various non-flow processes like constant volume process, constant pressure process, Isothermal process, Adiabatic process, Poly-tropic process
**Properties of Steam:** Steam formation, Types of Steam, Enthalpy, Specific volume, Internal energy and dryness fraction of steam, use of Steam tables, steam calorimeters.
**Steam Boilers:** Introduction, Classification, Cochran, Lancashire and Babcock and Wilcox boiler, functioning of different mountings and accessories.

**UNIT - III**
**Heat Engines:** Heat Engine cycle and Heat Engine, working substances, Classification of heat engines, Description and thermal efficiency of Carnot; Rankine; Otto cycle and Diesel cycles.
**Internal Combustion Engines:** Introduction, Classification, Engine details, four- stroke/ two-stroke cycle Petrol/Diesel engines, Indicated power, Brake Power, Efficiencies.

**UNIT - IV**
**Pumps:** Types and operation of Reciprocating, Rotary and Centrifugal pumps, Priming
**Air Compressors:** Types and operation of Reciprocating and Rotary air compressors, significance of Multistage.

**Refrigeration & Air Conditioning:** Refrigerant, Vapor compression refrigeration system, vapor absorption refrigeration system, Domestic Refrigerator, Window and split air conditioners.

**UNIT - V**

**Couplings, Clutches and Brakes:** Construction and applications of Couplings (Box; Flange; Pin type flexible; Universal and Oldham), Clutches (Disc and Centrifugal), and Brakes (Block; Shoe; Band and Disc).

**Transmission of Motion and Power:** Shaft and axle, Belt drive, Chain drive, Friction drive, Gear drive.

**Engineering Materials**: Types and applications of Ferrous & Nonferrous metals, Timber, Abrasive material, silica, ceramics, glass, graphite, diamond, plastic and polymer.

**TEXT BOOKS:**

1. Basic Mechanical Engineering / Pravin Kumar/ Pearson
2. Introduction to Engineering Materials / B.K. Agrawal/ Mc Graw Hill

**REFERENCE BOOKS:**

1. Fundamental of Mechanical Engineering/ G.S. Sawhney/PHI
2. Thermal Science and Engineering / Dr. D.S. Kumar/ Kataria

**B.TECH. MECHANICAL ENGINEERING**
**WORLD CLASS MANUFACTURING**
**(Open Elective – II)**

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T/P/D C** |
| **Course Code**: **ME621OE** | **3 0/0/0 3** |

**Pre-requisites:** None

**Course Objectives:** To understand the concept of world class manufacturing, dynamics of material flow, OPT and Lean manufacturing.

**Course Outcomes:** Students should be able to compare the existing industry with WCM companies.

**UNIT - I**

**Information Age and Global Competitiveness:** The Emergence of Information Age; Competition and Business Challenge; Operating Environment; Globalization and International Business; Global Competitiveness and Manufacturing Excellence; World Class Manufacturing and Information Age Competition; Manufacturing Challenges, Problems in Manufacturing Industry.

**UNIT - II**

**Cutting Edge Technology:** Value Added Engineer in - Hall’s Framework; Schonberger’s Framework of WCM; Gunn’s Model; Maskell’s Model.

**Philosophy of World Class Manufacturing:** Evolution of WCM; Ohno’s View on WCM; Principles and Practices; Quality in WCM; Deming’s & Shingo’s Approach to Quality Management; Culmination of WCM.

**UNIT - III**

**System and Tools for World Class Manufacturing:** The Integration Imperative; Overview of Systems and Tools; Information Management Tools - Product and Process Design Tools, Bar Code Systems, Kanban: A Lean Production Tool, Statistical Quality Control (SQC), Material Processing, and Handling Tools; Assessment of Manufacturing Systems and Tools.

**Labor and HRD Practices in WCM:** Human Resource Dimensions in WCM; Morale and Teamwork; High Employee Involvement; Cross Functional Teams; Work Study Methods; Human Integration Management.

**UNIT - IV**

**Competitive Indian Manufacturing:** Manufacturing Performance and Competitiveness - Indian Firms: Manufacturing Objectives and Strategy; Usage of Management Tools and Technologies; Manufacturing Management Practices; IT Infrastructure and Practices; Strategic Intent Framework; Breadth and Integration of IT Infrastructure.

**Globalization and World Class Manufacturing:** Generic Manufacturing Strategies for Information Age; Planning Methodology and Issues in Strategic Planning of WCM; Performance Measurement - PO-P System, TOPP System and Ambite System.

**UNIT - V**

**The Future WCM:** Manufacturing Strategy: Futile Search for an Elusive Link, Manufacturing Strategic Intent Classification, Translating Intent into Action.

**Case Studies:** Accelerated Fermentation Process – Using World Class Enzymes; Birla Cellulosic Kharach.

**TEXT BOOKS:**

1. World Class Manufacturing- A Strategic Perspective / BS Sahay, KBS Saxena & Ashish Kumar / Macmillan
2. Making Common Sense Common Practice – Models for Manufacturing Excellence / Ron Moore / Butter Worth Heinemann

**REFERENCE BOOKS:**

1. Managing Technology and Innovation for Competitive Advantage / V. K. Narayanan/ Prentice Hall
2. World Class Manufacturing - The Lesson of Simplicity / Richard J Schonberger / Free Press

**B.TECH. MECHANICAL ENGINEERING**
**FUNDAMENTALS OF ROBOTICS**
**(Open Elective – II)**

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T/P/D C** |
| **Course Code**: **ME622OE** | **3 0/0/0 3** |

**Course Objectives:** The goal of the course is to familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, and incorporate robotic technology in engineering systems.

- Make the students acquainted with the theoretical aspects of Robotics
- Enable the students to acquire practical experience in the field of Robotics through design projects and case studies.
- Make the students to understand the importance of robots in various fields of engineering.
- Expose the students to various robots and their operational details.

**Course outcomes:** After this completion of this course, the student should be able to

- Understand the basic components of robots.
- Differentiate types of robots and robot grippers.
- Model forward and inverse kinematics of robot manipulators.
- Analyze forces in links and joints of a robot.
- Programme a robot to perform tasks in industrial applications.
- Design intelligent robots using sensors.

**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.

Machine (robot) vision:

**TEXT BOOKS:**

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Robotics / John J. Craig/ Pearson

**REFERENCE BOOKS:**

1. Theory of Applied Robotics /Jazar/Springer.
2. Robotics / Ghosal / Oxford

**B.TECH. MECHANICAL ENGINEERING**
**FABRICATION PROCESSES**
**(Open Elective –II)**

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T/P/D C** |
| **Course Code**: **ME623OE** | **3 0/0/0 3** |

**Course Objectives:** Understand the philosophies of various Manufacturing process.

**Course Outcomes:** For given product, one should be able identify the manufacturing process.

**UNIT – I**

**Casting:** Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances and their construction; Properties of moulding sands.

Methods of Melting - Crucible melting and cupola operation – Defects in castings;

Casting processes – Types – Sand moulding, Centrifugal casting, die- casting, Investment casting, shell moulding; Principles of Gating – Requirements – Types of gates, Design of gating systems – Riser – Function, types of Riser and Riser design.

**UNIT – II**

**Welding:** Classification – Types of welds and welded joints; Gas welding - Types, oxy-fuel gas cutting. Arc welding, forge welding, submerged arc welding, Resistance welding, Thermit welding.

Inert Gas Welding - TIG Welding, MIG welding, explosive welding, Laser Welding; Soldering and Brazing; Heat affected zone in welding. Welding defects – causes and remedies; destructive and non- destructive testing of welds.

**UNIT – III**

Hot working, cold working, strain hardening, recovery, recrystallisation, and grain growth.

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 – IV**

**Extrusion of Metals:** Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion and pipe making, Hydrostatic extrusion. Forces in extrusion

**UNIT – V**

**Forging Processes:** Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging – Forging hammers : Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.

**TEXT BOOKS:**

1. Manufacturing Technology / P.N. Rao / Mc Graw Hill
2. Manufacturing Engineering and Technology/Kalpakjin S/ Pearson.

**REFERENCE BOOKS:**

1. Metal Casting / T.V Ramana Rao / New Age
2. Métal Fabrication Technology/ Mukherjee/PHI

**B.TECH. MECHANICAL ENGINEERING**
**TOTAL QUALITY MANAGEMENT**
**(Open Elective - III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T/P/D C** |
| **Course Code**: **ME831OE** | **3 0/0/0 3** |

**UNIT - I**

Introduction, The concept of TQM, Quality and Business performance, attitude, and involvement of top management, communication, culture and management systems.

Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs. Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

**UNIT -II**

**Customer Focus and Satisfaction**: Process vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships.

Bench Marking: Evolution of Bench Marking, meaning of bench marking, benefits of bench marketing, the bench marking procedure, pitfalls of bench marketing.

**UNIT- III**

**Organizing for TQM**: The systems approach, organizing for quality implementation, making the transition from a traditional to a TQM organization, Quality Circles, seven Tools of TQM: Stratification, check sheet, Scatter diagram, lshikawa diagram, paneto diagram, Kepner &Tregoe Methodology.

**UNIT- IV**

**The Cost of Quality**: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost information, Accounting Systems and Quality Management.

**UNIT -V**

**ISO9000:** Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQC Q- 90. Series Standards, benefits of ISO9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

**TEXT BOOK:**

1. Total Quality Management / Joel E. Ross/Taylor and Franscis Limited
2. Total Quality Management/P. N. Mukherjee/PHI

**REFERENCE BOOKS:**

1. Beyond TQM / Robert L.Flood
2. Statistical Quality Control / E.L. Grant.
3. Total Quality Management:A Practical Approach/H. Lal
4. Quality Management/Kanishka Bedi/Oxford University Press/2011
5. Total Engineering Quality Management/Sunil Sharma/Macmillan

**B.TECH. MECHANICAL ENGINEERING**
**INDUSTRIAL SAFETY, HEALTH, AND ENVIRONMENTAL ENGINEERING**
**(Open Elective - III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T/P/D C** |
| **Course Code: ME832OE** | **3 0/0/0 3** |

**Pre-requisites:** None

**Course Objectives:**

- To provide exposure to the students about safety and health provisions related to hazardous processes as laid out in Factories act 1948.
- To familiarize students with powers of inspectorate of factories.
- To help students to learn about Environment act 1948 and rules framed under the act.
- To provide wide exposure to the students about various legislations applicable to an industrial unit.

**Course Outcomes:**

- To list out important legislations related to Health , Safety and Environment
- To list out requirements mentioned in factories act for the prevention of accidents. To understand the health and welfare provisions given in factories act.
- To understand the statutory requirements for an Industry on registration, license and its renewal.
- To prepare onsite and offsite emergency plan.

**UNIT - I**

**Factories Act – 1948 :** Statutory authorities – inspecting staff, health, safety, provisions relating to hazardous processes, welfare, working hours, employment of young persons – special provisions – penalties and procedures-Telangana Factories Rules 1950 under Safety and health chapters of Factories Act 1948

**UNIT II**

**Environment Act – 1986:** General Powers of the central government, prevention, control and abatement of environmental pollution-Biomedical waste (Management and handling Rules, 1989-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001- No Objection certificate from statutory authorities like pollution control board. Air Act 1981 and Water Act 1974: Central and state boards for the prevention and control of air pollution-powers and functions of boards – prevention and control of air pollution and water pollution – fund – accounts and audit, penalties and procedures.

**UNIT - III**

**Manufacture, Storage and Import of Hazardous**

**Chemical Rules 1989 :** Definitions – duties of authorities – responsibilities of occupier – notification of major accidents –information to be furnished – preparation of offsite and onsite plans – list of hazardous and toxic chemicals – safety reports – safety data sheets.

**UNIT - IV**

**Other Acts and Rules :** Indian Boiler Act 1923, static and mobile pressure vessel rules (SMPV), motor vehicle rules, mines act 1952, workman compensation act, rules – electricity act and rules – hazardous wastes (management7 and handling) rules, 1989, with amendments in 2000- the building and other construction workers act 1996., Petroleum rules, Gas cyclinder rules-Explosives Act 1983-Pesticides Act

**UNIT - V**

**International Acts and Standards:** Occupational Safety and Health act of USA (The Williames-Steiger Act of 1970) – Helath and safety work act (HASAWA 1974, UK) – OSHAS 18000 – ISO 14000 – American National Standards Institute (ANSI).

**TEXT BOOKS:**

1. The Factories Act 1948, Madras Book Agency, Chennai, 2000
2. The Environment Act (Protection) 1986, Commercial Law Publishers (India) Pvt. Ltd., New Delhi.
3. Industrial Safety, Health and Environment Management Systems / R. K. Jain, Sunil S. Rao / Khanna Publishers.

**REFERENCE BOOKS:**

1. Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt. Ltd., New Delhi.
2. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt. Ltd., New Delhi.
3. The Indian boilers act 1923, Commercial Law Publishers (India) Pvt. Ltd., Allahabad.
4. The Mines Act 1952, Commercial Law Publishers (India) Pvt. Ltd., Allahabad.
5. The manufacture, storage, and import of hazardous chemical rules 1989, Madras Book Agency, Chennai.

**B.TECH. MECHANICAL ENGINEERING**
**BASICS OF THERMODYNAMICS**
**(Open Elective - III)**

| | | | |
|---|---|---|---|
| **B.Tech. IV Year II Sem.** | **L** | **T/P/D** | **C** |
| **Course Code**: **ME833OE** | **3** | **0/0/0** | **3** |

**Pre-requisite**: Engineering Chemistry and Physics

**Course Objective**: To understand the treatment of classical Thermodynamics and to apply the First and Second laws of Thermodynamics to engineering applications

**Course Outcomes**: At the end of the course, the student should be able to:

- Understand and differentiate between different thermodynamic systems and processes
- Understand and apply the laws of Thermodynamics to different types of systems undergoing various processes
- Understand and analyze the Thermodynamic cycles

**UNIT – I**

**Introduction: Basic Concepts:** System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle, Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility

**UNIT - II**

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

**UNIT – III**

First and Second Laws of Thermodynamics: First Law: Cycle and Process, Specific Heats (cp and cv), Heat interactions in a Closed System for various processes, Limitations of First Law, Concept of Heat Engine (H.E.) and Reversed H.E. (Heat Pump and Refrigerator), Efficiency/COP, Second Law: Kelvin-Planck and Clausius Statements, Carnot Cycle, Carnot Efficiency, Statement of Clausius Inequality, Property of Entropy, T-S and P-V Diagrams

**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.

Atmospheric air - Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, , Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation ,Psychrometric chart.

**UNIT - V**

**Power Cycles:** Otto, Diesel cycles - Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis

**Refrigeration Cycles:** Bell-Coleman cycle, Vapour compression cycle-performance Evaluation.

**TEXT BOOKS:**

1. Basic Engineering Thermodynamics / PK Nag / Mc Graw Hill
2. Engineering Thermodynamics / chattopadhyay/ Oxford

**REFERENCE BOOKS:**

1. Thermodynamics for Engineers / Kenneth A. Kroos , Merle C. Potter/ Cengage
2. Thermodynamics /G.C. Gupta /Pearson

**B.TECH. MECHANICAL ENGINEERING**
**RELIABILITY ENGINEERING**
**(Open Elective - III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T/P/D C** |
| **Course Code**: **ME834OE/AM852PE/EI862PE** | **3 0/0/0 3** |

**Prerequisite:** Mathematics III

**Course Objectives:**
- To introduce the basic concepts of reliability, various models of reliability
- To analyze reliability of various systems
- To introduce techniques of frequency and duration for reliability evaluation of repairable systems.

**Course Outcomes:** After completion of this course, the student will be able to
- model various systems applying reliability networks
- evaluate the reliability of simple and complex systems
- estimate the limiting state probabilities of repairable systems
- apply various mathematical models for evaluating reliability of irrepairable systems

**UNIT – I**
**Basic Probability Theory:** Elements of probability, probability distributions, Random variables, Density and Distribution functions- Binomial distribution- Expected value and standard deviation - Binomial distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution.
**Definition of Reliability:** Definition of terms used in reliability, Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Hazard models - Bath tub curve, Effect of preventive maintenance. Measures of reliability: Mean Time to Failure and Mean Time Between Failures.

**UNIT – II**
**Network Modeling and Evaluation Of Simple Systems:** Basic concepts- Evaluation of network Reliability / Unreliability - Series systems, Parallel systems- Series-Parallel systems- Partially redundant systems- Examples.
**Network Modeling and Evaluation of Complex systems**: Conditional probability method- tie set, Cutset approach- Event tree and reduced event tree methods- Relationships between tie and cutsets- Examples.

**UNIT – III**
**Time Dependent Probability:** Basic concepts- Reliability function f(t). F(t), R(t) and h(t) - Relationship between these functions.

**Network Reliability Evaluation Using Probability Distributions:** Reliability Evaluation of Series systems, Parallel systems – Partially redundant systems- determination of reliability measure- MTTF for series and parallel systems – Examples.

**UNIT – IV**

**Discrete Markov Chains:** Basic concepts- Stochastic transitional probability matrix- time dependent probability evaluation- Limiting State Probability evaluation- Absorbing states – Examples

**Continuous Markov Processes**: Modeling concepts- State space diagrams- Unreliability evaluation of single and two component repairable systems

**UNIT – V**

**Frequency and Duration Techniques:** Frequency and duration concepts, application to multi state problems, Frequency balance approach.

**Approximate System Reliability Evaluation:** Series systems – Parallel systems- Network reduction techniques- Cut set approach- Common mode failures modeling and evaluation techniques- Examples.

**TEXT BOOKS:**

1. Roy Billinton and Ronald N Allan, Reliability Evaluation of Engineering Systems, Plenum Press, 1983.
2. E. Balagurusamy, Reliability Engineering by Tata McGraw-Hill Publishing Company Limited, 2002.

**REFERENCE BOOK:**

1. K. K. Agarwal, Reliability Engineering-Kluwer Academic Publishers, 1993**.**

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)**
**FABRICATION PROCESSES**
**(Open Elective - I)**

| | |
|---|---|
| **B.Tech. III Year I Sem.** | **L T P C** |
| **Course Code: NT511OE** | **3 0 0 3** |

**Course Objectives:** Understand the philosophies of various Manufacturing process.

**Course Outcomes:** For given product, one should be able identify the manufacturing process.

**UNIT – I**
**Casting:** Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances and their construction; Properties of moulding sands.
Methods of Melting - Crucible melting and cupola operation – Defects in castings;
Casting processes – Types – Sand moulding, Centrifugal casting, die- casting, Investment casting, shell moulding; Principles of Gating – Requirements – Types of gates, Design of gating systems – Riser – Function, types of Riser and Riser design.

**UNIT – II**
**Welding:** Classification – Types of welds and welded joints; Gas welding - Types, oxy-fuel gas cutting. Arc welding, forge welding, submerged arc welding, Resistance welding, Thermit welding.
Inert Gas Welding - TIG Welding, MIG welding, explosive welding, Laser Welding; Soldering and Brazing; Heat affected zone in welding. Welding defects – causes and remedies; destructive and non- destructive testing of welds.

**UNIT – III**
Hot working, cold working, strain hardening, recovery, recrystallisation, and grain growth.
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 – IV**
**Extrusion of Metals:** Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion and pipe making, Hydrostatic extrusion. Forces in extrusion

**UNIT – V**

**Forging Processes:** Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging – Forging hammers : Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.

**TEXT BOOKS:**

1. Manufacturing Technology / P.N. Rao / Mc Graw Hill
2. Manufacturing Engineering and Technology/Kalpakjin S/ Pearson.

**REFERENCE BOOKS:**

1. Metal Casting / T. V Ramana Rao / New Age
2. Métal Fabrication Technology/ Mukherjee/PHI

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)**
**NON DESTRUCTIVE TESTING METHODS**
**(Open Elective - I)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year I Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: NT512OE** | **3** | **0** | **0** | **3** |

**Course overview:** The aim is to introduce students the overview of the non destructive testing methods of materials. The course covers NDE, Ultrasonic, MPI testing of metal parts. It gives an idea about selection of the testing criteria. It briefly describe the thermo-graph and radio graph methods of testing and provide selection properties for different tests.

**Course Objectives:** This course has the basic idea of the properties of steal and ferrous metals. The objectives aim to:

- Identify the basic methods of testing.
- Understand the concept of non destructive testing.
- Describe the various types of NDT tests carried out on components.
- Describe ultrasonic method of testing the materials.
- Analyze the different types of test carried out on components and surfaces.
- Understand the properties of materials suitable for NDT test.
- Understand the radiography uses in engineering.

**Course Outcomes:** At the end of the course the students are able to:

- Identify the requirements of testing criteria as per material composition.
- Understand the theory of non destructive testing methods is used.
- Determine the type of requirement of non destructive test.
- Distinguish between the various NDT test as Ultrasonic and Eddy current methods.
- Understand the properties of radiation used in engineering.
- Describe the various types of non destructive test used to determine the surface cracks.

**UNIT - I**

**Overview of NDT -** NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, various physical characteristics of materials and their applications in NDT, Visual inspection.

**UNIT - II**

**Surface NDE Methods:** Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

**UNIT - III**

**Thermography and Eddy Current Testing** - Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

**UNIT - IV**

**Ultrasonic Testing and Acoustic Emission -** Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique IV Principle, AE parameters, Applications

**UNIT - V**

**Radiography -** Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

**TEXT BOOKS:**

1. Baldev Raj, T. Jayakumar, M. Thavasimuthu, Practical Non-Destructive Testing¡¨, Narosa Publishing House, 2009.
2. Ravi Prakash, Non-Destructive Testing Techniques¨, 1st revised edition, New Age International Publishers, 2010

**REFERENCES:**

1. ASM Metals Handbook, ¨Non-Destructive Evaluation and Quality Control¨, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Paul E Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005
3. Charles, J. Hellier, Handbook of Non-destructive evaluation”, McGraw Hill, New York 2001.

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)**
**FUNDAMENTALS OF ENGINEERING MATERIALS**
**(Open Elective - I)**

| | |
|---|---|
| **B.Tech. III Year I Sem.** | **L T P C** |
| **Course Code: NT513OE** | **3 0 0 3** |

**Course Overview:**
The aim is to introduce students the overview of the properties of materials used in engineering manufacturing process. The course covers basic concept of ferrous, non-ferrous metals and its alloys. It emphasizes on transformation of iron at various temperatures. It briefly describes the heat treatment given to iron and its alloys. It gives the general overview idea of composite materials.

**Course Objectives:** This course has the basic idea of the properties of steal and ferrous metals. The objectives aim to:
- Identify the basic crystalline structure of steal.
- Understand the concept of TTT.
- Describe the various heat treatment methods to obtain the desired properties.
- Describe the composition of carbon contents in steel.
- Analyze the different forms of iron obtained during heating of steel.
- Understand the properties of non-ferrous alloys.
- Understand requirement.

**Course Outcomes:** At the end of the course the students are able to:
- This subject gives student a technical knowledge about behavior of metals.
- Identify the crystalline structure of steel.
- Understand the theory of time temperature and transformation.
- Determination of different uses of heat treatment in steel.
- Distinguish between the various forms of steel.
- Understand the properties of non-ferrous alloys.
- Describe the various uses of composite materials.

**UNIT – I**
**Structure of Metals**: Crystallography, Miller’s indices, Packing Efficiency, Density calculations. Grains and Grain Boundaries. Effect of grain size on the properties. Determination of grain size by different methods. Constitution of Alloys: Necessity of alloying, Types of solid solutions, Hume - Rothery rules, Intermediate alloy phases.

**UNIT –II**
**Phase Diagrams**: Construction and interpretation of phase diagrams, Phase rule. Lever rule. Binary phase Diagrams, Isomorphous, Eutectic and Eutectoid transformations with examples.

**UNIT – III**

**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.

**UNIT – IV**

**Cast Irons**: Structure and properties of White Cast iron, Malleable Cast iron, Grey cast iron. Engineering Materials-III: Non-ferrous Metals and Alloys: Structure and properties of copper and its alloys, Aluminium and its alloys, Al-Cu phase diagram, Titanium and its alloys.

**UNIT – V**

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

**TEXT BOOKS:**

1. Material Science and Metallurgy/ Kodgire
2. Essentials of Materials Science and engineering / Donald R. Askeland / Thomson.

**REFERENCE BOOKS:**

1. Introduction to Physical Metallurgy / Sidney H. Avner.
2. Materials Science and engineering / William and callister.
3. Elements of Material science / V. Rahghavan

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)**
**INTRODUCTION TO MATERIALS HANDLING**
**(Open Elective – II)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: NT621OE** | **3** | **0** | **0** | **3** |

**Course Overview**

Course covers a systems approach to managing activities associated with traffic, transportation, inventory management, warehousing, packaging, order processing, and materials handling. This course is designed to give students a comprehensive understanding of the issues involved in the design of an industrial production system. It will cover the problems in plant location, product analysis, process design, equipment selection, materials handling, and plant layout.

**Course Objectives:**

- To develop competency for system visualization and design.
- To enable student to design cylinders and pressure vessels and to use IS code.
- To enable student select materials and to design internal engine components.
- To introduce student to optimum design and use optimization methods to design mechanical components.
- To enable student to design machine tool gearbox.
- To enable student to design material handling systems.
- Ability to apply the statistical considerations in design and analyze the defects and failure modes in

**Course Outcomes:**

- Demonstrate ability to successfully complete Fork Lift Certification to safely and effectively operate in the manufacturing environment.
- Demonstrate proficiency in supply chain operations, utilizing appropriate methods to plan and implement processes necessary for the purchase and conveyance of goods in a timely and cost-effective manner
- It explains about the different types of material handling, advantages and disadvantages. It also suggests the selection procedure for the material handling along with its specifications.
- Need for Material handling also explained with different techniques like Automated Material handling Design Program, Computerized material handling Planning will be dealt.
- The Material handling is explained with models, selection procedure of material handling is depending on different function oriented systems. This also related with plant layout by which the minimization of the handling charges will come down.
- The ergonomics related to material handling equipment about design and miscellaneous equipments.

**UNIT – I**

Types of intraplant transporting facility, principal groups of material handling equipments, choice of material handling equipment, hoisting equipment, screw type, hydraulic and pneumatic conveyors, general characteristics of hoisting machines, surface and overhead equipments, general characteristics of surface and overhead equipments and their applications. Introduction to control of hoisting equipments.

**UNIT – II**

Flexible hoisting appliances like ropes and chains, welded load chains, roller chains, selection of chains hemp rope and steel wire rope, selection of ropes, fastening of hain sand ropes , different types of load suspension appliances, fixed and movable pulleys, different types of pulley systems, multiple pulley systems . Chain and rope sheaves and sprockets.

**UNIT – III**

Load handling attachments, standard forged hook, hook weights, hook bearings, cross piece and casing of hook, crane grab for unit and piece loads, carrier beams and clamps, load platforms and side dump buckets, electric lifting magnets, grabbing attachments for loose materials, crane attachments for handling liquid materials.

**UNIT – IV**

Arresting gear, ratchet type arresting gear, roller ratchet, shoe brakes and its different types like electromagnetic, double shoe type, thruster operated, controller brakes, shoe brakes, thermal calculations of shoe brakes and life of linings, safety handles, load operated constant force and variable force brakes general theory of band brakes, its types and construction.

**UNIT – V**

Different drives of hosting gears like individual and common motor drive for several mechanisms, traveling gear, traveling mechanisms for moving trolleys and cranes on runway rails, mechanisms for trackless, rubber-tyred and crawler cranes motor propelled trolley hoists and trolleys, rails and traveling wheels, slewing, jib and luffing gears. Operation of hoisting gear during transient motion, selecting the motor rating and determining braking torque for hoisting mechanisms, drive efficiency calculations, selecting the motor rating and determining braking torque for traveling mechanisms, slewing mechanisms, jib and luffing mechanisms. (Elementary treatment is expected)

**TEXT BOOKS:**

1. Materials Handling Equipment – N. Rudenko , Envee Publishers, New Delhi
2. Materials Handling Equipment – M.P. Alexandrov. Mie publications, Moscow

**REFERENCE BOOKS:**

1. Aspects of Material handling - Arora
2. Introduction to Material Handling- Ray
3. Plant Layout and Material Handling- Chowdary RB

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)**
**NON-CONVENTIONAL ENERGY SOURCES**
**(Open Elective – II)**

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T P C** |
| **Course Code: NT622OE** | **3 0 0 3** |

**Course Overview:**
Non Conventional resources include solar energy, wind, falling water, the heat of the earth (geothermal), plant materials (biomass), waves, ocean currents, temperature differences in the oceans and the energy of the tides. Non Conventional energy technologies produce power, heat or mechanical energy by converting those resources either to electricity orto motive power. The policy maker concerned with development of the national grid system will focus on those resources that have established themselves commercially and are cost effective for on grid applications. Such commercial technologies include hydroelectric power, solar energy, fuels derived from biomass, wind energy and geothermal energy. Wave, ocean current, ocean thermal and other technologies that are in the research or early commercial stage, as well as non-electric Non Conventional energy technologies, such as solar water heaters and geothermal heat pumps, are also based on Non Conventional resources, but outside the scope of this Manual.

**Course Objectives:**
- Graduates will demonstrate the ability to use basic knowledge in mathematics, science and engineering and apply them to solve problems specific to mechanical engineering (Fundamental engineering analysis skills).
- Graduates will demonstrate the ability to design and conduct experiments, interpret and analyze data, and report results (Information retrieval skills).
- Graduates should be capable of self-education and clearly understand the value of life-long learning (Continuing education awareness).
- Graduates will develop an open mind and have an understanding of the impact of engineering on society and demonstrate awareness of contemporary issues (Social awareness).
- Graduate will be able to design a system to meet desired needs within environmental, economic, political, ethical health and safety, manufacturability and management knowledge and techniques to estimate time, resources to complete project (Practical engineering analysis skills).

**Course Outcomes:**
- Introduction to Renewable Energy Sources, Principles of Solar Radiation, Different Methods of Solar Energy Storage and its Applications, Concepts of Solar Ponds, Solar Distillation and Photo Voltaic Energy Conversion

- Introduction to Flat Plate and Concentrating Collectors ,Classification of Concentrating Collectors
- Introduction to Wind Energy, Horizontal and Vertical Access Wind Mills, Bio-Conversion
- Types of Bio-Gas Digesters and Utilization for Cooking Geothermal Energy Resources
- Types of Wells and Methods of Harnessing the Energy, Ocean Energy and Setting of OTEC Plants
- Tidal and Wave Energy and Mini Hydel Power Plant, Need and Principles of Direct Energy Conversion
- Concepts of Thermo-Electric Generators and MHD Generators

**UNIT - I**

Statistics on conventional energy sources and supply in developing countries, Definition-Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES. Classification of NCES - Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources, comparison of these energy sources.

**UNIT - II**

Solar Energy-Energy available form Sun, Solar radiation data, Solar energy conversion into heat, Flat plate and Concentrating collectors, Mathematical analysis of Flat plate collectors and collector efficiency, Principle of Natural and Forced convection, Solar engines-Stirling, Brayton engines, Photovoltaic, p-n junction, solar cells, PV systems, Stand-alone, Grid connected solar power satellite.

**UNIT - II**

Wind energy conversion, General formula -Lift and Drag- Basis of wind energy conversion -Effect of density, frequency variances, angle of attack, and wind speed. Windmill rotors-Horizontal axis and vertical axis rotors. Determination of torque coefficient, Induction type generators- working principle.

**UNIT - IV**

Nature of Geothermal sources, Definition and classification of resources, Utilization for electric generation and direct heating, Well Head power generating units, Basic features-Atmospheric exhaust and condensing, exhaust types of conventional steam turbines.

Pyrolysis of Biomass to produce solid, liquid and gaseous fuels, Biomass gasification, Constructional details of gasifier, usage of biogas for chulhas, various types of chulhas for rural energy needs.

**UNIT - V**

Wave, Tidal and OTEC energy- Difference between tidal and wave power generation, Principles of tidal and wave power generation, OTEC power plants, Operational of small cycle experimental facility, Design of 5 Mw OTEC pro-commercial plant, Economics of OTEC, Environmental impacts of OTEC. Status of multiple product OTEC systems.

**TEXT BOOKS:**


1. Ashok V Desai, Non-Conventional Energy, Wiley Eastern Ltd, New Delhi, 2003
2. K M, Non-Conventional Energy Systems, Wheeler Publishing Co. Ltd, New Delhi, 2003.


**REFERENCE BOOKS:**


1. Ramesh R & Kumar K U, *Renewable Energy Technologies,* Narosa Publishing House, New Delhi, 2004
2. Wakil MM, *Power Plant Technology,* Mc Graw Hill Book Co, New Delhi, 2004.
3. Non - Conventional Energy Sources. Rai

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)**
**ROBOTICS**
**(Open Elective – II)**

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T P C** |
| **Course Code: NT623OE** | **3 0 0 3** |

**Pre-requisites:** Basic principles of Kinematics and mechanics

**Course Objectives:** The goal of the course is to familiarize the students with the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, and incorporate robotic technology in engineering systems.

- Make the students acquainted with the theoretical aspects of Robotics
- Enable the students to acquire practical experience in the field of Robotics through design projects and case studies.
- Make the students to understand the importance of robots in various fields of engineering.
- Expose the students to various robots and their operational details.

**Course Outcomes:** At the end of the course, the student will be able to understand the basic components of robots. Differentiate types of robots and robot grippers. Model forward and inverse kinematics of robot manipulators. Analyze forces in links and joints of a robot. Programme a robot to perform tasks in industrial applications. Design intelligent robots using sensors.

**UNIT – I**

**Introduction:** Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications.

**Components of the Industrial Robotics:** common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

**UNIT – II**

**Motion Analysis:** Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems.

**Manipulator Kinematics**-H notation-H method of Assignment of frames-H Transformation Matrix, joint coordinates and world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulation.

**UNIT – III**

Differential transformation of manipulators, Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion – straight line motion.

**UNIT IV**

**Robot actuators and Feedback components:**

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors.

**UNIT V**

**Robot Application in Manufacturing:**

Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

**TEXT BOOKS:**

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson

**REFERENCE BOOKS:**

1. Robot Dynamics and Controls / Spony and Vidyasagar / John Wiley
2. Robot Analysis and control / Asada , Slotine / Wiley Inter-Science

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)**
**CONCEPTS OF NANO SCIENCE AND TECHNOLOGY**
(**Open Elective - III**)

| | | | | |
|---|---|---|---|---|
| **B.Tech. IV Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: NT831OE** | **3** | **0** | **0** | **3** |

**Course Objectives:**

- Beginners will be able to acquaint themselves with the excited subject though they are novice, whereas advanced learners will equip themselves to solve the complicated issues further.
- To know the importance of the synthesis method addressed in the material properties and give practical experience of nanomaterials synthesis/properties and characterization; investigations into the various factors influence the properties of nanomaterials, optimizing the procedures, and implementations to the new designs
- To provide a sound understanding of the various concepts involved in fabrication of device architectures' and able to evaluate them in advance

**Course Outcome:** The intended course covers the whole spectrum of nanomaterials ranging from introduction, classification, synthesis, properties, and characterization tools of nanophase materials to application including some new developments in various aspects.

**UNIT - I**

**Introduction to Nano:** Importance, Definition and scope, Nano size, challenges, applications. Electrons**,** Other Materials**,** Nano magnetism as a case study; Fundamental terms (Physics & Chemistry) in nano-science and technology; Feynman's perspective; Scaling laws pertaining to mechanics, optics, electromagnetism; Importance of Quantum mechanics, statistical mechanics and chemical kinetics in nano-science and technology;

**UNIT - II**

**Classification of nano materials:** Scientific basis for top-down and bottom-up approaches to synthesize Nanomaterials; How to characterize Nanomaterials?

**UNIT - III**

**Tools for Nanoscience and Technology:** Tools for measuring properties of Nanostructures, Tools to Make Nanostructures. Nano scale Bio-structures, modelling

**UNIT - IV**

**Nano-Biotechnology**: Bio-molecules; Biosensors; Nanomaterials in drug delivery; Working in clean room environments; Safety and related aspects of Nanomaterials;

**UNIT – V**

**Carbon Nanomaterials and Applications:** Carbon Nano structures and types of Carbon Nano tubes, growth mechanisms of carbon nanotubes. Carbon clusters and Fullerenes, Lithium & Hydrogen adsorption & storages, Fuel cell applications and energy storage, Chemical Sensors applications of CNTs

**TEXT BOOKS AND REFERENCES:**

1. Textbook of Nanoscience and Nanotechnology – B. S. Murthy, P. Shankar, Baldev Raj, B. B. Rath and James Murday, University Press-IIM Series in Metallurgy and Materials Science.
2. A Textbook of Nanoscience and Nanotechnology – T. Pradeep, Tata McGraw Hill edition.
3. Nanotechnology Fundamentals and Applications- by Manasi Karkare I. K International
4. Nanoscience and Nanotechnology in engineering – by Vijay K Varadan A Sivathanu pillai Word scientific
5. Nanotechnology Applications To Telecommunications And Networking By Daniel Minoli, Wiley Interscience
6. Nanotechnology Principles and Applications by Sulabha Kulkarni

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)**
**SYNTHESIS OF NANOMATERIALS**
(**Open Elective - III**)

| | L | T | P | C |
|---|---|---|---|---|
| **B.Tech. IV Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: NT832OE** | **3** | **0** | **0** | **3** |

**Course Objectives:**

- To provide knowledge about top-down and bottom-up approaches for the synthesis of nanomaterials.
- To enhance the various nanosynthesis techniques and to identify and solve problems
- To design and conduct experiments relevant to nanochemistry, as well as to analyze the results.
- To improve usage of synthesis methods for modern technology

**Course Outcome:** To provide abundant knowledge on various synthesis methods of nanomaterials.

**UNIT - I**
Introduction, Bottom-up approach: Sol-gel method, emulsion and Top-down: ball milling approach with examples.

**UNIT - II**
Physical methods: Inert gas condensation, Arc discharge, plasma synthesis, electric explosion of wires, molecular beam epitaxy, Physical Vapour Deposition, thermal evaporation, lithography and sputtering.

**UNIT - III**
Chemical methods: Nanocrystals by chemical reduction, photochemical synthesis, electrochemical synthesis, co-precipitation method. Semiconductor nanocrystals by arrested precipitation, sonochemical routes

**UNIT - IV**
Biological methods – use of bacteria, fungi, actinomycetes for nano-particle synthesis nano-particles Solvated metal atom dispersion, Template based synthesis of nanomaterials.

**UNIT - V**
Thermolysis route - spray pyrolysis, solvothermal and hydrothermal routes, solution combustion synthesis, Chemical vapor deposition

**TEXTBOOKS:**

1. Textbook of Nanoscience and Nanotechnology – B. S. Murthy, P. Shankar, Baldev Raj, B. B .Rath and James Murday, University Press-IIM Series in Metallurgy and Materials Science.
2. A Textbook of Nanoscience and Nanotechnology – T. Pradeep, Tata McGraw Hill edition.
3. Nanostructures and Nanomaterials by Guozhong Cao
4. Inorganic Materials Synthesis and Fabrication by J.N. Lalena, D.A. Cleary, E.E. Carpenter, N.F. Dean, John Wiley & Sons Inc.
5. Introduction to Nano Technology by Charles P. Poole Jr and Frank J. Owens. Wiley India Pvt Ltd.
6. The Chemistry of nanomaterials: Synthesis, Properties and Applications, Vol-I by C.N.R. Rao, A. Muller and A.K. Cheetham
7. The Physics of Micro/Nano- Fabrication by Ivor Brodie and Julius J.Muray

**REFERENCE BOOKS:**

1. Encyclopedia of Nanotechnology by M. Balakrishna Rao and K. Krishna Reddy, Vol I to X, Campus books.
2. Encyclopedia of Nanotechnology by H.S. Nalwa
3. Nano: The Essentials – Understanding Nano Science and Nanotechnology – by T. Pradeep, Tata McGraw Hill

**B.TECH. MECHANICAL ENGINEERING (MATERIAL SCIENCE AND NANOTECHNOLOGY)**
**CHARACTERIZATION OF NANOMATERIALS**
(**Open Elective - III**)

| | | | | |
|---|---|---|---|---|
| **B.Tech. IV Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: NT833OE** | **3** | **0** | **0** | **3** |

**Course Objectives:**

- To develop ability to understand modern characterization techniques especially utilized to probe in nanoscopic regime
- To elucidate on application of standard spectroscopy, microscopy techniques for element analysis, structure analysis, depth profiling, topography imaging, as well as surface and interface analysis
- To provide overview of principles underlying the characterization methods and basic theory for analysis of the data obtained from the instrument
- The objective of this course is to make the students understand the principles underlying various spectroscopies and instrumentations specific to nanomaterials

**UNIT - I**

**Fundamentals of Electron Microscopy:** Advantages of Electron Microscope over Optical Microscope (Magnification, Resolution, Depth of field). Theory and principle of Electron Microscope, Electron sources, Electron lenses (Electrostatic and Electromagnetic).

**UNIT - II**

**Scanning Electron Microscopy: SEM**: Theory of operation, Specimen-Beam interactions Importance of beam spot size, Machine variables, Scanning Electron Microscope (SEM). **Specimen Preparation in SEM**: Special methods for various sample types – Biological sample preparation, Applications of SEM

**UNIT - III**

**Transmission Electron Microscopy: TEM**: Theory of operation, Modes of operation, Transmission Electron Microscope (TEM),Bright field Imaging, Electron diffraction, Dark field imaging, High Resolution TEM (HRTEM), Applications of TEM.

**UNIT - IV**

**Atomic Force Microscopy:** AFM: Basic concepts – Interactive forces, Principle and instrumentation, Force curves and force measurements, Modes of imaging: Tapping, contact and non-contact, Probes, Tip functionalization,

**UNIT - V**

**X-Ray Diffraction and Spectroscopic methods:**

X-ray diffraction–Powder method, Single crystal diffraction technique -Determination of crystal strucures – Nanostructural analysis – Profile analysis (peak broadening and micro strain) – Crystallite size analysis using Scherer formula and Williamson – Hall equation. UV Spectroscopy, IR Spectroscopy and Raman Spectroscopy

**TEXT BOOKS:**

1. Nanotechnology: Principles and Practices – Sulabha K. Kulkarni – Capital Publishing Company
2. 2. Nano: The Essentials – Understanding Nanoscience and Nanotechnology by T. Pradeep. Tata McGraw Hill
3. 3. Introduction to Nano Technology by Charles. P. Poole Jr and Frank J. Owens, Wiley India Pvt Ltd.
4. A practical approach to X-Ray diffraction analysis by C. Suryanarayana

**REFERENCES:**

1. Haynes. R, Woodruff. D. P. and Talchar, T.A., optical Microscopy of Materials Cambridge University press, 1986.
2. Flegler, S.L., Heckman, J.W. and Klomparens, K.L., scanning and Transmission Electron Microscopy: A Introduction WH Freeman & Co, 1993.
3. Paul E. West, introduction to Atomic Force Microscopy Theory Practice Applications
4. Julian Chen N, C., introduction to Scanning Tunneling Microscopy, Oxford University Press, Inc., 1993.
5. Magonov, S.M., and Whangbo, M-H., surface Analysis with STM and AFM: Experimental and Theoretical Aspects of Image Analysis VCH Publishers, Inc., New York 1996.
6. Goldstein, J., Newbury, D.E., Joy, D.C., and Lym, C.E., scanning Electron Microscopy and X-ray Microanalysis, 2003.

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**
**ANALOG AND DIGITAL IC APPLICATIONS**
**(OPEN ELECTIVE – I)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year I Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: MT511OE** | **3** | **0** | **0** | **3** |

**UNIT - I**

**Integrated Circuits :** Classification, chip size and circuit complexity, basic information of Op amp, ideal and practical Op-amp, internal circuits, Op-amp characteristics, DC and AC characteristics, 741 op-amp and its features, modes of operation-inverting, non-inverting, differential.

**OP-AMP Applications**: Basic application of Op-amp, instrumentation amplifier, ac amplifier, V to I and I to V converters, sample & hold circuits, multipliers and dividers, Differentiators and Integrators, Comparators.

**UNIT - II**

Schmitt trigger, Multivibrators, introduction to voltage regulators, features of 723.

**Active Filters & Oscillators:** Introduction, 1st order LPF, HPF filters. Band pass, Band reject, and all pass filters. Oscillator types and principle of operation – RC, Wien, and quadrature type, waveform generators – triangular, saw tooth, square wave and VCO.

**UNIT - III**

**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.

**D-A and A- D Converters** : Introduction, basic DAC techniques, weighted resistor DAC, R-2R ladder DAC, inverted R-2R DAC, and IC 1408 DAC, Different types of ADCs - parallel comparator type ADC, counter type ADC, successive approximation ADC and dual slope ADC. DAC and ADC specifications.

**UNIT - IV**

Classification of Integrated circuits, comparison of various logic families, standard TTL NAND Gate- Analysis& characteristics, TTL open collector O/Ps, Tristate TTL, MOS & CMOS open drain and tristate outputs, CMOS transmission gate, IC interfacing- TTL driving CMOS & CMOS driving TTL.

Design using TTL-74XX & CMOS 40XX series, code converters, decoders, Demultiplexers, decoders, & drives for LED & LCD display. Encoder, priority Encoder, multiplexers, & their applications, priority generators/checker circuits. Digital arithmetic circuits-parallel binary adder/subtractor circuits using 2’s, Complement system. Digital comparator circuits.

**UNIT - V**

**Sequential Circuits:** Flip-flops & their conversions. Design of synchronous counters. Decade counter, shift registers, & applications, familiarities with commonly available 74XX & CMOS 40XX series of IC counters.

**Memories:** ROM architecture, types, & applications, RAM architecture, Static & Dynamic RAMs, synchronous DRAMs.

**TEXT BOOKS:**

1. Linear Integrated Circuits –D. Roy Choudhury, New Age International (p) Ltd, 2nd Ed., 2003.
2. Op-Amps & Linear ICs – Ramakanth A. Gayakwad, PHI, 1987.

**REFERENCES:**

1. Operational Amplifiers & Linear Integrated Circuits – R.F. Coughlin & Fredrick F. Driscoll, PHI, 1977.
2. Operational Amplifiers & Linear Integrated Circuits: Theory & Applications –Denton J. Daibey, TMH.
3. Design with Operational Amplifiers & Analog Integrated Circuits-Sergio Franco, McGraw Hill, 3rd Ed., 2002.
4. Digital Fundamentals – Floyd and Jain, Pearson Education, 8th Edition, 2005.

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**
**INTELLECTUAL PROPERTY RIGHTS**
**(Open Elective – I)**

| | |
|---|---|
| **B.Tech. III Year I Sem.** | **L T P C** |
| **Course Code: MT512OE** | **3 0 0 3** |

**UNIT – I**

Introduction to Intellectual property: Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

**UNIT – II**

Trade Marks: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting, and evaluating trade mark, trade mark registration processes.

**UNIT – III**

Law of copy rights : Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Law of patents: Foundation of patent law, patent searching process, ownership rights, and transfer

**UNIT – IV**

Trade Secrets: Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

**UNIT – V**

New development of intellectual property: new developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international – trade mark law, copy right law, international patent law, and international development in trade secrets law.

**TEXT BOOKS & REFERENCES:**

1. Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
2. Intellectual property right – Unleashing the knowledge economy, prabuddha ganguli, Tata Mc Graw Hill Publishing company ltd.,

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**
**COMPUTER ORGANIZATION**
**(Open Elective – I)**

| | |
|---|---|
| **B.Tech. III Year I Sem.** | **L T P C** |
| **Course Code: MT513OE** | **3 0 0 3** |

**Course Objectives:**

- To understand basic components of computers.
- To understand the architecture of 8086 processor.
- To understand the instruction sets, instruction formats and various addressing modes of 8086.
- To understand the representation of data at the machine level and how computations are performed at machine level.
- To understand the memory organization and I/O organization.
- To understand the parallelism both in terms of single and multiple processors.

**Course Outcomes:**

- Able to understand the basic components and the design of CPU, ALU and Contr**ol** Unit.
- Ability to understand memory hierarchy and its impact on computer cost/performance.
- Ability to understand the advantage of instruction level parallelism and pipelining for high performance Processor design.
- Ability to understand the instruction set, instruction formats and addressing modes of 8086.
- Ability to write assembly language programs to solve problems.

**UNIT - I**

**Digital Computers:** Introduction, Block diagram of Digital Computer, Definition of Computer Organization, Computer Design and Computer Architecture.

**Basic Computer Organization and Design:** Instruction codes, Computer Registers, Computer instructions, Timing and Control, Instruction cycle, Memory Reference Instructions, Input – Output and Interrupt, Complete Computer Description.

**Micro Programmed Control:** Control memory, Address sequencing, micro program example, design of control unit.

**UNIT - II**

**Central Processing Unit:** The 8086 Processor Architecture, Register organization, Physical memory organization, General Bus Operation, I/O Addressing Capability, Special Processor Activities, Minimum and Maximum mode system and timings.

8086 Instruction Set and Assembler Directives-Machine language instruction formats, Addressing modes, Instruction set of 8086, Assembler directives and operators.

**UNIT - III**

Assembly Language Programming with 8086- Machine level programs, Machine coding the programs, Programming with an assembler, Assembly Language example programs.
Stack structure of 8086, Interrupts and Interrupt service routines, Interrupt cycle of 8086, Interrupt programming, Passing parameters to procedures, Macros, Timings and Delays.

**UNIT - IV**

**Computer Arithmetic:** Introduction, Addition and Subtraction, Multiplication Algorithms, Division Algorithms, Floating - point Arithmetic operations.
**Input-Output Organization:** Peripheral Devices**,** Input-Output Interface, Asynchronous data transfer, Modes of Transfer, Priority Interrupt, Direct memory Access, Input –Output Processor (IOP),Intel 8089 IOP.

**UNIT - V**

**Memory Organization:** Memory Hierarchy, Main Memory, Auxiliary memory, Associate Memory, Cache Memory.
**Pipeline and Vector Processing:** Parallel Processing, Pipelining, Arithmetic Pipeline, Instruction Pipeline, RISC Pipeline, Vector Processing, Array Processors.
**Multi Processors:** Characteristics of Multiprocessors, Interconnection Structures, Inter processor arbitration, Inter processor communication, and synchronization.

**TEXT BOOKS:**

1. Computer System Architecture, M. Moris Mano, Third Edition, Pearson. **(UNITS- I , IV , V)**
2. Advanced Microprocessors and Peripherals, K M Bhurchandi, A.K Ray ,3rd edition, McGraw Hill India Education Private Ltd. **(UNITS - II, III).**

**REFERENCES:**

1. Microprocessors and Interfacing, D V Hall, SSSP Rao, 3rd edition, McGraw Hill India Education Private Ltd.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky: Computer Organization, 5th Edition, Tata McGraw Hill, 2002
3. Computer Organization and Architecture, William Stallings, 9th Edition, Pearson.
4. David A. Patterson, John L. Hennessy: Computer Organization and Design – The Hardware / Software Interface ARM Edition, 4th Edition, Elsevier, 2009.

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**
**DATA STRUCTURES**
**(Open Elective – II)**

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T P C** |
| **Course Code: EM614PE/MT621OE** | **3 0 0 3** |

**Course Objectives:**

- To understand the basic concepts such as Abstract Data Types, Linear, and Non Linear Data structures.
- To understand the notations used to analyze the Performance of algorithms.
- To understand the behavior of data structures such as stacks, queues, trees, hash tables, search trees, Graphs and their representations.
- To choose the appropriate data structure for a specified application.
- To understand and analyze various searching and sorting algorithms.
- To write programs in C to solve problems using data structures such as arrays, linked lists, stacks, queues, trees, graphs, hash tables, search trees.

**Course Outcomes:**

- Learn how to use data structure concepts for realistic problems.
- Ability to identify appropriate data structure for solving computing problems in respective language.
- Ability to solve problems independently and think critically.

**UNIT - I**

Basic concepts- Algorithm Specification-Introduction, Recursive algorithms, Data Abstraction Performance analysis- time complexity and space complexity, Asymptotic Notation-Big O, Omega, and Theta notations, Introduction to Linear and Non Linear data structures.

Singly Linked Lists-Operations-Insertion, Deletion, Concatenating singly linked lists, circularly linked lists-Operations for Circularly linked lists, Doubly Linked Lists- Operations- Insertion, Deletion.

Representation of single, two dimensional arrays, sparse matrices-array and linked representations.

**UNIT - II**

Stack ADT, definition, operations, array and linked implementations in C, applications-infix to postfix conversion, Postfix expression evaluation, recursion implementation, Queue ADT, definition and operations ,array and linked Implementations in C, Circular queues-Insertion and deletion operations, Deque (Double ended queue)ADT, array and linked implementations in C.

**UNIT - III**

Trees – Terminology, Representation of Trees, Binary tree ADT, Properties of Binary Trees, Binary Tree Representations-array and linked representations, Binary Tree traversals, threaded binary trees, Max Priority Queue ADT-implementation-Max Heap-Definition, Insertion into a Max Heap, Deletion from a Max Heap.

Graphs – Introduction, Definition, Terminology, Graph ADT, Graph Representations-Adjacency matrix, Adjacency lists, Graph traversals - DFS and BFS.

**UNIT - IV**

Searching - Linear Search, Binary Search, Static Hashing-Introduction, hash tables, hash functions, Overflow Handling. Sorting-Insertion Sort, Selection Sort, Radix Sort, Quick sort, Heap Sort, Comparison of Sorting methods.

**UNIT - V**

Search Trees-Binary Search Trees, Definition, Operations- Searching, Insertion and Deletion, AVL Trees-Definition and Examples, Insertion into an AVL Tree ,B-Trees, Definition, B-Tree of order m, operations-Insertion and Searching, Introduction to Red-Black and Splay Trees(Elementary treatment-only Definitions and Examples), Comparison of Search Trees.

Pattern matching algorithm- The Knuth-Morris-Pratt algorithm, Tries (examples only).

**TEXT BOOKS:**

1. Fundamentals of Data structures in C, 2nd Edition, E. Horowitz, S. Sahni and Susan Anderson-Freed, Universities Press.
2. Data structures A Programming Approach with C, D. S. Kushwaha and A.K. Misra, PHI.

**REFERENCE BOOKS:**

1. Data structures: A Pseudo code Approach with C, 2nd edition, R. F. Gilberg And B. A. Forouzan, Cengage Learning.
2. Data structures and Algorithm Analysis in C, 2nd edition, M. A. Weiss, Pearson.
3. Data Structures using C, A.M. Tanenbaum, Y. Langsam, M. J. Augenstein, Pearson.
4. Data structures and Program Design in C, 2nd edition, R. Kruse, C. L. Tondo and B. Leung, Pearson.
5. Data Structures and Algorithms made easy in JAVA, 2nd Edition, Narsimha Karumanchi, Career Monk Publications.
6. Data Structures using C, R. Thareja, Oxford University Press.
7. Data Structures, S. Lipscutz, Schaum's Outlines, TMH.
8. Data structures using C, A. K. Sharma, 2nd edition, Pearson..
9. Data Structures using C & C++, R. Shukla, Wiley India.
10. Classic Data Structures, D. Samanta, 2nd edition, PHI.
11. Advanced Data structures, Peter Brass, Cambridge.

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**
**ARTIFICIAL NEURAL NETWORKS**
**(Open Elective – II)**

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T P C** |
| **Course Code: MT622OE** | **3 0 0 3** |

**Course Objectives:**

- To understand the biological neural network and to model equivalent neuron models.
- To understand the architecture, learning algorithm and issues of various feed forward and feedback neural networks.

**Course Outcomes:** By completing this course the student will be able to:

- Create different neural networks of various architectures both feed forward and feed backward.
- Perform the training of neural networks using various learning rules.
- Perform the testing of neural networks and do the perform analysis of these networks for various pattern recognition applications.

**UNIT - I**

**Introduction**: A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks

**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 - II**

**Single Layer Perceptron**: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment

**Multilayer Perceptron**: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection

**UNIT - III**

**Back Propagation:** Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues, and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning

**UNIT - IV**

**Self-Organization Maps (SOM):** Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification

**UNIT - V**

**Neuro Dynamics:** Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a Recurrent Network Paradigm

**Hopfield Models –** Hopfield Models, Computer Experiment

**TEXT BOOKS:**

1. Neural Networks a Comprehensive Foundations, Simon Haykin, PHI edition.

**REFERENCE BOOKS:**


1. Artificial Neural Networks - B. Yegnanarayana Prentice Hall of India P Ltd 2005
2. Neural Networks in Computer Inteligance, Li Min Fu TMH 2003
3. Neural Networks -James A Freeman David M S Kapura Pearson Education 2004.
4. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**
**INDUSTRIAL MANAGEMENT**
**(Open Elective – II)**

| **B.Tech. III Year II Sem.** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| **Course Code: MT623OE** | **3** | **0** | **0** | **3** |

**UNIT - I**

**Introduction to Management:** Entrepreneurship and organization - Nature and Importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management

**UNIT - II**

**Designing Organizational Structures:** Departmentation and Decentralization, Types of Organization structures - Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

**UNIT - III**

**Operations Management:** Objectives- product design process- Process selection-Types of production system (Job, batch and Mass Production),-Plant location-factors- Urban-Rural sites comparison- Types of Plant Layouts-Design of product layout- Line balancing(RPW method)

Value analysis-Definition-types of values- Objectives- Phases of value analysis- Fast diagram

**UNIT - IV**

**Work Study:** Introduction – definition – objectives – steps in work study – Method study – definition – objectives – steps of method study. Work Measurement – purpose – types of study – stop watch methods – steps – key rating – allowances – standard time calculations – work sampling.

**Statistical Quality Control:** variables-attributes, Shewart control charts for variables- $\overline{X}$ chart, R chart, - Attributes-Defective-Defect- Charts for attributes-p-chart -c chart (simple Problems), Acceptance Sampling- Single sampling- Double sampling plans-OC curves.

**UNIT - V**

**Job Evaluation**: methods of job evaluation – simple routing objective systems – classification method – factor comparison method – point method – benefits of job evaluation and limitations.

**Project Management (PERT/CPM):** Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (simple problems)

**TEXT BOOKS:**

1. Industrial Engineering and Management/O.P. Khanna/Khanna Publishers
2. Industrial Engineering and Management Science/T.R. Banga and S. C. Sarma/Khanna Publishers

**REFERENCE BOOKS:**

1. Motion and Time Study by Ralph M Barnes/ John Willey & Sons Work Study by ILO
2. Human factors in Engineering & Design/Ernest J McCormick / TMH
3. Production & Operation Management /Paneer Selvam /PHI
4. Industrial Engineering Management/NVS Raju/Cengage Learning
5. Industrial Engineering Hand Book /Maynard
6. Industrial Engineering Management / Ravi Shankar/ Galgotia

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**
**RENEWABLE ENERGY SOURCES**
**(Open Elective – III)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. IV Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: MT831OE/ME853PE** | **3** | **0** | **0** | **3** |

**Course Objectives:**

- To explain the concepts of Non-renewable and renewable energy systems
- To outline utilization of renewable energy sources for both domestic and industrial applications
- To analyse the environmental and cost economics of renewable energy sources in comparison with fossil fuels.

**Course Outcomes:**

- Understanding of renewable energy sources
- Knowledge of working principle of various energy systems
- Capability to carry out basic design of renewable energy systems

**UNIT-I**

**Global and National Energy Scenario:** Over view of conventional & renewable energy sources, need & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, $CO_2$ reduction potential of renewable energy- concept of Hybrid systems.

**UNIT-II**

**Solar Energy:** Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Applications Solar Photovoltaic Conversion solar photovoltaic, solar thermal, applications of solar energy systems.

**UNIT-III**

**Wind Energy:** Wind Energy Conversion, Potential, Wind energy potential measurement, Site selection, Types of wind turbines, Wind farms, wind Generation and Control. Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind energy – Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices. Wind mill component design, economics and demand side management, energy wheeling, and energy banking concepts. Safety and environmental aspects, wind energy potential and installation in India.

**UNIT-IV**

**Biogas:** Properties of biogas (Calorific value and composition), biogas plant technology and status, Bio energy system, design and constructional features. Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass, bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

**UNIT-V**

**Ocean Energy:** Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development of tidal energy.

3. **Small hydro Power Plant:** Importance of small hydro power plants and their Elements, types of turbines for small hydro, estimation of primary and secondary power.
4. **Geothermal Energy**: Geothermal power plants, various types, hot springs and steam ejection.

**REFERENCE BOOKS:**

5. Non-Conventional Energy Sources by G.D Rai
6. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986.
7. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
8. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**
**PRODUCTION PLANNING AND CONTROL**
**(Open Elective – III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T P C** |
| **Course Code: MT832OE/ME854PE** | **3 0 0 3** |

**Pre-requisites:** Management Science & Productivity.

**Course Objectives**: Understand the importance of Production planning & control. Learning way of carrying out various functions it so as to produce right product, right quantity at right time with minimum cost.

**Course Outcomes:** At the end of the course, the student will be able to, Understand production systems and their characteristics. Evaluate MRP and JIT systems against traditional inventory control systems. Understand basics of variability and its role in the performance of a production system. Analyze aggregate planning strategies. Apply forecasting and scheduling techniques to production systems. Understand theory of constraints for effective management of production systems.

**UNIT – I**
**Introduction**: Definition – Objectives of Production Planning and Control – Functions of production planning and control - Types of production systems - Organization of production planning and control department.
**Forecasting** – Definition- uses of forecast- factors affecting the forecast- types of forecasting- their uses - general principle of forecasting. Forecasting techniques- quantitative and qualitative techniques. Measures of forecasting errors.

**UNIT – II**
**Inventory management** – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – Basic EOQ model- Inventory control systems –continuous review systems and periodic review systems, MRP I, MRP II, ERP, JIT Systems - Basic Treatment only. **Aggregate planning –** Definition – aggregate-planning strategies – aggregate planning methods – transportation model.

**UNIT – III**
**Line Balancing**: Terminology, Methods of Line Balancing, RPW method, Largest Candidate method and Heuristic method.
Routing – Definition – Routing procedure – Factors affecting routing procedure, Route Sheet.

**UNIT – IV**
**Scheduling** –Definition – Scheduling Policies – types of scheduling methods – differences with loading – flow shop scheduling **–** job shop scheduling, line of balance (LOB) – objectives - steps involved.

**UNIT – V**

**Dispatching**: Definition – activities of dispatcher – dispatching procedures – various forms used in dispatching.

**Follow up**: definition – types of follow up – expediting – definition – expediting procedures- Applications of computers in planning and control.

**TEXT BOOKS:**

1. Operations management – Heizer- Pearson.
2. Production and Operations Management / Ajay K Garg / Mc Graw Hill.

**REFERENCE BOOKS:**

1. Production Planning and Control- Text & cases/ SK Mukhopadhyaya /PHI.
2. Production Planning and Control- Jain & Jain – Khanna publications

**B.TECH. MECHANICAL ENGINEERING (MECHATRONICS)**
**ENTREPRENEURSHIP AND SMALL BUSINESS ENTERPRISES**
**(Open Elective – III)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. IV Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: CE833OE** | **3** | **0** | **0** | **3** |

**Course Objective:** The aim of this course is to have a comprehensive perspective of inclusive learning, ability to learn and implement the Fundamentals of Entrepreneurship.

**Course Outcome:** It enables students to learn the basics of Entrepreneurship and entrepreneurial development which will help them to provide vision for their own Start-up.

**Unit – 1: Entrepreneurial Perspectives:**
Evolution, Concept of Entrepreneurship, Types of Entrepreneurs, Entrepreneurial Competencies, Capacity Building for Entrepreneurs.
Entrepreneurial Training Methods; Entrepreneurial Motivations; Models for Entrepreneurial Development, The process of Entrepreneurial Development.

**Unit – 2: New Venture Creation:**
Introduction, Mobility of Entrepreneurs, Models for Opportunity Evaluation; Business plans – Purpose, Contents, Presenting Business Plan, Procedure for setting up Enterprises, Central level - Startup and State level - T Hub, Other Institutions initiatives.

**Unit – 3: Management of MSMEs and Sick Enterprises**
Challenges of MSMEs, Preventing Sickness in Enterprises – Specific Management Problems; Industrial Sickness; Industrial Sickness in India – Symptoms, process and Rehabilitation of Sick Units.

**Units – 4: Managing Marketing and Growth of Enterprises:**
Essential Marketing Mix of Services, Key Success Factors in Service Marketing, Cost and Pricing, Branding, New Techniques in Marketing, International Trade.

**Units – 5: Strategic perspectives in Entrepreneurship:**
Strategic Growth in Entrepreneurship, The Valuation Challenge in Entrepreneurship, The Final Harvest of New Ventures, Technology, Business Incubation, India way – Entrepreneurship; Women Entrepreneurs – Strategies to develop Women Entrepreneurs, Institutions supporting Women Entrepreneurship in India.

**TEXT BOOKS:**

1. Entrepreneurship Development and Small Business Enterprises, Poornima M.Charantimath, 2e, Pearson, 2014.
2. Entrepreneurship, A South – Asian Perspective, D.F.Kuratko and T.V.Rao, 3e, Cengage, 2012.

**REFERENCES:**

1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
2. The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2015.

**B.TECH. METALLURGICAL AND MATERIALS ENGINEERING**
**MATERIAL CHARACTERIZATION TECHNIQUES**
**(OPEN ELECTIVE –I)**

| | |
|---|---|
| **B.Tech. III Year I Sem.** | **L T P C** |
| **Course Code: MM511OE** | **3 0 0 3** |

**Course Objective:** This course is intended to give an exposure to evaluation of special characteristics of materials (Structural, Mechanical & Thermal etc.) in order to understand their suitability in Engineering Applications

**Course Outcome:** At the end of the course the student will be able to characterize, identify, and apply the material to the concerned application.

**UNIT-I**
**X-Ray Diffraction:** Introduction, Production and properties of x-rays, Bragg's law of diffraction. Experimental Methods of Diffraction, Intensity of Diffracted beams - Scattering by an electron by an atom, by a unit cell, structure-factor calculations; factors affecting Diffraction Intensities.
**Application of XRD:** Orientation of single crystals, Effect of plastic deformation, the structure of polycrystalline Aggregates, Determination of crystal structure, Precise lattice parameter measurements, Phase - diagram determination, Order-disorder transformation, Chemical analysis by Diffraction, Stress measurement

**UNIT-II**
**Elements of Quantitative Metallography and Image Processing.**
**Scanning Electron Microscopy:** Principle, Interaction of electron beams with matter, Construction and Working principle Scanning Electron Microscopy, Working Distance, Depth of field, Depth of focus and Spot Size, Specimen preparation for Scanning Electron Microscopy, Different types of modes used in Scanning Electron Microscopy (Secondary Electron and Backscatter Electron) and their applications, Advantages, limitations and applications of Scanning Electron Microscopy, Electron Backscattered Diffraction.

**UNIT-III**
**Transmission Electron Microscopy:** Principle, Construction and Working principle of Transmission Electron Microscopy, Resolving power and Magnification, Depth of field and Depth of focus, Bright and dark field, Specimen preparation for the Transmission Electron Microscopy: Selected Area Diffraction, Applications of Transmission Electron Microscopy, Advantage and Limitations of Transmission Electron Microscopy.

**UNIT-IV**

**Spectroscopy – Energy Dispersive Spectroscopy, Wavelength Dispersive Spectroscopy,** Electron Probe Microanalyzer**,**

**UNIT-V**

Principles, Instrumentation, operation and application of thermal analysis, Thermogravimetric Analysis, TGA, Differential Scanning Calorimetry, Differential thermal analysis**,** Dynamic Mechanical Analysis, Dialatometry.

**TEXT BOOKS:**

1. Material Characterization: Introduction to Microscopic and Spectroscopic Methods – Yang Leng – John Wiley & Sons (Asia) Pvt. Ltd. 2008
2. Microstructural Characterization of Materials - David Brandon, Wayne D Kalpan, John Wiley & Sons Ltd., 2008.

**REFERENCES:**

1. Fundamentals of Molecular Spectroscopy – IV Ed. – Colin Neville Banwell and Elaine M. McCash, Tata McGraw-Hill, 2008.
2. Elements of X-ray diffraction – Bernard Dennis Cullity & Stuart R Stocks, Prentice Hall , 2001 – Science

**B.TECH. METALLURGICAL AND MATERIALS ENGINEERING**
**SCIENCE AND TECHNOLOGY OF NANO MATERIALS**
**(OPEN ELECTIVE - II)**

| | | | | |
|---|---|---|---|---|
| **B.Tech. III Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: MM621OE** | **3** | **0** | **0** | **3** |

**Course Objective:** This course is intended to expose the students to the most exciting area of nano materials. This would emphasize the classification, synthesis and applications of these materials.

**Course Outcome:** The student will be able to design a component/material that would provide us a 'better tomorrow' via nanotechnology.

**UNIT-I**
Introduction: History and Scopy, classification of nanostructural materials, Applications, Challenges and future prospects

**UNIT-II**
Unique properties of nano-materials, microstrucutre and defects in nano-crystalline materials, effect of nano-dimension on material behaviours

**UNIT-III**
Synthesis Routes: Bottom up approaches, top down approaches, consolidation of nano-powders.

**UNIT-IV**
Application of nano-materials: Nano-electronics, Micro and Nano-electromechanical systems, nano-sensors, Nano-catalyst, Structure and engineering, Automotive, Nano-medical, water and environment treatment, energy, defence and space, textile and paints**.**

**UNIT-V**
Nanostructured materials with high application potential: Quantum dots, Carbon nanotubes, GaN Nanowires, Nanocrystalline Zno, Nanocrystalline $Tio_2$, Multilayered films

**TEXT BOOKS:**

1. Text book of Nano Science and Technology: B S Murthy, Universities press-IIM series in Metallurgy and Material Sciene
2. Nano Essentials: T Pradeep / TMH


**REFERENCES:**

1. Springer Handbook of Nanotechnology
2. Nano Materials Synthersis, Properties and applications, 1996 Edlstein and Cammarate.
3. Nano Materials A.K. Bandyopadyay/ New age Publications

**B.TECH. METALLURGICAL AND MATERIALS ENGINEERING**
**METALLURGY FOR NON METALLURGISTS**
**(OPEN ELECTIVE - II)**

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T P C** |
| **Course Code: MM622OE** | **3 0 0 3** |

**Course Objectives:**
- To describe the basic principles of metallurgy and the importance of metallurgy in various discipline of engineering.
- Gain a thorough knowledge about heat treatment of steels.
- Gain knowledge about properties and uses of cast irons and non ferrous metals.
- Gain a working knowledge of basic testing methods for metals.

**Course Outcomes:** At the end of the course Student would be able
- To use and apply metallurgy in his own branch of engineering.
- The student will be able to justify the various testing methods adopted for metals.

**UNIT-I**
**Introduction:** Crystal structure and defects, Crystal structure of metals, Classification of steels, Carbon steels

**UNIT-II**
**Heat Treatment of Steels:** The Iron carbon systems, Common phases in steels, Annealing, Normalizing, Hardening and tempering

**UNIT-III**
**Cast irons:** Properties and applications of Ductile irons, Malleable irons, Compacted graphite iron.

**UNIT-IV**
**Non Ferrous Metals:** Properties and applications of Light Metals (Al, Be, Mg, Ti), Super alloys

**UNIT-V**
**Testing of Metals:** Hardness testing, Tensile Testing, Impact Testing, Fatigue Testing.

**TEXT BOOKS:**

1. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007
2. Introduction to Physical Metallurgy – SH Avner, TATA Mc GRAW HILL ,1997
3. Mechanical Metallurgy – G. E. Dieter

**REFERENCES:**


1. Engineering Physical Metallurgy and Heat treatment – Y Lakhtin
2. C. Suryanarayana, Experimental Techniques in Mechanics and Materials, John Wiley, John Wiley, NJ, USA, 2006
3. Foundations of Materials Science and Engineering – WF Smith

# B.TECH. METALLURGICAL AND MATERIALS ENGINEERING
# DESIGN AND SELECTION OF ENGINEERING MATERIALS
# (OPEN ELECTIVE - III)

| | | | | |
|---|---|---|---|---|
| **B.Tech. IV Year II Sem.** | **L** | **T** | **P** | **C** |
| **Course Code: MM831OE** | **3** | **0** | **0** | **3** |

**Course Objective:** This course aims at making student to understand and design a material for a given application considering the composition, manufacturing process and properties that are required in service.

**Course Outcome:** Understand the Relationship between materials selection, processing and applications.

**UNIT-I**
**Materials selection process:** Criteria for selection of materials

**UNIT-II**
**Effect of composition, processing and structure on materials properties:** Concepts in the design of industrial components

**UNIT-III**
**Properties vs Performance materials:** Aerospace and defense applications: design and alloy based on LCF, TMF, Creep fatigue interaction, hot corrosion resistance, role of DBTT for Naval applications, Intermetallics, Aluminides

**UNIT-IV**
**Nuclear Material: Manufacturing aspects of design**
Nuclear application: radiation damage, effect of radiation damage on YS, UTS, DBTT, design of alloy for fission and fusion reactors

**UNIT-V**
**Special Materials: Manufacturing aspects of design**
Selection and design of ceramics composites and polymers for specific applications,

**TEXT BOOKS**

1. M.F. Ashby, Materials Selection in Mechanical Design, Pergamon Press, 1992
2. G.E. Dieter, Engineering Design, A Materials and Processing Approach, 2nd ed., McGraw-Hill, 1991

**REFERENCES**

1. T.H. Courtney, *Mechanical Behavior of Materials,* McGraw-Hill, 1990
2. J.R. Dixon and C. Poli, *Engineering Design and Design for Manufacturing,* Field Stone Publishers, 1995

**B.TECH. MINING ENGINEERING**
**INTRODUCTION TO MINING TECHNOLOGY**
**(Open Elective - I)**

| | |
|---|---|
| **B.Tech. III Year I Sem** | **L T P C** |
| **Course Code: MN511OE** | **3 0 0 3** |

**Course Objectives:** The student is expected to learn the fundamentals of mining engineering so as to encourage multi-disciplinary research and application of other branches of engineering to mining technology.

**Course Outcomes:** Upon completion of the course, the student shall be able to understand various stages in the life of the mine, drilling , blasting and 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.

**TEXT BOOKS:**
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. C. P. Chugh, Drilling technology handbook, Oxford and IBH, 1st Ed, 1977.
2. R. D. Singh, Principles and practices of modern coal mining, New age international, 1st Ed, 1997.

**B.TECH. MINING ENGINEERING**
**COAL GASIFICATION, COAL BED METHANE AND SHALE GAS**
**(Open Elective - II)**

| | |
|---|---|
| **B.Tech. III Year II Sem** | **L T P C** |
| **Course Code: MN621OE** | **3 0 0 3** |

**Course Objectives**: To specialize the students with additional knowledge on geological and technological factors of coal gasification industry mining methods of underground coal gasification, linkage techniques etc.

**Course Outcomes**; Student can get specialized in the underground coal gasification concepts, application and future scope in various geomining conditions.

**UNIT-I**
Underground Coal Gasification (UCG) Concept; Chemistry, conditions suitable for UCG, Principles of UCG., Merits and Demerits.

**UNIT-II**
UCG Process Component factors: Technology of UCG, opening up of coal seam for UCG.

**UNIT-III**
Mining methods of UCG: Chamber method, Stream method, Borehole procedure method, Blind bore hole method.

**UNIT-IV**
Non-Mining methods of UCG: Level seams, Inclined seams.

**UNIT-V**
Linkage Techniques: Pekcolation linkage, Electro linkage, Boring linkage, compressed-air-linkage, Hydraulic fracture linkage. Future Scope and Development: Innovations.

**TEXT BOOKS:**
1. Underground Coal Mining Methods – J.G. SINGH
2. Winning and Working Coal in India Vol.II- R. T. Deshmukh and D.J.Deshmukh.

**REFERENCE BOOK:**
1. Principles and Practices of Modern Coal Mining – R.D. SINGH

**B.TECH. MINING ENGINEERING**
**SOLID FUEL TECHNOLOGY**
**(Open Elective - III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem** | **L T P C** |
| **Course Code: MN831OE** | **3 0 0 3** |

**Pre-requisites**: Under graduate Physics and Chemistry

**Course Objectives**: Understand coal formation, properties, and their evaluation along with various issues of coal washing

**Course Outcomes:** Students can understand the fundamentals of
Processes of formation of coal, properties and evaluation and coal preparation and washability characteristics of coal

**UNIT-I**
Introduction: Processes of formation of coal, Theories of origin of coal, Eras of coal formation, Indian Coalfields and its subsidiaries: Occurrence and distribution, coal bearing formations, coal type and rank variation, Characteristics of major coalfields, Coal production from different sectors.

**UNIT-II**
Coal petrography: Macro and micro lithotypes, Composition of macerals, application of coal petrography, Mineral matter in coal: Origin and chemical composition, Impact of mineral matter in coal process industry.

**UNIT-III**
Coal properties and their evaluation: proximate and ultimate analysis, calorific value, crossing and ignition point temperature, plastic properties (free swelling index, Caking index, Gray King Low Temperature Assay, Roga index, plastometry, dilatometry).

**UNIT-IV**
Physical properties like specific gravity, hard groove grindability index, heat of wetting, crossing point temperature of coal, Behavior of coal at elevated temperatures and products of thermal decomposition, Classification of coal - International and Indian classification, grading of Indian coals.

**UNIT-V**
Coal Washing: Principles, objectives, coal preparation, washability characteristics; Selection, testing, storage and utilization of coking and non-coking coal, Use of coal by different industries.

**TEXT BOOKS:**


1. S. Sarkar, Fuels and Combustion, Orient Longman Private Ltd., 2nd edition, 1990
2. O. P. Gupta, Elements of Fuels, Furnaces and Refractories, Khanna Publication, 3rd Edition, 1996.


**REFERENCE BOOKS:**


1. M. A. Elliot, Chemistry of Coal Utilization, Wiley, 1981.
2. D. Chandra, R. M. Singh, and M. P. Singh, Text Book of Coal, Tara Book Agency, 2000.

**B.TECH. MINING ENGINEERING**
**HEALTH AND SAFETY IN MINES**
**(Open Elective - III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem** | **L T P C** |
| **Course Code: MN832OE** | **3 0 0 3** |

**Course Objectives:** To brief mining students in health and safety engineering concepts, causes of accident, training, human behavioral approach in safety etc.

**Course Outcomes:** student will gain knowledge and able to understand the importance of health and safety including the role of safety risk assessment in mining industry

**UNIT-I**
Introduction to accidents, prevention, health and safety in industry : Terminology, reason for preventing accidents – moral and legal.
Safety scenario in Indian mines, Accidents in Indian mines, Measurement of safety performance. Classification of accidents as per Mining legislation/law and general classification of accidents.

**UNIT-II**
Causes and preventive measures of accidents in underground and opencast mines i.e., due to fall of roof and sides, transportation of machinery, haulage and winding, drilling and blasting, movement of machinery in opencast mines and electricity etc., ; accident analysis and report, cost of accidents, statistical analysis of accidents and their importance for promotion of safety.

**UNIT-III**
System engineering approach to safety, techniques used in safety analysis, generic approach to loss control within mining operations. Concept of ZAP and MAP.

**UNIT-IV**
Risk management, Risk identification, Risk estimation and evaluation, Risk minimization techniques in mines. Risk analysis using FTA, HAZOP, ETA etc; health risk assessment and occupational diseases in mining.

**UNIT-V**
Development of safety consciousness, publicity and propaganda for safety; training of workmen, Human Behavioral approach in safety, safety polices and audio-visual aids, safety drives campaigns, safety audit. Safety management and organization; Internal safety organization

**TEXT BOOKS:**

1. Occupational Safety and Health in Industries and Mines by C.P. Singh
2. S.K. Das, Mine Safety and Legislation. Lovely Prakashan, Dhanbad, 2002

**REFERENCE BOOKS:**

1. N.J. Bahr, System Safety Engineering, and Risk Assessment: A Practical Approach, Taylor and Francis, NY, 1997.
2. Indian Mining Legislation – A Critical Appraisal by Rakesh & Prasad

**B.TECH. PETROLEUM ENGINEERING**
**MATERIALS SCIENCE AND ENGINEERING**
**(Open Elective - I)**

| | |
|---|---|
| **B.Tech. III Year I Sem.** | **L T/P/D C** |
| **Course Code**: **PE511OE** | **3 0/0/0 3** |

**Course Objectives:** This subject is intended to:
- Provide all the technical/engineering inputs to the learner to choose or select suitable materials of construction of chemical/petrochemical process equipment, piping and internals.
- Import expertise to the material so that it meets the specific life expectancy, by reducing the shutdown frequency.
- Learn the techniques in minimizing equipment breakdown and increasing the on-stream factor.
- To gain knowledge in choosing/selecting the material such that it withstands the severe process operating conditions such as cryogenic, high temperature, high pressure, acidic, basic, stress induced chemical/petrochemical environments keeping view the reliability and safety of the process equipment.

**Course Outcome:** After the course, the students will be to
- Equipped with knowledge to prepare material selection diagram, evaluation of equipment life and prediction of life of the equipment.
- Acquiring the abilities to carryout reliability studies.
- Ready to carryout equipment failure analysis and propose the remedial measures.

**UNIT - I**
Classification of engineering materials, Levels of Structure, Structure-Property relationships in materials, Crystal Geometry and non-crystalline(amorphous) states. Lattice –Bravais lattices, crystal systems with examples. Lattice co-ordinates, Miller and Miller- Bravais Indices for directions and places: ionic, covalent and metallic solids; packing factors and packing efficiency, ligancy and coordination number. Structure determination by Brag’s X-ray diffraction method.

**UNIT - II**
Crystal Imperfections-classification-point defects-estimation of point defects-Dislocations-classification(edge and screw)-surface defects -dislocation motion and its relevance to mechanical and chemical properties –stress-strain relationship and diagrams for different materials(metals, non-metals, rubbers and plastics and polymers)-elastic and plastic deformation-slip -stress required to move a dislocation. Multiplication of dislocations –dislocation reactions, effect on mechanical behavior of materials. Strain hardening/work hardening –dynamic recovery and recrystallization.

**UNIT - III**

Fracture and failure of materials: ductile fracture analysis-brittle fracture analysis-fracture toughness-ductile-brittle transition-fatigue fracture-theory, creep and mechanism –methods to postpone the failure and fracture of materials and increase the life of the engineering components /structures.

**UNIT - IV**

Solid –liquid and solid-solid Equilibria for metals and alloys. Phase rule-phase diagram for pure metals (single component system),alloys(binary systems)-micro structural changes during cooling-Lever rule and its applications-typical phase diagrams-homogeneous and heterogeneous systems, formation of Eutectic, Eutectoid mixtures- non-equilibrium cooling. Binary Systems(phase diagrams) for study: Cu-Ni/Bi-Cd/Pb-Sn/ Fe-C /Al-Cu

Materials for chemical and petrochemical industrial process equipment- Effect of alloying on mechanical and chemical behavior of materials, applications of heat treatment methods for strengthening of engineering materials.

**UNIT - V**

Composite structures and their advantages over conventional materials–Matrix-reinforcement properties and evaluation of strength properties with different orientation of reinforcement-applications –Nano materials –synthesis and characterization.

Stability criteria of materials in chemical/petrochemical industrial environments. Corrosion and Oxidation of materials –basic mechanisms-types of corrosion, Corrosion testing and evaluation Prevailing methods to combat corrosion. Coatings –metallic non-metallic, passivity, cathodic protection.

**TEXT BOOKS:**

1. Materials Science and Engineering, Raghavan, V., 5th Edition, PHI, New Delhi, 2009.
2. Material Science and Engineering, Ravi Prakash, William F. Smith, and Javed Hashemi, 4th Edition, Tata-McGraw Hill, 2008.

**REFERENCE BOOKS:**

1 Elements of Material Science and Engineering, Lawrence H. Van Vlack, 6th Edition, Pearson, 2002.
2 Materials Science and Engineering, Balasubramaniam, R., Callister's, Wiley, 2010.
3. Corrosion Engineering, Mars G. Fontana, Tata-McGraw Hill, 2005.

**B.TECH. PETROLEUM ENGINEERING**
**RENEWABLE ENERGY SOURCES**
**(Open Elective - I)**

| | |
|---|---|
| **B.Tech. III Year I Sem.** | **L T/P/D C** |
| **Course Code**: **PE512OE** | **3 0/0/0 3** |

**Course Objectives:**
- To explain the concepts of Non-renewable and renewable energy systems
- To outline utilization of renewable energy sources for both domestic and industrial applications
- To analyse the environmental and cost economics of renewable energy sources in comparison with fossil fuels.

**Course Outcomes:**
- Understanding of renewable energy sources
- Knowledge of working principle of various energy systems
- Capability to carry out basic design of renewable energy systems

**UNIT-I**
**Global and National Energy Scenario:** Over view of conventional & renewable energy sources, need & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, $CO_2$ reduction potential of renewable energy- concept of Hybrid systems.

**UNIT-II**
**Solar Energy:** Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Applications Solar Photovoltaic Conversion solar photovoltaic, solar thermal, applications of solar energy systems.

**UNIT-III**
**Wind Energy:** Wind Energy Conversion, Potential, Wind energy potential measurement, Site selection, Types of wind turbines, Wind farms, wind Generation and Control. Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind energy – Hybrid systems, wind resource assessment, Betz limit, site selection, wind energy conversion devices. Wind mill component design, economics and demand side management, energy wheeling, and energy banking concepts. Safety and environmental aspects, wind energy potential and installation in India.

**UNIT-IV**

**Biogas:** Properties of biogas (Calorific value and composition), biogas plant technology and status, Bio energy system, design and constructional features. Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass, bio diesel production, Urban waste to energy conversion, Biomass energy programme in India.

**UNIT-V**

**Ocean Energy:** Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal power plants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development of tidal energy.

1. **Small hydro Power Plant:** Importance of small hydro power plants and their Elements, types of turbines for small hydro, estimation of primary and secondary power.
2. **Geothermal Energy**: Geothermal power plants, various types, hot springs and steam ejection.

**REFERENCE BOOKS:**


1. Non-Conventional Energy Sources by G.D Rai
2. Twidell, J.W. and Weir, A., Renewable Energy Sources, EFN Spon Ltd., 1986.
3. Kishore VVN, Renewable Energy Engineering and Technology, Teri Press, New Delhi, 2012
4. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K, 1996.

**B.TECH. PETROLEUM ENGINEERING**
**ENVIRONMENTAL ENGINEERING**
**(Open Elective - I)**

| | |
|---|---|
| **B.Tech. III Year I Sem.** | **L T/P/D C** |
| **Course Code**: **PE513OE** | **3 0/0/0 3** |

**Course Objectives:** This subject provides the knowledge of water sources, water treatment, design of distribution system waste water treatment, and safe disposal methods. The topics of characteristics of waste water, sludge digestion are also included.

**Course Outcomes:** At the end of the course, the student will be able to:

- Analyze characteristics of water and wastewater
- Estimate the quantity of drinking water and domestic wastewater generated
- Design components of water supply systems Design sewerage system

**UNIT – I**

Introduction: Waterborne diseases – protected water supply – Population forecasts, design period – types of water demand – factors affecting – fluctuations – fire demand – water quality and testing – drinking water standards: sources of water - Comparison from quality and quantity and other considerations – intakes – infiltration galleries.

**UNIT – II**

Layout and general outline of water treatment units – sedimentation – principles – design factors – coagulation-flocculation clarifier design – coagulants - feeding arrangements. Filtration – theory – working of slow and rapid gravity filters – multimedia filters – design of filters – troubles in operation - comparison of filters – disinfection – theory of chlorination, chlorine demand - other disinfection practices- Miscellaneous treatment methods.

**UNIT – III**

Distribution systems requirement –method and layouts -Design procedures- Hardy Cross and equivalent pipe methods pipe – joints, valves such as sluice valves, air valves, scour valves and check valves water meters – laying and testing of pipe lines – pump house - Conservancy and water carriage systems – sewage and storm water estimation – time of concentration – storm water overflows combined flow

**UNIT - IV**

characteristics of sewage – cycles of decay – decomposition of sewage, examination of sewage – B.O.D. Equation – C.O.D. Design of sewers – shapes and materials – sewer appurtenances manholes – inverted siphon – catch basins – flushing tanks – ejectors, pumps and pump houses – house drainage – components requirements – sanitary fittings-traps – one pipe and two pipe systems of plumbing – ultimate disposal of sewage – sewage farming – dilution.

**UNIT – V**

Waste water treatment plant – Flow diagram - primary treatment Design of screens – grit chambers – skimming tanks – sedimentation tanks – principles of design – Biological treatment – trickling filters – standard and high rate – Construction and design of oxidation ponds. Sludge digestion – factors effecting – design of Digestion tank – Sludge disposal by drying – septic tanks working principles and design – soak pits.

**TEXT BOOKS:**

1. Environmental Engineering by H.S Peavy, D. R. Rowe, G. Tchobanog lous, McGraw Hill Education (India) Pvt Ltd, 2014
2. Environmental Engineering by D. P. Sincero and G.A Sincero, Pearson 2015.
3. Water Supply & Environmental Engineering by A.K. Chatterjee.
4. Water Supply and sanitary Engineering by G.S. Bindi, Dhanpat Rai & Sons Publishers.

**REFERENCES:**

1. Water and Waste Water Technology by Steel, Wiley
2. Waste water engineering by Metcalf and Eddy, McGraw Hill, 2015.
3. Water and Waste Water Engineering by Fair Geyer and Okun, Wiley, 2011
4. Water and Waste Water Technology by Mark J Hammar and Mark J. Hammar Jr.Wiley, 2007.

**B.TECH. PETROLEUM ENGINEERING**
**ENERGY MANAGEMENT AND CONSERVATION**
**(Open Elective - II)**

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T/P/D C** |
| **Course Code**: **PE621OE** | **3 0/0/0 3** |

**Course Objectives**: To acquaint the student with the conventional energy sources and their utilization. To understand the importance of heat recovery and energy conservation methods and energy audit.

**Course Outcomes:** Students would have a good knowledge about conventional energy sources and their audit. Ability to apply the fundamentals of energy conservation and management.

**UNIT-I**
Global & Indian Energy Scenario-Classification of Energy sources-Energy needs of growing economy-Energy sector reform, Energy and Environment: Global Environmental Concerns , Basics of Energy and its various forms.

**UNIT-II**
Energy Audit**:** Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments. Material and Energy balance**:** Facility as an energy system, Methods for preparing process flow, Material and energy balance diagrams,

**UNIT-III**
Energy Action Planning, Financial Management**:** Financial analysis techniques- Risk and sensitivity analysis- Financing options, Energy performance contracts and role of ESCOs-Energy Monitoring and Targeting**:** Elements of monitoring & targeting, Data and information-analysis, Techniques -energy consumption, Production, Cumulative sum of differences (CUSUM).

**UNIT-IV**
Building Envelope – principles of analysis – Envelope performance -Envelope analysis of Existing and new buildings – Building standards for new and Existing constructions.
HVAC Systems types – Energy conservation opportunities – cooling equipment – Domestic hot water Estimating HVAC Energy consumption.

**UNIT-V**
Principles of Electric Energy Management, Energy Management control systems – Energy systems maintenance. Energy management in water and waste water treatment – solid waste treatment- air pollution control systems .

Energy Management in Boilers and Fired systems – Steam and condensate systems – cogeneration – Waste Heat recovery. Energy Management in Process Industries, Energy Security, Codes, Standards, Electricity Act, Energy Conservation Act.

**TEXT BOOKS:**

1. Energy Management by Murfy
2. General Aspects of Energy Management and Audit, National Productivity Council of India, Chennai (Course Material- National Certification Examination for Energy Management)

**REFERENCE BOOKS:**

1. Energy Management Handbook, W.C. Turner, 5th Edition, Marcel Dekker, Inc, New York, 2005.
2. Guide to Energy Management, B. L. Capehart, W. C. Turner, W. J. Kennedy, CRC Press, New York, 2005.
3. Energy Management by O.P. Collagan

**B.TECH. PETROLEUM ENGINEERING**
**OPTIMIZATION TECHNIQUES**
**(Open Elective - II)**

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T/P/D C** |
| **Course Code**: **PE622OE** | **3 0/0/0 3** |

**Prerequisite:** Mathematics –I & Mathematics –II

**Course Objectives:**
- To introduce various optimization techniques i.e classical, linear programming, transportation problem, simplex algorithm, dynamic programming
- Constrained and unconstrained optimization techniques for solving and optimizing an electrical and electronic engineering circuits design problems in real world situations.
- To explain the concept of Dynamic programming and its applications to project implementation.

**Course Outcomes:** After completion of this course, the student will be able to
- explain the need of optimization of engineering systems
- understand optimization of electrical and electronics engineering problems
- apply classical optimization techniques, linear programming, simplex algorithm, transportation problem
- apply unconstrained optimization and constrained non-linear programming and dynamic programming
- Formulate optimization problems.

**UNIT – I**
**Introduction and Classical Optimization Techniques:** Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.
**Classical Optimization Techniques:** Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints.
Solution by method of Lagrange multipliers – Multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

**UNIT – II**
**Linear Programming:** Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm.

**Transportation Problem:** Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems.

**UNIT – III**

**Unconstrained Nonlinear Programming:** One dimensional minimization methods, Classification, Fibonacci method and Quadratic interpolation method

**Unconstrained Optimization Techniques:** Univariant method, Powell's method and steepest descent method.

U**NIT – IV**

**Constrained Nonlinear Programming:** Characteristics of a constrained problem - classification - Basic approach of Penalty Function method - Basic approach of Penalty Function method - Basic approaches of Interior and Exterior penalty function methods - Introduction to convex programming problem.

**UNIT – V**

**Dynamic Programming:** Dynamic programming multistage decision processes – types – concept of sub optimization and the principle of optimality – computational procedure in dynamic programming – examples illustrating the calculus method of solution - examples illustrating the tabular method of solution.

**TEXT BOOKS:**

1. Singiresu S. Rao, Engineering Optimization: Theory and Practice by John Wiley and Sons, 4th edition, 2009.
2. H. S. Kasene & K. D. Kumar, Introductory Operations Research, Springer (India), Pvt. Ltd., 2004

**REFERENCE BOOKS:**

1. George Bernard Dantzig, Mukund Narain Thapa, “Linear programming”, Springer series in operations research 3rd edition, 2003.
2. H.A. Taha, “Operations Research: An Introduction”, 8th Edition, Pearson/Prentice Hall, 2007.
3. Kalyanmoy Deb, “Optimization for Engineering Design – Algorithms and Examples”, PHI Learning Pvt. Ltd, New Delhi, 2005.

**B.TECH. PETROLEUM ENGINEERING**
**ENTREPRENEURSHIP AND SMALL BUSINESS ENTERPRISES**
**(Open Elective – II)**

| | |
|---|---|
| **B.Tech. III Year II Sem.** | **L T/P/D C** |
| **Course Code**: **PE623OE** | **3 0/0/0 3** |

**Course Objective:** The aim of this course is to have a comprehensive perspective of inclusive learning, ability to learn and implement the Fundamentals of Entrepreneurship.

**Course Outcome:** It enables students to learn the basics of Entrepreneurship and entrepreneurial development which will help them to provide vision for their own Start-up.

**Unit – 1: Entrepreneurial Perspectives:**
Evolution, Concept of Entrepreneurship, Types of Entrepreneurs, Entrepreneurial Competencies, Capacity Building for Entrepreneurs.
Entrepreneurial Training Methods; Entrepreneurial Motivations; Models for Entrepreneurial Development, The process of Entrepreneurial Development.

**Unit – 2: New Venture Creation:**
Introduction, Mobility of Entrepreneurs, Models for Opportunity Evaluation; Business plans – Purpose, Contents, Presenting Business Plan, Procedure for setting up Enterprises, Central level - Startup and State level - T Hub, Other Institutions initiatives.

**Unit – 3: Management of MSMEs and Sick Enterprises**
Challenges of MSMEs, Preventing Sickness in Enterprises – Specific Management Problems; Industrial Sickness; Industrial Sickness in India – Symptoms, process and Rehabilitation of Sick Units.

**Units – 4: Managing Marketing and Growth of Enterprises:**
Essential Marketing Mix of Services, Key Success Factors in Service Marketing, Cost and Pricing, Branding, New Techniques in Marketing, International Trade.

**Units – 5: Strategic perspectives in Entrepreneurship:**
Strategic Growth in Entrepreneurship, The Valuation Challenge in Entrepreneurship, The Final Harvest of New Ventures, Technology, Business Incubation, India way – Entrepreneurship; Women Entrepreneurs – Strategies to develop Women Entrepreneurs, Institutions supporting Women Entrepreneurship in India.

**TEXT BOOKS:**
1. Entrepreneurship Development and Small Business Enterprises, Poornima M. Charantimath, 2e, Pearson, 2014.
2. Entrepreneurship, A South – Asian Perspective, D. F. Kuratko and T.V. Rao, 3e, Cengage, 2012.

**REFERENCES:**

1. Entrepreneurship, Arya Kumar, 4 e, Pearson 2015.
2. The Dynamics of Entrepreneurial Development and Management, Vasant Desai, Himalaya Publishing House, 2015.

**B.TECH. PETROLEUM ENGINEERING**
**DISASTER MANAGEMENT**
**(Open Elective – III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T/P/D C** |
| **Course Code**: **PE831OE** | **3 0/0/0 3** |

**Course Objectives:** The subject provides different disasters, tools, and methods for disaster management.

**Course Outcomes:** At the end of the course, the student will be able to:
- Understanding Disasters, man-made Hazards and Vulnerabilities
- Understanding disaster management mechanism
- Understanding capacity building concepts and planning of disaster managements

**UNIT - I**
**Understanding Disaster:** Concept of Disaster - Different approaches- Concept of Risk - Levels of Disasters - Disaster Phenomena and Events (Global, national and regional)
**Hazards and Vulnerabilities:** 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:** Capacity Building: Concept - Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - 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. Manual on Disaster Management, National Disaster Management, Agency Govt of India.
2. Disaster Management by Mrinalini Pandey Wiley 2014.
3. Disaster Science and Management by T. Bhattacharya, McGraw Hill Education (India) Pvt Ltd Wiley 2015

**REFERENCES:**

1. Earth and Atmospheric Disasters Management, N. Pandharinath, CK Rajan, BS Publications 2009.
2. National Disaster Management Plan, Ministry of Home affairs, Government of India (http://www.ndma.gov.in/images/policyplan/dmplan/draftndmp.pdf)

**B.TECH. PETROLEUM ENGINEERING**
**FUNDAMENTALS OF LIQUEFIED NATURAL GAS**
**(Open Elective – III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T/P/D C** |
| **Course Code**: **PE832OE** | **3 0/0/0 3** |

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

- Gain basic knowledge of LNG and its prospective.
- Learn different liquefaction technologies of LNG.
- Have knowledge on different functional units on receiving terminals
- Analyze transportation of LNG and regasification.
- Understand HSE of LNG industry.

**Course Outcomes:** Upon successful completion of this course, the student will be able to:

- Have good knowledge on LNG process.
- Classify different liquefaction techniques.
- Understand different units in LNG processing and transportation.
- Have knowledge associated with safety aspects of LNG.

**UNIT-I**
**Introduction:** Overview of LNG industry: History of LNG industry – Base load LNG – Developing an LNG Project – World and Indian Scenario – Properties of LNG.

**UNIT-II**
**Liquefaction Technologies:** Propane precooled mixed refrigerant process – Description of Air products $C_3$MR LNG process – Liquefaction – LNG flash and storage.
**Cascade process:** Description of ConocoPhillips optimized cascade (copoc) process – Liquefaction – LNG flash and storage.
**Other Liquefaction Processes:** Description of Linde MFC LNG process- Precooling and Liquefied Petroleum Gas (LPG) recovery – Liquefaction and subcooling- Trends in LNG train capacity – strategy for grassroots plant- offshore LNG production.

**UNIT-III**
**Supporting Functional Units in LNG Plants:** Gas pretreatment: Slug catcher – NGL stabilization column – Acid gas removal unit – Molecular sieve dehydrating unit – Mercury and sulphur removal unit – NGL recovery – Nitrogen rejection – Helium recovery.

**UNIT-IV**
**Receiving Terminals:** Receiving terminals in India – Main components and description of marine facilities – storage capacity – Process descriptions.
Integration with adjacent facilities – Gas inter changeability – Nitrogen injection – Extraction of $C_2^+$ components.

**LNG Shipping Industry & Major Equipment in LNG Industry:** LNG Shipping Industry: LNG fleet – Types of LNG ships – Moss – Membrane – prismatic; Cargo measurement and calculations

**UNIT-V**

**Major equipment in LNG industry:** Cryogenic heat exchangers: Spiral – Wound heat exchangers – Plate-fin heat exchangers – Cold boxes; Centrifugal compressors – Axial compressors – Reciprocating compressors. LNG pumps and liquid expanders – Loading Arms and gas turbines.

**Vaporizers:** Submerged combustion vaporizers- Open rack vaporizers – Shell and tube vaporizers: direct heating with seawater, and indirect heating with seawater. Ambient air vaporizers: Direct heating with ambient air – Indirect heating with ambient air.; LNG tanks.

**Safety, Security and Environmental Issues:** Safety design of LNG facilities – Security issues for the LNG industry – Environmental issues – Risk based analysis of an LNG plant.

**TEXT BOOK:**

1. LNG: Basics of Liquefied Natural Gas, I st Edition, Stanley Huang, Hwa Chiu and Doug Elliot, PETEX, 2007.

(https://ceonline.austin.utexas.edu/petexonline/file.php/1/ebook_demos/lng/HTML/index.html.)

**REFERENCE BOOKS:**

1. Marine Transportation of LNG (Liquefied) and related products, Richard G. Wooler, Gornell Marine Press, 1975.
2. Marine Transportation of Liquefied Natural Gas, Robert P Curt, Timothy D. Delaney, National Maritime Research Centre, 1973.
3. Natural Gas: Production, Processing and Transport, Alexandre Rojey, Editions OPHRYS, 1997.

**B.TECH. PETROLEUM ENGINEERING**
**HEALTH, SAFETY AND ENVIRONMENT IN PETROLEUM INDUSTRY**
**(Open Elective - III)**

| | |
|---|---|
| **B.Tech. IV Year II Sem.** | **L T/P/D C** |
| **Course Code: PE833OE** | **3 0/0/0 3** |

**Course Objectives:**

- Knowledge of environment issues and all related Acts.
- Knowledge of drilling fluids and its toxic effects with environment.
- Proper disposal of drilling cutting after appropriate treatment.
- Treatment of produced water and makeup water and its disposal as per state pollution control board norms.
- Knowledge of oil mines regulations and proper implementation in drilling & production mines as per Act.
- Knowledge of Hazop in drilling rigs & production installations.
- Knowledge of disaster management to fight any fire accident at drilling rig/ production installation/production platform.

**Course Outcomes:**

- The student can have the knowledge of various Acts related to safety, Health and environment in petroleum industry.
- The student can have the knowledge of various drilling fluids handling and safe disposal such toxic products.
- Knowledge of disaster management to fight any crisis.
- Knowledge of Hazard studies and occupational health hazards in the industry.

**UNIT - I**

**Introduction to environmental control in the petroleum industry:** Overview of environmental issues- A new attitude.

**Drilling and production operations:** Drilling- Production- Air emissions.

**UNIT - II**

**The impact of drilling and production operations:** Measuring toxicity- Hydrocarbons- Salt- Heavy metals- Production chemicals- Drilling fluids- Produced water- Nuclear radiation- Air pollution- Acoustic impacts- Effects of offshore platforms- Risk assessment.

**Environmental transport of petroleum wastes:** Surface paths- Subsurface paths- Atmospheric paths. Planning for Environmental protection.

**Waste treatment methods:** Treatment of water- Treatment of solids- Treatment of air emissions-Waste water disposal: surface disposal.

**UNIT - III**

**Oil mines regulations:** Introduction-Returns, Notices and plans- Inspector, management and duties- Drilling and workover- Production- Transport by pipelines- Protection against gases and fires- Machinery, plants and equipment- General safety provisions- Miscellaneous-Remediation of contaminated sites- Site assessment-Remediation process.

**UNIT- IV**

Toxicity, physiological, asphyxiation, respiratory, skin effect of petroleum hydrocarbons and their mixture- Sour gases with their threshold limits- Guidelines for occupational health monitoring in oil and gas industry. Corrosion in petroleum industry- Additives during acidizing, sand control and fracturing.

**UNIT - V**

Hazard identification- Hazard evaluation- Hazop and what if reviews- Developing a safe process and safety management- Personal protection systems and measures.

Guidelines on internal safety audits (procedures and checklist)- Inspection & safe practices during electrical installations- Safety instrumentation for process system in hydrocarbon industry- Safety aspects in functional training-Work permit systems.

Classification of fires- The fire triangle- Distinction between fires and explosions-Flammability characteristics of liquids and vapors- Well blowout fires and their control- Fire fight equipment- Suppression of hydrocarbons fires.

**TEXT BOOKS:**

1. Environmental Control in Petroleum Engineering, John C. Reis, Gulf Publishing Company, 1996.
2. Application of HAZOP and What if Reviews to the Petroleum, Petrochemical and Chemical Process Industries, Dennis P. Nolan, Noyes Publications, 1994.
3. Oil Industry Safety Directorate (OISD) Guidelines, Ministry of Petroleum & Natural Gas, Government of India and Oil Mines Regulations-1984, Directorate General of Mines Safety, Ministry of Labor and Employment, Government of India.

**REFERENCE BOOKS:**

1. Guidelines for Process Safety Fundamentals in General Plant Operations Centre for Chemical Process Safety, American Institute of Chemical Engineers, 1995.
2. Guidelines for Fire Protection in Chemical, Petrochemical and Hydrocarbon Processing Facilities, Centre for Chemical Process Safety, American Institute of Chemical Engineers, 2003.
3. Guidelines for Hazard Evaluation Procedures Centre for Chemical Safety, Wiley-AIChE, 3rd Edition, 2008.
4. Guideline for Process Safety Fundamentals in General Plant Operations, Centre for Chemical Process Safety, AIChE, 1995.
5. Chemical Process Industry Safety, K S N Raju, McGraw Hill, 2014.