# ACADEMIC REGULATIONS

# PROGRAM STRUCTURE

# AND

# DETAILED SYLLABUS

# MECHANICAL ENGINEERING

## FOR

## CHOICE BASED CREDIT SYSTEM (CBCS)

## BASED B.TECH FOUR YEAR DEGREE PROGRAM

**(Applicable for the batches admitted from AY 2018-19)**

**GEETHANJALI COLLEGE OF ENGINEERING AND TECHNOLOGY**
**AN AUTONOMOUS INSTITUTION**
**Cheeryal (V), Keesara (M), Medchal (Dist.), Telangana – 501301**
**(Affiliated to JNTU, Hyderabad/ AICTE Approved / UGC Autonomous/ NAAC 'A' Grade)**

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# ACADEMIC REGULATIONS 2018

## For CBCS Based B.Tech PROGRAMMES

(Effective for the students admitted into FIRST year from the Academic Year **2018-19**)

**1. Under-Graduate Degree Programme (B.Tech) in Engineering**

Geethanjali College of Engineering and Technology (GCET) offers **four (**4) Year (**eight** (8) Semesters) **Bachelor of Technology** (B.Tech) Degree Programme, under Choice Based Credit System (CBCS) with effect from the Academic Year 2018-19, in the following Branches of Engineering

| ***S. No.*** | ***Branch*** |
|---|---|
| I | Civil Engineering |
| II | Computer Science and Engineering |
| III | Electrical and Electronics Engineering |
| IV | Electronics and Communication Engineering |
| V | Information Technology |
| VI | Mechanical Engineering |

**2. Eligibility for Admission**

**2.1** Admission to the B.Tech Programme shall be made either on the basis of the merit rank obtained by the qualifying candidate at an Entrance Test conducted by the Telangana State Government (EAMCET), OR the JNTUH, OR on the basis of any other order of merit approved by the University, subject to reservations as prescribed by the Government of Telangana from time to time.

**2.2** The medium of instruction for all the B.Tech programmes shall be ENGLISH only.

**3. B.Tech Programme Structure**

**3.1** A student after securing admission shall complete the B.Tech programme in a minimum period of **four (4)** academic years ( **eight** (8) semesters), and a maximum period of **eight (8)** academic years (**sixteen** (16) semesters) starting from the date of commencement of first year first semester (soon after securing admission), failing which student shall forfeit seat in B.Tech program. Each student shall secure 160 credits (with CGPA $\geq$ 5) required for the completion of the undergraduate 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 as listed below.

3.2.1 **Semester Scheme:**

Each B.Tech program is of **four** (4) academic years (**eight** (8) semesters**)**, with each academic year being divided into two semesters of **20 weeks (minimum of 90 working days)** each. Each semester has - '**Continuous Internal Evaluation (CIE)**' and '**Semester End Examination (SEE)**'. **Choice Based Credit System (CBCS)** and

**Credit Based Semester System (CBSS)** as denoted by UGC and curriculum / programme structure as suggested by AICTE are followed.

3.2.2 **Credit Courses:**

All courses are to be registered by a student in a semester to earn credits. Credits shall be assigned to each course in a L: T: P/D: C (Lecture periods: Tutorial periods: Practicals / Drawing periods: Credits) Structure, based on the following general pattern...

- One credit - for one hour / week / semester for Theory / Lecture (L) / Tutorial(T) courses;
- One-half (½) of a credit – for one hour / week / semester for Laboratory / Practical (P) Courses or Drawing Periods (D).
- No Credits for mandatory courses.
- Other student activities (co-curricular and extra-curricular), namely, NCC, NSS, NSO, Study Tour, Guest Lecture etc. and identified Mandatory Courses, if any, shall not carry credits.

3.2.3 **Course Classification:**

All courses offered for the B.Tech programme are broadly classified as: (a) Foundation Courses (FnC), (b) Core Courses (CoC), and (c) Elective Courses (EℓC).

Foundation Courses (FnC) are further categorized as : (i) HSMC (Humanities and Social Sciences including Management Courses ), (ii) BSC (Basic Science Courses), and (iii) ESC (Engineering Science Courses);

- Core Courses (CoC) and Elective Courses (EℓC) are categorized as PS (Professional Courses), which are further subdivided as – (i) PCC (Professional/ Departmental Core) Courses, (ii) PE (Professional/ Departmental Electives), (iii) OE (Open Electives); (iv) Technical Seminar, (v) Mini project and (vi) Project Work (PW) and (vii) Internship;
- Mandatory course(s) (MC – Non credit oriented)

| S.No | Broad Course Classification | Course Group/Category | Course Description |
|---|---|---|---|
| 1 | **Foundation Courses (FnC)** | BS-Basic Sciences | Includes Mathematics , Physics and Chemistry courses |
| 2 | | ES-Engineering Sciences | Includes Fundamental Engineering courses |
| 3 | | HS-Humanities and Social sciences | Includes courses related to humanities, Social Sciences and Management |
| 4 | **Core Courses (CoC)** | PC-Professional Core | Includes core courses related to parent discipline/department/ branch of Engineering |
| 5 | **Elective Courses ((EℓC)** | PE-Professional Electives | Includes elective courses related to parent discipline / department / branch of Engineering |
| 6 | | OE-Open Electives | Elective Courses Which include interdisciplinary course or courses in an area outside the parent discipline/department /branch of engineering |
| 7 | **Core Courses** | Project Work | B.Tech Project |
| 8 | | Internship/Mini Project/Technical Seminar | Internship/Mini- Project/Technical Seminar |

## 4 Course Registration

**4.1** A 'Faculty Advisor or Counselor' shall be assigned to a group of 20 students, who shall advise him about the B.Tech programme, its structure along with curriculum, choice / option for course(s), based on his competence, progress, pre-requisites and interest.

**4.2** A Student may be permitted to Register for Course(s) of his CHOICE with a typical total of 20 Credits per Semester (Minimum being 16 C and Maximum being 24 C, permitted deviation being ± 20%), based on his PROGRESS and SGPA/ CGPA, and study of the 'PRE-REQUISITES' as indicated for various Course(s), in the Department Course Structure and Syllabus contents. However, a MINIMUM of 16 Credits per Semester must be registered to ensure the 'STUDENTSHIP' in any Semester.

**4.3** A student must register for all the course(s) in a semester as specified in the program structure, before registering for any extra course(s), from the program structure, subject to **a maximum of four** (4) **more credits** with the approval of the faculty advisor.

**4.4** If any theory course(s) has an associated laboratory / practical course, while registering for such course(s), the student shall register for laboratory / practical course(s) along with the corresponding theory course(s) in the same semester**.**

**4.5** Student's choice for 'extra course(s)' to reach the Maximum Permissible Limit of 24 Credits (above the typical 20 Credit norm) must be clearly indicated, which needs the specific approval and signature of the Faculty Advisor/ Counselor**.**

**4.6** Academic section of the college invites 'Registration Forms' from students a priori (before the beginning of the semester). Registration requests for any 'CURRENT SEMESTER' shall be completed BEFORE the commencement of SEEs (Semester End Examinations) of the 'PRECEDING SEMESTER'.

**4.7** A student can apply for registration, ONLY AFTER obtaining the 'WRITTEN APPROVAL' from his faculty advisor, which should be submitted to the College Academic Committee through Head of the Department concerned (a copy of the same being retained with Head of the Department, Faculty Advisor and the student).

**4.8** If the student submits ambiguous choices or multiple options or erroneous entries - during registration for the course(s) under a given / specified course(s) Group/ Category, namely, core elective with laboratory, professional elective and open elective as listed in the programme structure, Faculty Advisor shall rectify such errors and advise the student accordingly.

**4.9** Course(s) options exercised by the student and approved by Faculty Advisor are final and CANNOT be changed, or inter-changed. Further, alternate choices shall also not be considered. However, if the course(s) that has (have) already been listed for registration (by 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 new course(s) (subject to offering of such course(s)), or for another existing course(s) offered, which may be considered. Such alternate arrangements shall be made by the department, with due notification and time-framed schedule, within the FIRST WEEK from the commencement of class-work for that semester.

**4.10** Dropping of course(s) may be permitted, only after obtaining prior approval from the faculty advisor / counselor 'within a period of 15 days' from the beginning of the current semester.

**4.11** Open electives: The students have to choose open electives from the list of open electives given. However, the student cannot opt for an open elective course(s) offered by his own (parent) department.

**4.12** Professional electives: The students have to choose the required professional electives from the list given.

**5. Courses to be offered**

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

**5.2** A Course may be offered to the students, ONLY IF a Minimum of 20 students (1/3 of the Section Strength) opts for the same. The maximum strength of a section is limited to 80 (60 + 1/3 of the section strength).

**5.3** More than **one Instructor** may offer the **same course(s)** (laboratory / practical may be included with the corresponding theory course(s) in the same semester) in any semester. However, selection of choice for students **shall be based on - 'first come first serve basis and CGPA criterion'**.

**5.4** If more entries for registration of a course(s) come into picture then the Head of the Department concerned shall decide whether or not to offer such a course(s) for two or more sections.

**5.5** In case of options coming from students of other departments / branches / disciplines (not considering OPEN ELECTIVES), PRIORITY shall be given to the student of the 'Parent Department'.

**6 Attendance Requirements**

**6.1** A student shall be eligible to appear for the semester end examinations, if the student acquires a minimum of 75% attendance in aggregate of all the courses (excluding attendance in mandatory course(s) such as Environmental Science, Constitution of India, Intellectual Property Rights, Professional Ethics and Gender Sensitization lab) registered for in that semester.

**6.2** A student shall acquire a minimum of 75% attendance in each mandatory course. If he fails to acquire a minimum of 75% attendance in mandatory course(s), such student is deemed to have failed in that mandatory course(s) and shall re-register for such course(s) as and when offered next. Condonation of attendance is not allowed in mandatory course(s).

**6.3** 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 valid medical grounds, or participation in sports, games, NCC, NSS, other co-curricular and extra-curricular activities, recognized for the purpose, and the participation having prior approval of the competent authority. Such condonation shall be based on the student's representation with supporting evidence.

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

**6.5** Shortage of attendance below 65% in aggregate shall in "**NO"** case be condoned.

**6.6** Students, whose shortage of attendance is not condoned in any semester, are not eligible to take their Semester End Examinations. They get detained and their registration for that semester shall stand cancelled. They shall not be promoted to the next semester. They may seek re-registration for all those course(s) registered in that semester in which they

were detained, by seeking re-admission into that semester as and when offered. In the case of elective course(s), namely, professional elective(s) and / or open elective(s), the same may also be re-registered, if offered. However, if those elective(s) are not offered in later semesters, then alternate elective(s) may be chosen from the SAME set of elective course(s) offered under that specific category.

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

**7 Academic Requirements**

The following academic requirements have to be satisfied, in addition to the attendance requirements mentioned in section 6.

**7.1** A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course, if the student secures not less than 35% marks (e.g. 25 out of 70 marks in theory/laboratory/practical/drawing course(s)) 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 Pass (C) Grade or above in that course(s).

**7.2** Academic requirements in respect of Internship, Mini-Project, Technical Seminar, Project and mandatory non-credit course(s). Evaluation process of course(s) are as follows:

**7.2.1** A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Internship, if the student secures not less than 40% of the total marks allocated for the course. The student is deemed to have failed, if he does not submit a report on his Internship or does not make a presentation of the same before the Departmental Evaluation Committee as per schedule or secures less than 40% of marks in Internship evaluation.

**7.2.2** A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Mini Project, if the student secures not less than 40% of the total marks allocated for the course(s). The student is deemed to have failed, if he does not submit a report on his Mini Project or does not make a presentation of the same before the Departmental Evaluation Committee as per schedule or secures less than 40% of marks in Mini Project evaluation.

**7.2.3** A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Technical Seminar, if the student secures not less than 40% of the total marks allocated for the course(s). The student is deemed to have failed, if he does not submit a report on his Technical Seminar or does not make a presentation of the same before the Departmental Evaluation Committee as per schedule or secures less than 40% of marks in Technical Seminar evaluation.

**7.2.4** A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Project, if the student secures not less than 40% of the total marks allocated for the course(s). The student is deemed to have failed, if he does not submit a report on his Project or does not make a presentation of the same before the Departmental Evaluation Committee as per schedule or secures less than 40% of marks in Project evaluation.

Note: He may reappear once for each of the above evaluations (mentioned in 7.2.1 to 7.2.4), when they are scheduled again; if he fails in such 'one reappearance evaluation also', he has to reappear for the same in the next subsequent semester, as and when it is scheduled.

7.2.4.1 For mandatory / non-credit course(s), 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 course(s) in addition to satisfying the attendance requirements mentioned in section 6.2.

7.2.4.2 No marks / letter grades shall be allotted for mandatory/non-credit course(s). Only Pass / Fail shall be indicated in Grade Card.

7.2.4.3 If a student fails in mandatory / non-credit course(s), he shall re-register for that course(s) as and when offered next.

### 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 50% (20 out of 40 credits) of the credits specified in the program structure of first year (up to and including first year second semester), from all the relevant regular and supplementary examinations, whether the student takes those examinations or not (even if the student registers for less than 40 credits, student must still secure a minimum of 20 credits). |
| 3. | Second year First semester to Second year Second semester | Regular course of study of Second year First semester. |
| 4 | Second year Second semester to Third year First semester | (i) Regular course of study of Second year Second semester.<br>(ii) Must have secured at least 60% (48 out of 80 credits) of the credits specified in the program structure of second year (up to and including second year second semester), from all the relevant regular and supplementary examinations, whether the student takes those examinations or not (even if the student registers for less than 80 credits, student must still secure a minimum of 48 credits). |
| 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 60% (72 out of 120 credits) of the credits specified in the program structure of third year (up to and including third year second semester), from all the relevant regular and supplementary examinations, whether the student takes those examinations or not (even if the student registers for less than 120 credits, student must still secure a minimum of 72 credits). |
| 7 | Fourth year First semester to<br>Fourth year Second semester | Regular course of study of Fourth year First semester. |

**7.4** A Student shall register for all course(s) covering 160 credits as specified and listed in the Programme Structure, fulfills the Attendance and Academic requirements for 160 Credits securing a minimum of C Grade (Pass Grade) or above in each course(s), and 'earns ALL 160 Credits securing an SGPA ≥ 5.0 (in each Semester), and CGPA (at the end of each successive Semester) ≥ 5.0, in addition to fulfilling the academic requirements of mandatory course(s)s, to successfully complete the B.Tech Programme. The performance of the student in these 160 credits shall be taken into account for the calculation of 'the final CGPA (at the end of undergraduate programme), and shall be indicated in the grade card of IV year II semester.

**7.5** Students who fail to earn 160 credits as per the Programme Structure, and as indicated above, within 8 academic years from the date of commencement of their I Year shall forfeit their seats in B.Tech Programme and their admissions shall stand cancelled.

**7.6** A student detained due to shortage of attendance in any semester, may be re-admitted into that semester, as and when offered, with the Academic Regulations of the batch into which he gets readmitted. However, no grade allotments or SGPA/ CGPA calculations shall be done for the corresponding semester in which he got detained.

**7.7** A student detained due to lack of credits in any year, may be readmitted in the next year, after fulfillment of the Academic Requirements, with the Academic Regulations of the batch into which he gets readmitted.

**7.8** A student eligible to appear in the Semester End Examination in any course(s), but absent at it or failed (thereby failing to secure C Grade or above), may reappear for that course(s) at the supplementary examination as and when conducted. In such cases, his Internal Marks (CIE) assessed earlier for that course(s) shall be carried over, and added to the marks he obtains in the supplementary examination, for evaluating his performance in that course(s).

**8 Evaluation - Distribution and Weightage of Marks**

**8.1** The performance of a student in each semester shall be evaluated course-wise (irrespective of credits assigned) with a maximum of 100 marks for all types of course(s), namely, theory, drawing, practicals, Technical seminar, Project, Mini-Project, Internship etc. and their evaluation is as follows:

**8.1.1** Theory, practical, drawing and Project course(s) shall be evaluated based on 30% CIE (Continuous Internal Evaluation) and 70% SEE (Semester End Examination),

**8.1.2** Internship/Technical seminar shall be evaluated based on 100% CIE (Continuous Internal Evaluation)

**8.1.3** Mini-project shall be evaluated based on 100% SEE (Semester End Examination)

Note: A letter grade corresponding to the % marks obtained shall be given for all course(s) as mentioned in section 9.2

**8.2** For theory course(s), during the semester, there shall be TWO (2) mid-term examinations for 25 marks each. Each mid-term examination consists of one objective paper for TEN (10) marks, plus one subjective paper for FIFTEEN (15) marks, with duration of 120 minutes (20 minutes for objective and 100 minutes for subjective papers). Further, there shall be an allocation of five (5) marks for assignment. The objective paper is set with multiple choice questions, and / or True / False, and /or fill-in the blanks, and / or matching type questions. Subjective paper shall contain 3 questions, one from each unit or part thereof, with internal choice, each for 5 marks. All three questions are to be answered.

**8.2.1** The first mid-term examination shall be conducted for the first 50% of the syllabus, and the second mid-term examination shall be conducted for the remaining 50% of the syllabus.

**8.2.2** The first set of assignments should be submitted before the conduct of the first mid-term examinations, and the second set of assignments should be submitted before the conduct of the second mid-term examinations. The assignments shall be as specified by the course instructor concerned.

**8.2.3** The first mid-term examination marks and average of the marks of the first set of assignment shall make one set of CIE marks, and the second mid-term examination marks and the average of the marks of the second set of assignment shall make second set of CIE Marks; and the average of these two sets of marks shall be taken as the final marks secured by the student in the Continuous Internal Evaluation in that theory course(s).

**8.2.4** The details of the question paper pattern for Semester End Examination (SEE) shall be as follows:

- The examination shall be conducted for 70 marks. The question paper consists of two parts:
  - Part – A for 20 marks (Compulsory);
  - Part – B for 50 marks (Questions with Internal Choice);
- Part – A: Part A shall consist of ten questions, two from each unit of the prescribed syllabus of the course(s). Each question carries 2 marks. All questions are compulsory.
- Part – B: Part B shall consist of five questions, one each from the five units of the prescribed syllabus of the course(s). Each question carries 10 marks and may contain sub-questions. For each question, there shall be an internal choice (it means, there shall be two questions from each unit, and the student shall answer either of the questions). The student shall answer all the questions of Part B.

**8.2.5 Absence in mid-term examination (s):**

- If any student is absent in one mid-term examination for any course(s) on any valid reasons certified by the Head of the Department concerned, one written test shall be conducted on all units by the college in each course(s) at the end of the semester.
- If any student is absent in both mid-term examinations for any course(s) on any valid reasons certified by the Head of the Department concerned, only one written test for 25 marks shall be conducted on all units by the college in each course at the end of the semester, and the marks secured out of 25 shall be divided by two, shall be awarded against the said mid-term examination(s).
- A prescribed fee shall be payable by the student for appearing in the above mentioned written test.

**8.2.6** For laboratory / practicals / drawing course(s), there shall be a Continuous Internal Evaluation (CIE) during the semester for 30 marks, and 70 marks are assigned for laboratory / practical Semester End Examination (SEE). Out of the 30 marks for CIE, day-to-day work in the laboratory / practical shall be evaluated for 15 marks; and for the remaining 15 marks - two internal practical tests (each of 15 marks) shall be conducted by the concerned laboratory instructor, one at the end of 8 weeks and the other in the last week of the semester. The average of these two tests is taken into account. The SEE for practicals shall be conducted at the end of the semester by two examiners, namely, an

external examiner and laboratory faculty as internal examiner. The external examiner shall be appointed by the Chief Superintendent of Examinations of the college as per the recommendation of the Chairperson, Board of Studies of the department concerned. The panel of the external examiners shall be provided by the Chairperson, BoS at the commencement of the semester during the meeting of the BoS

**Absence in laboratory/practical internal examinations:**

- If any student is absent in one laboratory internal examination for any laboratory course for any valid reasons certified by the Head of the Department concerned, one test shall be conducted for 15 marks covering all experiments of that laboratory course, by the college at the end of the semester.
- If any student is absent in both the laboratory internal examinations for any valid reasons certified by the Head of the Department concerned, only one test shall be conducted covering all experiments and the marks secured out of 15 marks shall be divided by two, which shall be awarded against the said lab internal examinations.

**8.2.7** For the course having design and / or drawing (such as Engineering Graphics), the distribution shall be 30 marks for CIE (15 marks for day-to-day work, and 15 marks for internal tests) and 70 marks for SEE (question paper pattern shall be same as for theory examinations). There shall be two internal examinations in a semester and the average of the two shall be considered for the award of marks for internal examinations.

8.2.7.1 If any student is absent in the internal examination in design and / or drawing (such as Engineering Graphics) for any valid reasons certified by the Head of the Department concerned, one internal examination shall be conducted for 15 marks on all experiments of that laboratory / practical course(s), by the college at the end of the semester.

**8.2.8 Internship, Mini-Project, Technical Seminar and Project**

8.2.8.1 There shall be an internship, which the student shall carryout immediately after Second year second semester examinations and pursue it during summer vacation for a duration of four weeks. Internship carried out shall be submitted in a report form, and a presentation of the same shall be made before a committee, which evaluates it for 100 marks. The committee shall consist of Head of the Department, the supervisor allocated for the internship, and two Professors / Assoc-Professors of the department. There shall be only CIE for 100 marks for internship and shall be evaluated during third year first semester. There shall be no SEE for Internship.

8.2.8.2 There shall be a Mini Project, which the student shall carryout immediately after Third year second semester examinations and pursue it during summer vacation. Mini Project shall be submitted in a report form, duly approved by the departmental internal evaluation committee, and presented before the examination committee in Fourth year first semester. It shall be evaluated for 100 marks as SEE. The examination committee consists of an external examiner, Head of the Department, supervisor of the mini project and a senior faculty member of the department. There shall be no internal marks (CIE) for Mini Project.

8.2.8.3 There shall be a technical seminar presentation in Fourth year second semester, for which, the student shall collect the information on a specialized topic, prepare a technical report, submit it and present the same before a departmental committee. It shall be evaluated by the departmental committee, consisting of Head of the Department, seminar supervisor and a senior professor. The technical seminar report shall be evaluated for 100 marks as CIE. There shall be no SEE for the technical seminar.

8.2.8.4 There shall be a project, which the student shall carryout in final year second semester. There shall be three reviews, one at the end of the fourth week, another at the end of the ninth week and third at the end of the fourteenth week. The reviews shall be conducted

and evaluated by an internal project review committee. The committee shall consist of Head of the Department, the supervisor allocated for the project, and two Professors /Assoc-Professors of the department. Each review shall be evaluated for thirty (30) marks and average of all three reviews shall constitute CIE of thirty (30) marks. Project carried out shall be submitted in a dissertation form, and a presentation of the same shall be made before a final examination committee consisting of Head of the Department, the supervisor and an external examiner, appointed by the chief superintendent of examinations, selected from a panel of examiners suggested by the chairperson, BoS, which evaluates it for seventy (70) marks.

## 9 Grading procedure

**9.1** Grades shall be awarded to indicate the performance of students in each theory course, laboratory / practicals / Engineering Graphics / Drawing, Technical Seminar, Internship, Mini-Project, Project. Based on the percentage of marks obtained (Continuous Internal Evaluation plus Semester End Examination, both taken together) as specified in section 8 above, a corresponding letter grade shall be given.

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

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

**9.3** A student who has obtained an '**F'** grade in any course(s) shall be deemed to have '**failed'** and is required to reappear as a 'supplementary candidate' in the semester end examination, as and when conducted. However, the internal marks secured earlier in those course(s) shall remain the same.

**9.4** A student, who has not appeared for an examination in any course(s), shall be awarded '**Ab'** grade in that course(s), and shall be deemed to have '**failed'** in that course(s). Such a student shall be required to reappear as a 'supplementary candidate' in the semester end examination, as and when conducted. However, the internal marks secured earlier in those course(s) shall remain the same.

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

**Credit points (CP) = grade point (GP) x credits …. For a course**

**9.7** A student passes a course, only when the student secures a **GP ≥ 5 ('C' grade or above)** in that course.

**9.8** The Semester Grade Point Average (SGPA) is calculated by dividing the sum of credit points (ΣCP) secured from all course(s) registered for in a semester, by the total number of credits registered for in 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 course indicator index (takes into account all course(s) in a semester), 'N' is the number of courses '**registered'** for in that semester (as specifically required and listed under the program structure of the parent department), C is the number of credits allotted to the $i^{th}$ course, and G represents the grade points (GP) corresponding to the letter grade awarded for that $i^{th}$ course.

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

$$\text{CGPA} = \{ \sum_{j=1}^{M} C_j G_j \} / \{ \sum_{j=1}^{M} C_j \} \text{ ... for all S Semesters registered}$$
$$\text{(ie., upto and inclusive of S Semesters, } S \geq 2 \text{)},$$

where '**M'** is the **total** number of courses (as specifically required and listed under the program structure of the parent department) the student has '**registered'** for i.e. from the first semester onwards up to and inclusive of the eighth semester, 'j' is the course indicator index (takes into account, all course(s) from first semester to eighth semester), C is the number of credits allotted to the $j^{th}$ course, and G represents the grade points (GP) corresponding to the letter grade awarded for that $j^{th}$ course. After registration and completion of First year first semester, the SGPA of that semester itself may be taken as the CGPA, as there are no cumulative effects.

**Illustration of calculation of SGPA:**

| Course | Credits | Letter Grade | Grade Point | Credit Points |
|---|---|---|---|---|
| Course1 | 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 |
| **Total** | **21** | **Total Credit Points** | | **152** |

**SGPA = 152/21 = 7.24**

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

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

**CGPA = 518/69 = 7.51**

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

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

**9.11** SGPA and CGPA of a semester shall be mentioned in the semester Memorandum of Grades if all courses of that semester are passed in the first attempt. Otherwise, the SGPA and CGPA shall be mentioned only on the Memorandum of Grades generated after the student has passed his last examination in that semester. However, mandatory course(s) will not be taken into consideration.

**10. Passing Standards:**

**10.1** A student shall be declared **'SUCCESSFUL'** or **'PASSED'** in a semester, only when he gets a SGPA ≥ 5.00 (at the end of that particular Semester); and a student shall be declared **'SUCCESSFUL'** or **'PASSED'** in the entire B.Tech programme, only when he gets a CGPA ≥ 5.00, subject to the condition that he secures a GP ≥ 5 (C Grade or above) in every registered course(s) in each semester (during the entire B.Tech Programme) for award of the degree.

**10.2** After the completion of each semester, a Grade Card or Grade Sheet (Memorandum of Grades) shall be issued to all the registered students of that semester, indicating the letter grades and credits earned. It shall show the details of the course(s) registered (course(s) code, title, number of credits, grade earned etc.), credits earned, SGPA, and CGPA.

**11. Declaration of Results**

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

**11.2** For final % of marks equivalent to the computed final CGPA, the following formula shall be used:

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

**12. Award of Degree**

**12.1** A student who registers for all the specified course(s) as listed in the programme structure, satisfies all the programme requirements, and passes all the examinations prescribed in the entire B.Tech programme, and secures the required number of 160 credits (with CGPA ≥ 5.0), within eight (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 branch of Engineering studied.

**12.2** A student who qualifies for the award of the degree as listed in section 12.1, shall be placed in the following classes based on evaluation as per section 7.4:

12.2.1 Students with final CGPA (at the end of the B. Tech Programme) ≥ 8.00 and fulfilling the following conditions shall be placed in 'FIRST CLASS with DISTINCTION' -

i. should have passed all the courses in 'FIRST APPEARANCE' within the first four (4) academic years (or eight (8) sequential semesters) from the date of commencement of his first academic year,

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

iii. should not have been detained or prevented from writing the Semester End Examinations in any semester due to shortage of attendance or any other reason.

12.2.2 Students having final CGPA (at the end of B.Tech Programme) ≥ 8.00, but not fulfilling the above conditions shall be placed in 'FIRST CLASS'.

12.2.3 Students with final CGPA (at the end of the B.TECH Programme) ≥ 6.50 but < 8.00, shall be placed in 'FIRST CLASS'.

12.2.4 Students with final CGPA (at the end of the B.TECH Programme) ≥ 5.50 but < 6.50, shall be placed in 'SECOND CLASS'.

12.2.5 All other Students who qualify for the award of the degree (as per Section 12.1), with final CGPA (at the end of the B.Tech Programme) ≥ 5.00 but < 5.50, shall be placed in 'PASS CLASS'.

**12.3** A student with final CGPA (at the end of the B.Tech Programme) < 5.00 shall not be eligible for the award of the degree.

**12.4** Students fulfilling the conditions listed under section (iii) of 12.2.1 alone shall be eligible for the award of 'college rank' and / or 'gold/silver/bronze medal'.

**13. Withholding of Results**

**13.1** If the student has not paid fees to College at any stage, or has pending dues against his name due to any reason whatsoever, or if any case of indiscipline is pending against him, the result of the student may be withheld, and he shall 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. Transitory Regulations**

**14.1 General**

14.1.1 A Student who has discontinued for any reason, or has been detained for want of attendance as specified in section 6 or NOT promoted due to lack of required credits as specified in section 7, may be considered eligible for readmission to the same semester in which he got detained for want of attendance or promotion to the next year of study after

securing the required number of credits, as detailed in sections 14.2 through 14.4 as the case may be.

**14.2 For students detained due to shortage of attendance**:

14.2.1. A Student who has been detained in FIRST year of R13/R15 Regulations of JNTUH due to lack of attendance, shall be permitted to join FIRST year FIRST Semester of AR18 Regulations of GCET and is required to complete the study of B.Tech programme within the stipulated period of eight academic years from the date of first admission in FIRST Year. The AR18 Academic Regulations of GCET are applicable to the student from the year and semester of readmission onwards.

14.2.2. A student who has been detained in any semester of SECOND, THIRD and FOURTH years of R13/R15 regulations of JNTUH for want of attendance shall be permitted to join the corresponding semester of AR18 regulations of GCET and is required to complete the study of B.Tech within the stipulated period of eight academic years from the date of first admission in FIRST Year. The AR18 Academic Regulations of GCET are applicable to the student from the year and semester of readmission onwards.

14.2.3. A student who has been detained in any semester of FIRST, SECOND, THIRD or FOURTH years of AR16 regulations of GCET for want of attendance shall be permitted to join the corresponding semester of AR18 regulations of GCET and is required to complete the study of B.Tech within the stipulated period of eight academic years from the date of first admission in FIRST Year. The AR18 Academic Regulations of GCET are applicable to the student from the year and semester of readmission onwards.

**14.3 For students NOT promoted due to shortage of credits**:

14.3.1. A student of R13/R15 Regulations of JNTUH who has been detained due to lack of credits shall be promoted to the next semester under AR18 Regulations of GCET only after acquiring the required credits as per the corresponding regulations of his first admission. For subsequent promotions, the rule specified in section 14.4.4 shall be applicable. The student is required to complete the study of B.Tech within the stipulated period of eight academic years from the year of first admission in FIRST year. The AR18 Academic Regulations of GCET are applicable to a student from the year of readmission onwards.

14.3.2. A student of AR16 Regulations of GCET who has been detained due to lack of credits shall be promoted to the next semester under AR18 Regulations of GCET only after acquiring the required credits as per AR16 regulations. For subsequent promotions, the rule specified in section 14.4.4 shall be applicable. The student is required to complete the study of B.Tech within the stipulated period of eight academic years from the year of first admission in FIRST year. The AR18 Academic Regulations of GCET are applicable to the student from the year of readmission onwards.

**14.4. For all students readmitted under AR18 Regulations of GCET**:

14.4.1 A student who has failed in any course(s) under any regulation has to pass those course(s) in the same regulations.

14.4.2 If a student readmitted into AR18 Regulations has any course(s) to be studied in the semester of his re-admission or succeeding semesters with about 80% of the syllabus in common with course(s) he has studied under his previous regulations, that particular course(s) shall be substituted for by another course(s) by the college (see also section 14.4.3).

14.4.3 If a student taking readmission as per the provisions of section 14.1.1 had not studied in his previous semesters, any course(s) which is/are prescribed for study under AR18 Regulations (in any of the semester(s) preceding the semester of re-admission), he shall pass all such course(s) to meet the academic requirements of AR18 Regulations. One or more of these course(s) may be offered as substitute course(s), as per section

14.4.2. Other course(s) not offered as substitute course(s) shall constitute **Additional Course(s)**, which the student must pass to meet the academic requirements for the award of the degree. *Method of evaluation of additional courses shall be the same as the one detailed in section 8.* The college may conduct remedial classes and internal examinations for the benefit of the student. The Academic Regulations of GCET, AR18, under which a student has been readmitted, shall be applicable to the student from that semester.

14.4.4 **Promotion Rule for students initially admitted into R13/R15 Regulations of JNTUH or AR16 Regulations of GCET and re-admitted into AR18 Regulations of GCET**

- To be eligible for promotion from FIRST year to SECOND year, a student must secure a minimum of 50% of the total credits assigned to all the courses he had studied, including substitute courses but excluding Additional Courses, from all the examinations conducted, whether the student takes the examinations or not.
- To be eligible for promotion from SECOND year to THIRD year and THIRD year to FOURTH year, a student must secure a minimum of 60% of the total credits assigned to all the courses he had studied, including substitute courses but excluding Additional Courses, from all the examinations conducted, whether the student takes the examinations or not.
- For this purpose, if the number of credits secured so arrived at is not an integer, the fractional component shall be ignored if it is less than 0.5; else, it shall be rounded off to the next higher integer (e.g. 50.4 is taken as 50 and 50.5 is taken as 51).

14.4.5 The total number of credits that a student acquires for the award of degree, shall be the sum of all credits secured in all the regulations of his study including AR18 Regulations. Credits earned by the student in additional course(s), shall be considered only for award of B.Tech degree, but shall not be considered for calculating SGPA/CGPA.

**15. Student transfers**

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

**15.2** The student seeking transfer from various other universities/institutions, if failed in any course(s) in his earlier regulations, has to pass equivalent courses as prescribed by JNTUH and also pass the courses of GCET which the student has not studied at the earlier institution. Further, even if the student had passed some of the courses at the earlier institutions, if the same courses are prescribed in different semesters of AR18 regulations of GCET, the student has to study and pass those courses in GCET in spite of the fact that those courses are repeated.

**15.3** The transferred students from other universities/institutions shall be provided one chance to write the internal examinations in the failed courses and/or courses not studied as per the clearance (equivalence) letter issued by JNTUH.

**16. Scope**

i) Where the words “he”, “him”, “his”, occur in the write-up of regulations, they include “she”, “her”, “hers”.
ii) The Academic Regulations should be read as a whole, for the purpose of any interpretation.
iii) In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Head of the Institution is final.
iv) The college may change or amend the Academic Regulations, Program 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 College Authorities.
v) B.Tech (Regular) program is B.Tech 4 year degree program to which students are admitted to FIRST year

vi) B.Tech LE Scheme refers to the system under which students are admitted to SECOND year of the B.Tech FOUR (4) year degree program.

vii) The terms “mid-term” and “internal” are used interchangeably.

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## PUNISHMENT FOR MALPRACTICE

| | Nature of Malpractices | Punishment |
|---|---|---|
| | **If the candidate:** | |
| 1 (a) | Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the course of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the course of the examination) | Expulsion from the examination hall and cancellation of the performance in that course only. |
| 1 (b) | Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate 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 course only of all the candidates involved. In case of an outsider, he shall 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 course of the examination (theory or practical) in which the candidate is appearing. | Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the courses of that Semester/year.<br>The Hall Ticket of the candidate is to be cancelled. |
| 3 | Impersonates any other candidate in connection with the examination. | The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the courses of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the impostor is an outsider, he shall be handed over to the police and a case is registered against him. |

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| 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 course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. |
| 5 | Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks. | Cancellation of the performance in that course. |
| 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 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. | In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they shall 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 course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is |

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| | | 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 course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester / year. The candidate is also debarred and forfeits the seat. |
| 9 | If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8. | Student of the colleges expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester / year. The candidate is also debarred and forfeits the seat.<br>Person(s) who do not belong to the College shall be handed over to police and, a police case shall be registered against them. |

## ACADEMIC REGULATIONS FOR B.TECH (LATERAL ENTRY SCHEME) FROM THE Academic Year 2019-20

**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 120 credits and secure 120 credits with CGPA $\geq 5$ from SECOND year through FOURTH year B.Tech programme (LES) for the award of B.Tech degree.

**3.** The students, who fail to fulfill the requirement for the award of the degree in six academic years from the year of admission, 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 |
|---|---|---|
| i. | Second year first semester to Second year second semester | Regular course of study of Second year first semester. |
| ii. | 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 60% (24 out of 40 credits) of the credits specified in the program structure of second year (up to and including second year second semester), from all the relevant regular and supplementary examinations, whether the student takes those examinations or not (even if the student registers less than 40 credits student must still secure a minimum of 24 credits). |
| iii. | Third year first semester to Third year second semester | Regular course of study of Third year first semester. |
| iv. | 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 60% (48 out of 80 credits) of the credits specified in the program structure of third year (up to and including third year second semester), from all the relevant regular and supplementary examinations, whether the student takes those examinations or not (even if the student registers less than 80 credits student must still secure a minimum of 48 credits). |
| v. | 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. FOUR (4) - year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme).

## PUNISHMENT FOR MALPRACTICE

| | Nature of Malpractices | Punishment |
|---|---|---|
| | **If the candidate:** | |
| 1 (a) | Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the course of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the course of the examination) | Expulsion from the examination hall and cancellation of the performance in that course only. |
| 1 (b) | Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate 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 course only of all the candidates involved. In case of an outsider, he shall 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 course of the examination (theory or practical) in which the candidate is appearing. | Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the courses of that Semester/year.<br>The Hall Ticket of the candidate is to be cancelled. |
| 3 | Impersonates any other candidate in connection with the examination. | The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the courses of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the impostor is an outsider, he shall be handed over to the police and a case is registered against him. |

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|---|---|---|
| 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 course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. |
| 5 | Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks. | Cancellation of the performance in that course. |
| 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 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. | In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses of that semester/year. The candidates also are debarred and forfeit their seats. In case of outsiders, they shall 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 course and all the other courses the candidate has already appeared including practical examinations and project work and shall |

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| | | not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the candidate is course 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 course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester/year. The candidate is also debarred and forfeits the seat. |
| 9 | If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8. | Student of the colleges expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.<br>Person(s) who do not belong to the College shall be handed over to police and, a police case shall be registered against them. |

## Vision of the Institute

Geethanjali visualizes dissemination of knowledge and skills to students, who would eventually contribute to well being of the people of the nation and global community.

## Mission of the Institute

- To impart adequate fundamental knowledge in all basic sciences and engineering, technical and Inter-personal skills to students.
- To bring out creativity in students that would promote innovation, research and entrepreneurship.
- To preserve and promote cultural heritage, humanistic and spiritual values promoting peace and harmony in society.

## Vision of the Department

The Mechanical Engineering department strives to be recognized globally for outstanding education and research, imparting quality education, churning well-qualified engineers, who are creative, innovative, and entrepreneurial, solving problems for societal development.

## Mission of the Department

**M1:** Imparting quality education to students to enhance their skills and make them globally competitive

**M2:** Prepare graduates to engage in life-long learning, possess intellectual capabilities, serving society with a strong commitment to their profession, meeting technical challenges and exhibiting ethical responsibility for societal development.

**M3**: Conduct quality research, create opportunities for students and faculty to showcase their talent, disseminate knowledge, and promote community development, leading to peace and harmony in society.

## Programme Educational Objectives

**PEO1:** To prepare students with strong fundamental knowledge in basic sciences mathematics, engineering courses which would facilitate them find gainful employment with a sense of appreciation to pursue life-long learning for professional development.

**PEO2:** To inculcate problem solving skills in students, imbibing creativity and innovation which would enable them to develop modern machinery involving cutting edge technologies of multidisciplinary nature for societal development.

**PEO3:** To develop critical thinking with an aptitude to conduct research and development, instill professional ethics, develop effective communication and interpersonal skills with positive attitude to contribute significantly towards their chosen profession, thereby supporting community development.

## Program Outcomes (POs)

**PO1: Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2: Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3: Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO4: Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5: Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations

**PO6: The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7: Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO8: Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9: Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10: Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and

write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

**PO11: Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

**PO12: Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

## Program Specific Outcomes (PSOs)

**PSO1:** Apply Continuity, Energy and Momentum equations to mechanical systems, design and perform experiments in all fields of mechanical engineering

**PSO2:** Able to analyze, design and develop/model mechanical and its allied systems using software tools such as AUTOCAD, ANSYS, and Creo etc

**PSO3:** Able to design layouts for process and manufacturing industry taking into consideration optimization of resources for effective operation and maintenance.

## SCHEME OF INSTRUCTION AND EXAMINATION

## B. Tech. MECHANICAL ENGINEERING

**Academic Regulations – AR 18;** **Academic Year 2018 - 2019**

## PROGRAM STRUCTURE

### FIRST YEAR - SEMESTER - I

| S. No | Course Code | Course | Category | Number of Periods per Week | | | Scheme of Examination with Maximum Marks | | | No. of Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P/D | CIE | SEE | Total | C |
| 1 | 18PH1101 | Engineering Physics | BSC | 3 | 1 | - | 30 | 70 | 100 | 4 |
| 2 | 18MA1101 | Mathematics – I | BSC | 3 | 1 | - | 30 | 70 | 100 | 4 |
| 3 | 18CS1101 | Programming for Problem Solving | ESC | 2 | - | - | 30 | 70 | 100 | 2 |
| 4 | 18ME1101 | Engineering Mechanics - I | ESC | 3 | - | - | 30 | 70 | 100 | 3 |
| 5 | 18ME1102 | Engineering Graphics | ESC | 1 | - | 4 | 30 | 70 | 100 | 3 |
| 6 | 18PH11L1 | Engineering Physics Lab | BSC | - | - | 3 | 30 | 70 | 100 | 1.5 |
| 7 | 18CS11L1 | Programming for Problem Solving Lab | ESC | - | - | 2 | 30 | 70 | 100 | 1 |
| 8 | 18ME11L1 | Engineering Workshop | ESC | - | - | 3 | 30 | 70 | 100 | 1.5 |
| 9 | MC | Induction Program | MC | - | - | - | - | - | - | - |
| **Total** | | | | **12** | **2** | **12** | **240** | **560** | **800** | **20** |
| **Total Periods Per Week** | | | | **26** | | | | | | |

| Course Code | Definitions |
|---|---|
| L | Lecture |
| T | Tutorial |
| P | Practical |
| D | Drawing |
| BSC | Basic Science Courses |
| ESC | Engineering Science Courses |
| HSMC | Humanities and Social Sciences including Management courses |
| PCC | Professional core courses |
| PEC | Professional Elective courses |
| OEC | Open Elective courses |
| LC | Laboratory course |
| MC | Mandatory courses |
| PROJ | Project, Mini Project, Technical Seminar |

## FIRST YEAR – SEMESTER - II

| S. No | Course Code | Course | Category | Number of Periods per Week | | | Scheme of Examination with Maximum Marks | | | No. of Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P/D | CIE | SEE | Total | C |
| 1 | 18EN1201 | English | HSMC | 3 | - | - | 30 | 70 | 100 | 3 |
| 2 | 18MA1201 | Mathematics – II | BSC | 3 | 1 | - | 30 | 70 | 100 | 4 |
| 3 | 18CH1201 | Engineering Chemistry | BSC | 3 | 1 | - | 30 | 70 | 100 | 4 |
| 4 | 18CS1201 | Data Structures | ESC | 2 | - | - | 30 | 70 | 100 | 2 |
| 5 | 18ME1201 | Engineering Mechanics - II | ESC | 3 | - | - | 30 | 70 | 100 | 3 |
| 6 | 18EN12L1 | English Language and Communication Skills Lab | HSMC | - | - | 3 | 30 | 70 | 100 | 1.5 |
| 7 | 18CH12L1 | Engineering Chemistry Lab | BSC | - | - | 3 | 30 | 70 | 100 | 1.5 |
| 8 | 18CS12L1 | Data Structures Lab | ESC | - | - | 2 | 30 | 70 | 100 | 1 |
| 9 | 18MC1201 | Indian Constitution | MC | 3 | - | - | - | - | - | - |
| **Total** | | | | **17** | **2** | **8** | **240** | **560** | **800** | **20** |
| **Total Periods Per Week** | | | | **27** | | | | | | |

## SECOND YEAR – SEMESTER - I

| S. No | Course Code | Course | Category | Number of Periods per Week | | | Scheme of Examination with Maximum Marks | | | No. of Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P/D | CIE | SEE | Total | C |
| 1 | 18ME2101 | Metallurgy and Materials Science | ESC | 3 | - | - | 30 | 70 | 100 | 3 |
| 2 | 18ME2102 | Mechanics of Solids | PCC | 3 | - | - | 30 | 70 | 100 | 3 |
| 3 | 18EE2101 | Basic Electrical Engineering | ESC | 3 | - | - | 30 | 70 | 100 | 3 |
| 4 | 18ME2103 | Fluid Mechanics and Hydraulic Machinery | PCC | 3 | 1 | - | 30 | 70 | 100 | 4 |
| 5 | 18ME2104 | Thermodynamics | PCC | 3 | 1 | - | 30 | 70 | 100 | 4 |
| 6 | 18ME21L1 | MMS and MOS Lab | PCC | - | - | 2 | 30 | 70 | 100 | 1 |
| 7 | 18EE21L1 | Basic Electrical Engineering Lab. | ESC | - | - | 2 | 30 | 70 | 100 | 1 |
| 8 | 18ME21L2 | Fluid Mechanics and Hydraulic Machinery Lab. | PCC | - | - | 2 | 30 | 70 | 100 | 1 |
| 9 | 18CH2101 | Environmental Science | MC | 3 | - | - | - | - | - | 0 |
| **Total** | | | | **18** | **02** | **06** | **240** | **540** | **800** | **20** |
| **Total Periods Per Week** | | | | **26** | | | **-** | **-** | **-** | |

## SECOND YEAR – SEMESTER - II

| S. No | Course Code | Course | Category | Number of Periods per Week | | | Scheme of Examination with Maximum Marks | | | No. of Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P/D | CIE | SEE | Total | C |
| 1 | 18ME2201 | Thermal Engineering - I | PCC | 3 | - | - | 30 | 70 | 100 | 3 |
| 2 | 18MA2201 | Computational Mathematics | BSC | 3 | - | - | 30 | 70 | 100 | 3 |
| 3 | 18ME2202 | Kinematics of Machinery | PCC | 3 | 1 | - | 30 | 70 | 100 | 4 |
| 4 | 18ME2203 | Production Technology - I | PCC | 3 | - | - | 30 | 70 | 100 | 3 |
| 5 | **Open Elective - 1** | | OEC | 3 | - | - | 30 | 70 | 100 | 3 |
| | 18CE2221 | Global Warming and Climate Change (CE) | | | | | | | | |
| | 18EE2222 | Industrial Safety and Hazards (EEE) | | | | | | | | |
| | 18EC2224 | Electronic Measuring Instruments (ECE) | | | | | | | | |
| | 18CS2225 | JAVA Programming (CSE) | | | | | | | | |
| | 18MB2226 | Intellectual Property Rights (MBA) | | | | | | | | |
| 6 | 18ME22L1 | Thermal Engineering - I Lab. | PCC | - | - | 2 | 30 | 70 | 100 | 1 |
| 7 | 18MA22L1 | Computational Mathematics Lab | BSC | - | - | 2 | 30 | 70 | 100 | 1 |
| 8 | 18ME22L2 | Machine Drawing with Auto CAD Lab. | ESC | - | - | 2 | 30 | 70 | 100 | 1 |
| 9 | 18ME22L3 | Production Technology – I Lab. | PCC | - | - | 2 | 30 | 70 | 100 | 1 |
| **Total** | | | | **15** | **01** | **8** | **270** | **630** | **900** | **20** |
| **Total Periods Per Week** | | | | **24** | | | | | | |

## THIRD YEAR – SEMESTER - I

| S. No | Course Code | Course | Category | Number of Periods per Week | | | Scheme of Examination with Maximum Marks | | | No. of Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P/D | CIE | SEE | Total | C |
| 1 | 18ME3101 | Production Technology - II | PCC | 3 | - | - | 30 | 70 | 100 | 3 |
| 2 | 18ME3102 | Dynamics of Machinery | PCC | 3 | - | - | 30 | 70 | 100 | 3 |
| 3 | 18ME3103 | Thermal Engineering - II | PCC | 3 | - | - | 30 | 70 | 100 | 3 |
| 4 | 18ME3104 | Design of Machine Elements - I | PCC | 3 | - | - | 30 | 70 | 100 | 3 |
| 5 | **Professional Elective - I** | | PEC | 3 | - | - | 30 | 70 | 100 | 3 |
| | 18ME3105 | Advanced Welding Technology | | | | | | | | |
| | 18ME3106 | Mechanical Vibrations | | | | | | | | |
| | 18ME3107 | Automobile Engineering | | | | | | | | |
| | 18ME3108 | Materials Management | | | | | | | | |
| 6 | 18ME31L1 | Production Technology - II Lab | PCC | - | - | 2 | 30 | 70 | 100 | 1 |
| 7 | 18ME31L3 | Kinematics and Dynamics Lab | PCC | - | - | 2 | 30 | 70 | 100 | 1 |
| 8 | 18EN31L1 | Advanced English Communication Skills Lab. | HSMC | - | - | 2 | 30 | 70 | 100 | 1 |
| 9 | 18ME3109 | Internship | PROJ-I | - | - | 4 | 100 | - | 100 | 2 |
| **Total** | | | | **15** | **-** | **10** | **340** | **560** | **900** | **20** |
| **Total Periods Per Week** | | | | **25** | | | | | | |

**Note:** Students have to undergo Summer Internship during the summer vacation of II Year B.Tech II Semester, which shall be evaluated internally during III Year B.Tech I Semester. There is no Semester End Examination for this Summer Internship**.**

## THIRD YEAR – SEMESTER - II

| S. No | Course Code | Course | Category | Number of Periods per Week | | | Scheme of Examination with Maximum Marks | | | No. of Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P/D | CIE | SEE | Total | C |
| 1 | 18ME3201 | Finite Element Analysis | PCC | 3 | - | - | 30 | 70 | 100 | 3 |
| 2 | 18ME3202 | Design of Machine Elements - II | PCC | 3 | 1 | - | 30 | 70 | 100 | 4 |
| 3 | 18ME3203 | CAD/CAM | PCC | 3 | - | - | 30 | 70 | 100 | 3 |
| 4 | 18ME3204 | Heat Transfer | PCC | 3 | 1 | - | 30 | 70 | 100 | 4 |
| 5 | **Professional Elective -II** | | PEC | 3 | - | - | 30 | 70 | 100 | 3 |
| | 18ME3205 | Unconventional Machining Processes | | | | | | | | |
| | 18ME3206 | Gas Dynamics | | | | | | | | |
| | 18ME3207 | Robotics | | | | | | | | |
| | 18ME3208 | Tool Design | | | | | | | | |
| 6 | 18ME32L1 | Finite Element Analysis Lab. | PCC | - | - | 2 | 30 | 70 | 100 | 1 |
| 7 | 18ME32L2 | CAD/CAM Lab. | PCC | - | - | 2 | 30 | 70 | 100 | 1 |
| 8 | 18ME32L3 | Heat Transfer Lab. | PCC | - | - | 2 | 30 | 70 | 100 | 1 |
| 9 | 18MB3203 | Professional Ethics | MC | 3 | - | - | - | - | - | - |
| **Total** | | | | **18** | **02** | **06** | **240** | **560** | **800** | **20** |
| **Total Periods Per Week** | | | | **26** | | | | | | |

## FOURTH YEAR – SEMESTER - I

| S. No | Course Code | Course | Category | Number of Periods per Week | | | Scheme of Examination with Maximum Marks | | | No. of Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P/D | CIE | SEE | Total | C |
| 1 | 18ME4110 | Operations Research | HSMC | 3 | - | - | 30 | 70 | 100 | 3 |
| 2 | 18MB4102 | Engineering Economics and Accounting | HSMC | 3 | - | - | 30 | 70 | 100 | 3 |
| 3 | **Professional Elective - III** | | PEC | 3 | - | - | 30 | 70 | 100 | 3 |
| | 18ME4101 | Mechatronics | | | | | | | | |
| | 18ME4102 | Refrigeration and Air Conditioning | | | | | | | | |
| | 18ME4103 | Advanced Mechanics of Solids | | | | | | | | |
| | 18ME4104 | Automation in Manufacturing | | | | | | | | |
| 4 | **Professional Elective - IV** | | PEC | 3 | - | - | 30 | 70 | 100 | 3 |
| | 18ME4105 | Additive Manufacturing | | | | | | | | |
| | 18ME4106 | Mechanics of Composite Materials | | | | | | | | |
| | 18ME4107 | Production Planning and Control | | | | | | | | |
| | 18ME4108 | Power Plant Engineering | | | | | | | | |
| 5 | **Open Elective - II** | | OEC | 3 | - | - | 30 | 70 | 100 | 3 |
| | 18CE4131 | Building Technology (CE) | | | | | | | | |
| | 18EE4132 | Energy Conservation and Management (EEE) | | | | | | | | |
| | 18EC4134 | Principles of Communication Systems (ECE) | | | | | | | | |
| | 18CS4135 | Knowledge Management (CSE) | | | | | | | | |
| | 18MB4136 | Supply Chain Management (MBA) | | | | | | | | |
| 6 | 18ME41L1 | Digital Fabrication Lab | PCC | - | - | 2 | 30 | 70 | 100 | 1 |
| 7 | 18ME41L2 | Production Drawing Practice with AutoCAD Lab | ESC | - | - | 2 | 30 | 70 | 100 | 1 |
| 8 | 18ME41L3 | Operations Research Lab | HSMC | - | - | 2 | 30 | 70 | 100 | 1 |
| 9 | 18ME4109 | Mini Project | PROJ-M | - | - | 4 | 30 | 70 | 100 | 2 |
| | | | **Total** | **15** | **-** | **10** | **270** | **630** | **900** | **20** |
| | | **Total Periods Per Week** | | **25** | | | **-** | **-** | **-** | |

## FOURTH YEAR – SEMESTER - II

| S. No | Course Code | Course | Category | Number of Periods per Week | | | Scheme of Examination with Maximum Marks | | | No. of Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P/D | CIE | SEE | Total | C |
| 1 | **Professional Elective - V** | | PEC | 3 | - | - | 30 | 70 | 100 | 3 |
| | 18ME4201 | Industrial Management | | | | | | | | |
| | 18ME4202 | Advanced metal Forming | | | | | | | | |
| | 18ME4203 | Engineering Acoustics | | | | | | | | |
| | 18ME4204 | Computational Fluid Dynamics | | | | | | | | |
| 2 | **Professional Elective - VI** | | PEC | 3 | - | - | 30 | 70 | 100 | 3 |
| | 18ME4205 | Total Quality Management | | | | | | | | |
| | 18ME4206 | Renewable Energy Sources | | | | | | | | |
| | 18ME4207 | Tribology | | | | | | | | |
| | 18ME4208 | Fluid Power Systems | | | | | | | | |
| 3 | **Open Elective - III** | | OEC | 3 | - | - | 30 | 70 | 100 | 3 |
| | 18CE4241 | Disaster Management | | | | | | | | |
| | 18EE4242 | Micro-Electro-Mechanical Systems (EEE) | | | | | | | | |
| | 18EC4244 | Biomedical Instrumentation (ECE) | | | | | | | | |
| | 18CS4245 | Database Systems (CSE) | | | | | | | | |
| | 18MB4246 | Entrepreneurship (MBA) | | | | | | | | |
| 4 | 18ME4209 | Technical Seminar | PROJ-TS | - | - | 2 | 30 | 70 | 100 | 1 |
| 5 | 18ME4210 | Major Project | PROJ | - | - | 20 | 30 | 70 | 100 | 10 |
| | | **Total** | | **09** | **-** | **22** | **150** | **350** | **500** | **20** |
| | | **Total Periods Per Week** | | **31** | | | - | - | - | |

| Sl. No | Category | Breakup of Credits by GCET | Suggested Breakup of Credits by AICTE |
|---|---|---|---|
| 1. | Humanities and Social Sciences including Management courses | 12.5 | 12 |
| 2. | Basic Science Courses | 23 | 25 |
| 3. | Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computers etc. | 25.5 | 24 |
| 4. | Professional Core courses | 57 | 48 |
| 5. | Professional Elective courses relevant to chosen specialization/branch | 18 | 18 |
| 6. | Open subjects - Electives from other technical and/or elsewhere | 9 | 18 |
| 7. | Project work, seminar and internship in industry or elsewhere | 15 | 15 |
| 8. | Mandatory Courses (Environmental Sciences, Induction Program, Indian Constitution, Human Values and Professional Ethics | Non-credit | Non-credit |
| | **Total** | **160** | **160** |

| S.No | Broad Course Classification | Course Group/Category | Course Description |
|---|---|---|---|
| 1 | **Foundation Courses ( FnC )** | BS-Basic Sciences | Includes Mathematics , Physics and Chemistry courses |
| 2 | | ES-Engineering Sciences | Includes Fundamental Engineering courses |
| 3 | | HS-Humanities and Social sciences | Includes courses related to humanities, Social Sciences and Management |
| 4 | **Core Courses (CoC)** | PC-Professional Core | Includes core courses related to parent discipline/department/ branch of Engineering |
| 5 | **Elective Courses ((EℓC)** | PE-Professional Electives | Includes elective courses related to parent discipline / department / branch of Engineering |
| 6 | | OE-Open Electives | Elective Courses Which include interdisciplinary course or courses in an area outside the parent discipline/department /branch of engineering |
| 7 | **Core Courses** | Project Work | B.Tech Project |
| 8 | | Internship/Mini Project/Technical Seminar | Internship/Mini- Project/Technical Seminar |

# OPEN ELECTIVES

Open Electives offered by a Department SHOULD NOT be taken by the students of the same department

**Open Elective I**

| S. No. | Course Title | Course Code |
|---|---|---|
| 21 | Global Warming and Climate Change (CE) | 18CE2221 |
| 22 | Industrial Safety and Hazards (EEE) | 18EE2222 |
| 23 | Electronic Measuring Instruments (ECE) | 18EC2224 |
| 24 | JAVA Programming (CSE) | 18CS2225 |
| 25 | Intellectual Property Rights (MBA) | 18MB2226 |

**Open Elective II**

| S. No. | Course Title | Course Code |
|---|---|---|
| 31 | Building Technology (CE) | 18CE4131 |
| 32 | Energy Conservation and Management (EEE) | 18EE4132 |
| 33 | Principles of Communication Systems (ECE) | 18EC4134 |
| 34 | Knowledge Management (CSE) | 18CS4135 |
| 35 | Supply Chain Management (MBA) | 18MB4136 |

**Open Elective III**

| S. No. | Course Title | Course Code |
|---|---|---|
| 41 | Disaster Management (CE) | 18CE4241 |
| 42 | Micro-Electro-Mechanical Systems (EEE) | 18EE4242 |
| 43 | Biomedical Instrumentation (ECE) | 18EC4244 |
| 44 | Database Systems (CSE) | 18CS4245 |
| 45 | Entrepreneurship (MBA) | 18MB4246 |

# SYLLABUS

## I YEAR B. Tech I SEMESTER

# 18PH1101 – ENGINEERING PHYSICS

**B. Tech. ME- I Year, I Semester**

| L | T | P/D | C |
|---|---|---|---|
| 3 | 1 | - | 4 |

**Prerequisite(s):** None

**Course objectives:** Develop ability to,

1. Understand the concepts of laws of motion and conservation of momentum and energy.
2. Distinguish different types of harmonic oscillations.
3. Understand the propagation of waves in strings and distribution of energy.
4. Understand the concepts of interference and diffraction.
5. Understand the concepts of light amplification, working of various types of lasers, optical fibers and their applications.

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

**CO1:** Interpret and apply the laws of motion, conservation of momentum and energy.
**CO2:** Explain the difference between electrical and mechanical oscillations.
**CO3:** Demonstrate the wave propagation and energy distribution in strings.
**CO4:** Demonstrate the optical phenomena of interference and diffraction.
**CO5:** Explain the phenomena of light amplification process, construction and working of different types of lasers, fiber optics and their applications in different fields.

**UNIT-I: Introduction to Mechanics:** Introduction, Space and Time, Newton's laws of motion, Inertial frames, Mechanics of a particle: Conservation of linear momentum, Conservation of angular momentum, Conservation of energy. Forces in nature: conservative and non-conservative forces, Central forces and examples, main features of central force, conservative force as a negative gradient of potential energy (F= -grad U), Curl of a conservative force.

**UNIT-II: Harmonic Oscillations:** Simple harmonic oscillators, Mechanical and Electrical oscillators, Damped harmonic oscillator: over, critical and under damping, energy and power dissipation and quality factor of damped harmonic oscillator, steady state motion of forced

damped harmonic oscillator. Electrical analogy for a simple oscillator, mechanical and electrical impedance

**UNIT-III: Waves in one dimension:** Transverse wave on a string, wave equation on a string, harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their Eigen frequencies , longitudinal waves and the wave equations for them. Acoustic waves and speed of sound, standing sound waves

**UNIT-IV: Wave Optics:** Huygens principle, superposition of waves and interference of light by wave front splitting and amplitude splitting, Young's double slit experiment, Newton's rings, Michelson's interferometer anti-reflection coatings. Introduction to diffraction, diffraction due to single slit, double slit and diffraction grating

**UNIT-V: Lasers and Fiber Optics Laser:** Interaction of radiation with matter: absorption, spontaneous emission and stimulated emission. Characteristics of laser, resonating cavity, active medium, pumping methods and mechanisms, population inversion, construction and working of lasers: Nd : YAG laser, He-Ne laser, Carbon dioxide ($CO_2$) laser, applications of lasers.

**Fiber Optics:** Introduction, total internal reflection, acceptance angle, acceptance cone and numerical aperture, step and graded index optical fibers, losses associated with optical fibers, applications of optical fibers.

**TEXT BOOKS:**

1. Engineering Mechanics, MK Harbola, Cengage Learning, 2nd edition, 2009.
2. Vibrations and waves in physics, I. G. Main, Cambridge University Press, 3rd edition, 2018.

**REFERENCE BOOKS:**

1. Optics, Ajoy Ghatak, McGraw Hill Education, 2012.
2. The physics of vibrations and waves, H. J. Pain, Wiley,2006.
3. Principles of Lasers, O. Svelto, Springer, 5th edition, 2010.
4. Introduction to Mechanics, M.K.Verma, Universities Press, 2008.

## 18MA1101 - MATHEMATICS-I

**B. Tech. ME - I Year, I Semester**

**Prerequisite(s):** None.

| L | T | P/D | C |
|---|---|---|---|
| 3 | 1 | - | 4 |

**Course Objectives:** Develop ability to

1. Understand various types of matrices, properties and rank of the matrix to find the solution for system of equations, if it exists.
2. Apply the knowledge of eigenvalues and eigenvectors of a matrix from quadratic form into a canonical form through linear and orthogonal transformations.
3. Identify the methods of solving the differential equations of first order and applications in engineering problems namely, Newton's law of cooling, Natural growth and decay.
4. Solve second and higher order differential equations of various types.
5. Analyze properties of Laplace Transform, Inverse Laplace Transform, convolution theorem and their applications to ordinary differential equations.

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

**CO1:** Write the matrix representation of a set of linear equations and analyse solution of a system of equations.

**CO2:** Deduce eigenvalues and eigenvectors of a matrix and apply the same to reduce quadratic form into a canonical form through linear and orthogonal transformations

**CO3:** Identify the type of differential equation and use the appropriate method to solve the same.

**CO4:** Apply higher order differential equations to solve engineering problems.

**CO5:** Solve Ordinary differential equations of second and higher order using Laplace Transform techniques.

**UNIT-I: Matrices :** Matrices: Types of Matrices, Symmetric; Hermitian; Skew-symmetric; Skew-Hermitian; orthogonal matrices; Unitary Matrices; rank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss-Jordan method; System of linear equations; solving system of Homogeneous and Non-Homogeneous equations. Gauss elimination method.

**UNIT-II: Eigenvalues and Eigenvectors:** Linear Transformation and Orthogonal Transformation: Eigenvalues and Eigenvectors and their properties: Diagonalization of a matrix; Cayley-Hamilton Theorem (without proof); finding inverse and power of a matrix by Cayley-Hamilton Theorem; Quadratic forms and Nature of the Quadratic Forms; Reduction of Quadratic form to canonical forms by Orthogonal Transformation.

**UNIT-III: First Order Ordinary Differential Equations:** Exact, linear and Bernoulli's equations; Applications: Newton's law of cooling, Law of Natural Growth and Decay; Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

**UNIT-IV: Ordinary Differential Equations of Higher Order:** Second and higher order linear differential equations with constant coefficients, Non homogeneous of the type $e^{ax}$, sin ax, cos ax , $x^n$, $e^{ax}V(x)$, and $xV(x)$ ; Method of variation of parameters; Equations reducible to linear ODE with constant coefficients: Legendre's equation, Cauchy-Euler equation.

**UNIT-V: Laplace Transforms:** Definition of Laplace transform, domain of the function and Kernel for the Laplace transforms. Existence of Laplace transforms. Laplace transform of standard functions, first shifting theorem, Laplace transform of functions when they are multiplied or divided by "t". Laplace transforms of derivatives and integrals of functions-Unit step function-second shifting theorem-Dirac's delta function, Periodic function-Inverse Laplace transform by Partial fractions (Heaviside method), Inverse Laplace transforms of functions when they are multiplied or divided by "s". Inverse Laplace transforms of derivatives and integrals of functions, Convolution theorem-Applications to ordinary differential equations.

**TEXT BOOKS :**

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, 44th Edition, 2017.
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 10th Edition, 2011.

**REFERENCE BOOKS:**

1. A Text book of Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Publications.
2. Higher Engineering Mathematics, Ramana B.V., Tata McGraw Hill, New Delhi.
3. Engineering Mathematics, Paras Ram, 2nd Edition, CBS Publishers.

## 18CS1101 - PROGRAMMING FOR PROBLEM SOLVING

**B. Tech. ME - I Year, I Semester**

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

**Pre-requisite(s):** None.

**Course Objectives:** Develop ability to

1. Solve problems by developing algorithms to solve problems using Raptor tool.
2. Understand the concepts of variables, constants, basic data types and input and output statement in a C programming language.
3. Understand the use of sequential, selection and repetition control statements into the algorithms implemented using C programming language.
4. Understand of structured design by implementing programs with functions and passing of parameters to solve more complex problems.
5. Understand the concepts related to arrays, strings and pointers and also with dynamic memory allocation in the context of C programming language.

**Course Outcomes:** After completion of the course, student would be able to

**CO1:** Demonstrate problem solving skills by developing algorithms to solve problems using Raptor tool.

**CO2:** Incorporate the concept of variables, constants, basic data types and input and output statement in a C language program.

**CO3:** Incorporate the use of sequential, selection and repetition control statements into the algorithms implemented as computer programs using C language.

**CO4:** Demonstrate an understanding of structured design by implementing programs with functions and passing of parameters to solve more complex problems.

**CO5:** Write C programs using arrays, strings and pointers and also with dynamic memory allocation.

**UNIT – I: Basics of Computers : Logic Building:** Flow chart, Algorithm, Pseudo code. Introduction to Raptor Programming Tool

**Introduction to Programming** – Computer Languages, Creating and running programs, Program Development.

**Introduction to the C Language** – Background, C Programs, Identifiers, Data Types, Variables, Constants, Input/output functions.

**Operators** - Arithmetic, relational, logical, bitwise, conditional, increment/decrement, assignment etc.., C program examples. Expressions, Precedence and Associativity, Expression Evaluation, Type conversions.

**UNIT – II: Statements- Selection Statements (decision making)** – if and switch statements with Raptor Tool, and C program examples.

**Repetition statements (loops)** - while, for, do-while statements with Raptor Tool, and C Program examples

**Statements related to looping** – break, continue, goto, Simple C Program examples.

**UNIT – III: Functions:** Designing Structured Programs, Functions, user defined functions, inter function communication, Standard functions, Scope, Storage classes - auto, register, static, extern, scope rules, type qualifiers, C program examples.

**Recursion**- recursive functions, Limitations of recursion, example C programs

**UNIT –IV: Arrays:** Concepts, using arrays in C, arrays and functions, array applications, two – dimensional arrays, multidimensional arrays, C program examples.

**Strings** – Concepts, C Strings, String Input / Output functions, string manipulation functions, arrays of strings, string / data conversion, C program examples.

**UNIT – V: Pointers:** Introduction (Basic Concepts), Pointers for inter function communication, pointers to pointers, compatibility, void pointer, null pointer.

**Pointer Applications** - Arrays and Pointers, Pointer Arithmetic and arrays, passing an array to a function.

**Memory allocation functions** – malloc(), calloc(), realloc(), free().

Array of pointers, pointers to functions, C program examples.

**TEXT BOOK(S):**

1. Computer Science: A Structured Programming Approach Using C, B.A. Forouzan and R.F. Gilberg, 3rd Edition, Thompson Learning, 2007 Reprint.

**REFERENCE BOOKS:**

1. Raptor-A flow charting Tool http://raptor.martincarlisle.com
2. The C Programming Language, B.W. Kernighan and Dennis M. Ritchie, PHI.
3. Programming in C. P. Dey and M Ghosh , Oxford University Press.
4. Programming with C, B. Gottfried, 3rd edition, Schaum's outlines, TMH.
5. Problem Solving and Program Design in C, J.R. Hanly and E.B. Koffman, 7th Edition, Pearson education.

## 18ME1101– ENGINEERING MECHANICS - I

**B. Tech. ME - I Year, I Semester**

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

**Prerequisite(s):** None.

**Course Objectives:** Develop ability to

1. Understand basic terms, Represent and Analysis of forces to simplify any force system using free body diagram.
2. Accurately draw free body diagrams to determine various forces acting externally on a body to solve the problems when the body is under equilibrium condition.
3. Apply equilibrium equations to solve problems comprising frictional forces.
4. Determine centroid and centre of masses for discrete particles.
5. Determine moment of inertia for standard sections and composite bodies.

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

CO1. Describe position, forces, and moments in terms of vector notation in two and three dimensions.

CO2. Draw free body diagrams accurately and write appropriate equilibrium equations from the free body diagram, including support reactions.

CO3. Apply concepts of equilibrium to analyse systems that include frictional forces.

CO4. Calculate centroids and centres of mass for discrete particles.

CO5. Calculate moments of Inertia for standard sections and composite sections.

**UNIT-I: Introduction to Engineering Mechanics:** Types of force Systems, Basic concepts, Particle System of Forces, Coplanar Concurrent Forces.

Resultants of force system: Introduction, Parallelogram Law, force and components, Components in Space, Moment of Forces and principles of moments, Varignon's theorem and its Application, Couples and Resultant of Force System.

**UNIT-II: Equilibrium of force system:** Introduction, equilibrium in 2-D & 3-D; Rigid Body equilibrium, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems.

**UNIT-III: Friction:** Introduction, Theory of friction, Types of friction, Limiting friction, Angle of friction, Laws of Friction, cone of friction, Static and Dynamic Friction; Motion of Bodies, Block friction, ladder friction, wedge friction.

**UNIT-IV: Centroids and Center of Gravity:** Introduction, Centroid of Lines, Areas and Volumes from first principle, centroid of composite sections; Centre of Gravity and its implications. Theorem of Pappus.

**UNIT-V: Moments of Inertia:**Area moment of inertia: Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Product of Inertia, Parallel Axis Theorem, Perpendicular Axis Theorem.

Mass Moment of Inertia: Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, Mass moment of inertia of composite bodies.

**TEXT BOOKS :**

1. Engineering Mechanics, Ferdinand. L. Singer, Harper – Collins publishers, New Delhi. (1998).
2. Engineering Mechanics, S.S. Bhavikatti and J.G. Rajasekharappa, New Age International, India (2012).

**REFERENCE BOOKS:**

1. Engineering Mechanics, Timoshenko & Young, McGraw Hill, India (2007).
2. Engineering Mechanics, A.K. Tayal, Umesh Publications, New Delhi (2010).
3. Engineering Mechanics, R.S. Khurmi, S. Chand & Company Limited, New Delhi (2009).
4. Engineering Mechanics, K.L Kumar, Tata McGraw Hill, New Delhi (2009).
5. Engineering Mechanics, Irving. H. Shames, Prentice-Hall, India (1999).

## 18ME1102 - ENGINEERING GRAPHICS

**B Tech. ME - I Year, I Semester**

| L | T | P/D | C |
|---|---|---|---|
| 1 | - | 4 | 3 |

**Pre-requisite(s)**: None.

**Course objectives:** Develop ability to

1. Understand basic concepts in engineering drawing.
2. Understand the principle of orthographic projection and isometric projection for planes and solids.
3. Draw sectional views and development of surfaces.
4. Draw isometric views and pictorial views of solids.
5. Learn basic concepts and commands in AutoCAD.

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

**CO1:** Draw various curves and scales in engineering drawing practice.

**CO2:** Draw orthographic projections of points, lines and planes.

**CO3:** Draw orthographic projections of solids and sections.

**CO4:** Draw Isometric Views to Orthographic Views and Vice-versa and development of surfaces of objects.

**CO5:** Apply basic AutoCAD commands for engineered drawings.

**UNIT - I: Introduction to Engineering Drawing:** Principles of Engineering Graphics and their Significance, Conic Sections including the Rectangular Hyperbola – General method only. Cycloid, Epicycloid and Hypocycloid, Scales – Plain and Diagonal.

**UNIT - II: Orthographic Projections:** Principles of Orthographic Projections Conventions – Projections of Points and Lines, Projections of Plane regular geometric figures.

**UNIT - III:** Projections of Regular Solids, Sections or Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone, Sphere.

U**NIT - IV: Development of Surfaces of Right Regular Solids**: Prism, Cylinder, Pyramid and Cone.

**Isometric Projections:** Principles of Isometric Projection – Isometric Scale – Isometric Views –Conventions – Isometric Views of Lines, Plane Figures, Simple Solids – Isometric Projection of objects having non- isometric lines. Isometric Projection of Spherical Parts.

**UNIT - V:** Conversion of Isometric Views to Orthographic Views and Vice-versa – Conventions

**Introduction to CAD: (For Internal Evaluation Weightage only):**

Introduction to CAD Software Package Commands. - Free Hand Sketches of 2D- Creation of 2D Sketches by CAD Package.

**TEXT BOOKS :**

1. Engineering Drawing, N.D. Bhatt / Charotar, 53rd Edition 2016.
2. Engineering Drawing / Basant Agrawal and McAgrawal/ McGrawHill, 2nd Edition 2013.

**REFERENCE BOOKS:**

1. Engineering Drawing / N. S. Parthasarathy and Vela Murali/ Oxford, 1st Edition 2015.
2. Engineering Drawing/ M. B. Shah, B.C. Rane / Pearson, 2nd Edition 2013.
3. Computer Aided Engineering Drawing – K Balaveera Reddy, CBS Publishers. 2nd Edition 2015.

## 18PH11L1 - ENGINEERING PHYSICS LAB

**B. Tech. I Year I Semester - Common to CE and ME**

| L | T | P/D | C |
|---|---|---|---|
| - | - | 3/- | 1.5 |

**Pre-requisite(s): None**

**Course Objectives:** Develop ability to

1. Determine the frequency of a given tuning fork and AC source.
2. Determine the moduli of elasticity and coupling constant.
3. Determine radius of curvature of a plano convex lens, dispersive power of given prism and number of lines drawn on grating per inch.
4. Determine the resonant frequency and quality factor of LCR circuit.
5. Determine the wavelength of a given laser source, numerical aperture and attenuation of optical fiber.

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

**CO1:** Compute the frequency of tuning fork and AC source.

**CO2:** Infer the moduli of elasticity of given material, explain the concept of conservation of energy and resonance.

**CO3:** Demonstrate the optical phenomena like interference and diffraction.

**CO4:** Compute the resonance frequency and quality factor of a LCR circuit.

**CO5:** Calculate the wavelength of given laser source and numerical aperture, bending losses in optical fiber.

**List of Experiments:**

1. **Melde's experiment:**
   To determine the frequency of a vibrating bar or tuning fork using Melde's arrangement.
2. **Torsional Pendulum:**
   To determine the rigidity modulus of the material of the given wire using torsional pendulum
3. **Sonometer:**
   To determine the frequency of AC source using sonometer and electromagnet.
4. **Newton's rings:**
   To determine the radius of curvature of the plano-convex lens by forming Newton's rings
5. **Diffraction grating:**
   To determine the number of lines per inch of the grating

6. **Dispersive power:**

   To determine the dispersive power of prism by using spectrometer

7. **Coupled oscillator:**

   To determine the coupling constant by single coupled oscillator.

8. **LCR Circuit:**

   To determine resonant frequency and quality factor of LCR circuit

9. **LASER:**

   To study the characteristics of LASER source

10. **Optical fibre:**

    To determine the bending loss in optical fibre

11. **Optical fibre:**

    To determine the Numerical aperture of a given optical fibre

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

# 18CS11L1 - PROGRAMMING FOR PROBLEM SOLVING LAB

**B. Tech. ME - I Year, I Semester**

| L | T | P/D | C |
|---|---|---|---|
| - | - | 2 | 1 |

**Pre-requisite(s):** None.

**Course Outcomes:** Develop ability to

1. Solve problems by developing algorithms to solve problems using Raptor tool.
2. Understand the concepts of variables, constants, basic data types and input and output statement in a C programming language.
3. Understand the use of sequential, selection and repetition control statements into the algorithms implemented using C programming language.
4. Understand of structured design by implementing programs with functions and passing of parameters to solve more complex problems.
5. Understand the concepts related to arrays, strings and pointers and also with dynamic memory allocation in the context of C programming language.

**Course Outcomes:** After completion of the course, student would be able to

**CO1:** Demonstrate problem solving skills by developing algorithms to solve problems using Raptor tool.

**CO2:** Incorporate the concept of variables, constants, basic data types and input and output statement in a C language program.

**CO3:** Incorporate the use of sequential, selection and repetition control statements into the algorithms implemented as computer programs using C language.

**CO4:** Demonstrate an understanding of structured design by implementing programs with functions and passing of parameters to solve more complex problems.

**CO5:** Write C programs using arrays, strings and pointers and also with dynamic memory allocation.

| **List of Experiments** | |
|---|---|
| 1 | Introduction to RAPTOR Tool<br>Draw Flow chart using RAPTOR for,<br>Read a number and Display the same number<br>Read and Display the student details<br>Read two numbers from user and calculate addition and subtraction of those numbers<br>Read two numbers from user at the time of execution and calculate multiplication and division of those numbers<br>Find the square of a given number (take the number from the user)<br>Calculate the value of Y from the equation $y = x^2 + 2x + 3$ (read the value of X from user) |
| 2 | Draw Flow chart using RAPTOR for,<br>Calculate the area of a Circle |

| | |
|---|---|
| | Calculate the area of a Square<br>Calculate the area of a Rectangle<br>Interchange two numbers<br>Find the sum of square of two numbers<br>Convert Centigrade to Fahrenheit<br>Convert Radius to Degrees<br>Display the roots of Quadratic Equation |
| 3 | Draw Flow chart using RAPTOR for,<br>Check the given number is Positive or Negative<br>Check the given number is even or odd<br>Display whether a person is eligible for vote or not<br>Calculate the Largest of two numbers<br>Check the given year is leap year or not<br>Check whether two numbers are equal or not<br>Find the largest value among three given numbers |
| 4 | Draw Flow chart using RAPTOR for,<br>Calculate and display the grade of a student<br>< 30 % - Fail<br>Between 31 and 50 – C grade<br>Between 51 to 60 – B grade<br>Between 61 to 75 – A grade<br>Greater than 75 - distinction<br>Find the quadratic roots of an equation ( real or imaginary)<br>Check the given number is multiple of 2, 4 and 8 |
| 5 | Draw Flow chart using RAPTOR for,<br>Display n numbers using looping<br>Calculate the sum of n natural numbers<br>Display the even numbers below n<br>Calculate sum of even numbers and odd numbers from 1 to n (n value supplied by the user) |
| 6 | Write a C program to display student details<br>Write a C program to perform arithmetic operations<br>Write a C program to implement increment and decrement operators<br>Write a C program to implement conditional operator<br>Write a C program to implement bit wise operator |
| 7 | Write a C program to calculate the biggest of given two numbers<br>Write a C Program to print the result depending on the following<br>< 30 % - Fail<br>Between 31 and 50 – C grade<br>Between 51 to 60 – B grade<br>Between 61 to 75 – A grade<br>Write a C Program to implement arithmetic calculator using switch case |
| 8 | Write a C program to find sum of n natural numbers<br>Write a C program to find individual digits of the given number<br>Write a C program to find factorial of a given number |

| | |
|---|---|
| 9 | Write a C program to display the prime numbers below n ( where n value is given by user)<br>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.<br>Write a C program to generate the first n terms of the sequence.<br>Write a C program to find the quadratic roots of an equations<br>Write a c program to calculate sum of the following geometric equation<br>Sum=$1+x+x^2+x^3+\ldots..+x^n$ |
| 10 | Write a C program to find the given number is palindrome or not<br>Write a C program to find GCD and LCM of two given numbers using functions<br>Write a C program to find the factorial of a given number using recursive function<br>Write a C program to generate the fibonacci series using recursive function |
| 11 | Write a C program to find largest and smallest numbers in a list of array elements using functions<br>Write a C program to sort the given list of elements in ascending order using functions.<br>Write a C program to search for a given element in the list of array and display the "location" if the number is found else print "the number is not found".<br>Using fixed length array<br>Using variable length array. |
| 12 | Find the duplicate elements in the list of sorted array<br>Write a C program that uses functions to perform the Addition of Two Matrices<br>Write a C program that uses functions to perform the Multiplication of Two Matrices |
| 13 | Write a C program to find weather a given string is palindrome or not.<br>Write a C program to insert characters at a given location in a given string.<br>Write a C program to delete characters from a given string and position<br>Write a C program to print the number of vowels and consonants using Strings. |
| 14 | Write a C program to convert Roman number to Decimal Number.<br>Write a C program to find the 2's Compliment of a given string<br>Write a C program to Reverse a String by Passing it to function<br>C Program to Input a String with at least one Number, Print the Square of all the Numbers in a String |
| 15 | Write a C program to swap two integers using following methods<br>call by value<br>call by reference<br>Write a C program to find sum of even and odd numbers using functions and pointers |
| 16 | Write a C program to find Largest Number Using Dynamic Memory Allocation.<br>Write a C program to return multiples values from a function using pointers |

## 18ME11L1 - ENGINEERING WORKSHOP

**B. Tech. ME - I Year, I Semester**

| L | T | P/D | C |
|---|---|---|---|
| - | - | 3 | 1.5 |

**Prerequisite(s):** None.

**Objective**: Develop ability to

1. Develop a right attitude, team working, precision and safety at work place.
2. Gain a good basic working knowledge required for the production of various engineering products.
3. Provide hands on experience about use of different engineering materials, tools, equipments and processes those are common in the engineering field.
4. Know the labour involved, required tools, machinery or equipment with necessary time required in actual working in different trades.
5. Identify and use of marking tools, hand tools, measuring equipment and to work with prescribed tolerances.

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

**CO1:** Recognize dignity of labour and workshop regulations.

**CO2:** Study and practice on hand, power tools and their operations.

**CO3:** Practice on manufacturing of components using workshop trades including plumbing, fitting, carpentry, foundry, and welding.

**CO4:** Identify and apply suitable tools for different trades of engineering processes including drilling, material removing, measuring, chiseling.

**CO5:** Perform various basic house wiring techniques.

**A) Trades for Exercises:**

**At least two exercises from each trade:**

a. **Carpentry**: T-lap joint, cross lap joint, mortise and tenon joint, Bridle joint, Corner lap joint.

b. **Fitting**: Square joint, V joint, half round joint, dovetail joint, L-Fitting.

c. **Tin-Smithy**: Tray, cylinder, hopper, funnel, Open scoop.

d. **Black Smithy**: Simple exercises such as upsetting, drawing down, punching, bending, swaging and fullering.

e. **House-wiring**: Wiring for two lamps (bulbs) with independent switch controls with or without looping, wiring for stair case lamp, wiring for a water pump with single phase starter.

f. **Foundry**: Preparation of sand mould using Single Piece pattern, Preparation of sand mould using Split pattern.

g. **Welding Practice**- Single butt joint, Corner Joint, T-filled Joint, Lap Joint.

**B) Trades for Demonstration:**

a. Plumbing

b. Machine Shop

**TEXT BOOKS :**

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

**REFERENCE BOOKS:**

1. Engineering Workshop practice for JNTU, V. Ramesh Babu, VRB Publishers Pvt. Ltd.
2. Workshop Manual / P.Kannaiah/ K.L.Narayana/ SciTech Publishers.
3. Engineering Practices Lab Manual, Jeyapoovan, Saravana Pandian, Vikas publishers
4. Dictionary of Mechanical Engineering, GHF Nayler, Jaico Publishing House.

# SYLLABUS

## I YEAR B. Tech II SEMESTER

## 18EN1201 - ENGLISH

**B. Tech. ME - I Year, II Semester**

**Prerequisite(s):** None.

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

**Course Objectives:** Develop ability to

1. Improve the language proficiency in English with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
2. Equip themselves to study the academic subjects more effectively and critically using the theoretical and practical components of English syllabus.
3. Develop Study Skills and Communication Skills in formal and informal situations.
4. Speak proficiently and listen effectively.

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

**CO1:** Infer /use the vocabulary appropriately in any situation

**CO2:** Construct meaningful and explicit sentences in written form.

**CO3:** Acquire basic proficiency in English including reading comprehension and writing skills.

**CO4:** Communicate confidently in various contexts and different cultures

**CO5:** Comprehend the given text and respond appropriately.

**CO6:** Speak proficiently and listen effectively.

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

**Vocabulary Building**: The Concept of Word Formation—The use of Prefixes and Suffixes, One-word Substitutes.

**Grammar:** Identifying Common Errors in Writing with Reference to Articles and Prepositions.

**Reading:** Reading and Its Importance- Techniques for Effective Reading.

**Basic Writing Skills:** Sentence Structures-Use of Phrases and Clause in Sentences-Importance of Proper Punctuation-Techniques for writing precisely–Paragraph writing–Types, Structures and Features of a Paragraph-Creating Coherence-Organizing Principles of Paragraphs in Documents.

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

**Vocabulary Building:** Synonyms and Antonyms.

**Grammar:** Identifying Common Errors in Writing with Reference to Noun-Pronoun Agreement and Subject-Verb Agreement.

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

**Writing:** Format of a Formal Letter- Writing Formal Letters, Letter of Complaint, Letter of Requisition, Job Application with Resume.

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

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

**Grammar:** Identifying Common Errors in Writing with Reference to Misplaced Modifiers and Tenses.

**Reading:** Sub-skills of Reading-Skimming and Scanning.

**Writing**: Nature and Style of Sensible Writing -Abstract writing..

**UNIT-IV: 'What Should You Be Eating' from the prescribed text book 'English for Engineers' Published by Cambridge University Press.**

**Vocabulary Building**: Standard Abbreviations in English.

**Grammar:** Redundancies and Clichés in Oral and Written Communication.

**Reading**: Comprehension-Intensive Reading and Extensive Reading.

**Writing: Writing Practices—**Writing- Introduction and Conclusion, Blog-Writing and Responding to a Blog, Essay Writing, Précis Writing.

**UNIT-V: How a Chinese Billionaire Built Her Fortune' from the prescribed textbook 'English for Engineers' published by Cambridge University Press.**

**Vocabulary Building**: Technical Vocabulary and their usage.

**Grammar:** Active and Passive voice.

**Reading:** Reading Comprehension-Exercises for Practice.

**Writing: Technical Reports**-Introduction–Characteristics of Report– Categories of Reports-Formats-Structure of Reports (Manuscript Format)-Types of Reports- Writing a Report.

**TEXT BOOK(S):**

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

**REFERENCE BOOKS:**

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

## 18MA1201 - MATHEMATICS-II

**B. Tech. ME - I Year, II Semester**

| L | T | P/D | C |
|---|---|---|---|
| 3 | 1 | - | 4 |

**Prerequisite(s):** 18MA1101-Mathematics –I

**Course Objectives:** Develop ability to

1. Understand geometrical approach to the mean value theorems, their application to the mathematical problems and evaluate improper integrals using Beta and Gamma functions.
2. Identify the methods of differential calculus to optimize single and multivariable functions.
3. Evaluate multiple integrals and apply the same to solve engineering problems.
4. Explain properties of vector operators. Use vector calculus to determine the length of a curve, area between the surfaces and volume of solids.
5. Apply partial differential equations to solve problems in one dimensional heat and wave equations.

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

**CO1:** Apply mean value theorem on mathematical problems, evaluate improper integrals, surface areas and volumes of revolutions of curves.

**CO2:** Apply the methods of differential calculus to optimize single and multivariable functions.

**CO3:** Evaluate multiple integrals and apply the concepts of same to find the areas and volumes.

**CO4:** Apply vector operators on scalar and vector point functions to compute length of a curve, area between the surfaces and volume of solids, using vector calculus.

**CO5:** Apply partial differential equations to solve problems like one dimensional wave equation and one dimensional heat equation that arise in engineering branches.

**UNIT-I: Mean value Theorems and Improper Integrals:** Mean value theorems: Rolle's Theorem, Lagrange's mean value theorem and Cauchy's mean value theorem with their Geometrical Interpretation and applications,. Taylor's Series.

Definition of Improper Integral: Beta and Gamma functions and their applications.

Applications of definite integrals to evaluate surface areas and volumes of revolutions of curves (Only in Cartesian coordinates).

**UNIT-II: Multivariable calculus (Partial Differentiation and applications)**

Definitions of Limit and continuity: Partial Differentiation; Euler's Theorem; Total derivative; Jacobian; Functional dependence and independence, Maxima and minima of functions of two variables and three variables using method of Lagrange multipliers.

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

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

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

Applications: Areas (by double integrals) and volumes (by double integrals and triple integrals).

**UNIT-IV: Vector Calculus**

Vector Differentiation: Vector point functions and Scalar point functions. Gradient, Divergence and Curl. Directional derivatives, Tangent plane and normal line. Vector Identities. Scalar potential functions. Solenoidal and Irrotational vectors.

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

**UNIT-V: Partial Differential Equations**

Introduction and Formation of partial differential equation by elimination of arbitrary constants and arbitrary functions, solutions of first order linear (Lagrange) equation, Method of separation of variables for second order equations –Applications of Partial differential equations- one dimensional wave equation and one dimensional heat equation.

**TEXT BOOKS :**

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, 44th Edition, 2017.
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 10th Edition, 2011.

**REFERENCE BOOKS:**

1. A Text book of Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Publications.
2. Higher Engineering Mathematics, Ramana B.V., Tata McGraw Hill New Delhi.
3. Engineering Mathematics, Paras Ram, 2nd Edition, CBS Publishers.

## 18CH1201- ENGINEERING CHEMISTRY

**B. Tech. ME - I Year, II Semester**

| L | T | P/D | C |
|---|---|---|---|
| 3 | 1 | - | 4 |

**Prerequisite(s):** None.

**Course objectives:** Develop ability to

1. Bring adaptability to the concepts of chemistry and to impart the basic knowledge of atomic, molecular and electronic modifications which makes the student to understand the technology based on them.
2. Solve the problem of hardness and acquire the knowledge of various water treatment methods.
3. Acquire the knowledge of electrochemistry and corrosion which are essential for engineers to understand the problem of corrosion in industry.
4. Impart the knowledge of reaction mechanisms and synthetic aspects useful for understanding reaction pathways.
5. Acquire the knowledge on various spectroscopic techniques and apply them for medical and other fields.

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

**CO1:** Explain atomic, molecular and electronic changes.

**CO2:** Explain hardness of water and its treatment methods.

**CO3:** Explain the principles and concepts of electrochemistry. Understand the problem of corrosion in industry.

**CO4:** Explain various reaction mechanisms and apply them in synthesis of organic compounds.

**CO5:** Apply required skills of various spectroscopic techniques in medical and other fields.

**UNIT – I: Molecular structure and Theories of Bonding :**Atomic and Molecular orbitals. Linear Combination of Atomic Orbitals (LCAO), Molecular orbitals of diatomic molecules, molecular orbital energy level diagrams of $N_2$, $O_2$ and $F_2$ molecules. Crystal Field Theory (CFT): Salient Features of CFT – Crystal Field Splitting of transition metal ion d- orbitals in Tetrahedral and Octahedral geometries. Crystal Field Stabilization Energies (CFSE). Applications of CFT- Magnetic Properties of the Octahedral and Tetrahedral Complexes.

**UNIT - II: Water and its treatment:** Introduction – hardness of water – Causes of hardness - Types of hardness: temporary and permanent – expression and units of hardness – Estimation of hardness of water by complexometric method. Potable water and its specifications. Steps involved in treatment of water – Disinfection of water by chlorination and ozonization. Boiler feed water and its treatment – Calgon conditioning, Phosphate conditioning and Colloidal conditioning. External treatment of water – Ion exchange process. Desalination of water - Reverse osmosis. Numerical problems.

**UNIT - III: Electrochemistry and corrosion:** Electro chemical cells – electrode potential, standard electrode potential, types of electrodes – calomel, Quinhydrone and glass electrode. Nernst equation Determination of pH of a solution by using quinhydrone and glass electrode. Electrochemical series and its applications. Numerical problems. Potentiometric titrations. Batteries – Primary (Lithium cell) and secondary batteries (Lead – acid storage battery and Lithium ion battery).

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

**UNIT - IV: Reaction Mechanisms and molecules of industrial importance: Reaction Mechanisms:** Substitution reactions: Nucleophilic substitution reactions: Mechanism of $S_N1$, $S_N2$ reactions. Electrophilic and nucleophilic addition reactions: Addition of HBr to propene. Markownikoff's and anti Markownikoff'sadditions. Grignard additions on carbonyl compounds. Elimination reactions: Dehydro halogenation of alkylhalides. Saytzeff rule. Oxidation reactions: Oxidation of alcohols using $KMnO_4$ and chromic acid.

Reduction reactions: reduction of carbonyl compounds using $LiAlH_4$ & $NaBH_4$. Hydroboration of olefins. Structure, synthesis and pharmaceutical applications of Paracetamol and Aspirin.

**Polymers**

Classification of polymers, Types of Polymerization–addition and condensation, differences between addition and condensation polymers, Mechanism of free radical addition polymerization. Preparation, properties and engineering applications of PVC, Teflon and Nylon-6, 6.

**UNIT - V: Spectroscopic techniques and applications:** Principles of spectroscopy, selection rules and applications of electronic spectroscopy. vibrational and rotational spectroscopy. Basic

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

**TEXT BOOKS :**

3. Text book of Engineering Chemistry by Dr.A. Jayashree, Wiley publication, New-Delhi, 2018.
4. Engineering Chemistry by Dr. Thirumala Chary and Dr. E. Laxminarayana, Scitech publications, 2018.

**REFERENCE BOOKS:**

1. Selected topics in Inorganic Chemistry by Wahid U. Malik, G.D. Tuli and R.D Madan. S. Chand Publications, 17th Edition.
2. Elements of Physical Chemistry, by P.W. Atkins 4th Edition.
3. Fundamentals of Molecular Spectroscopy, by C.N. Ban well, 4th Edition.
4. Organic Chemistry: Structure and Function by K.P.C. Volhardt and N.E. Schore, 5th Edition.

## 18CS1201 - DATA STRUCTURES

**B. Tech. ME - I Year, II Semester**

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

**Prerequisite(s): 18CS1101-Programming for Problem Solving**.

**Course Objectives:** Develop ability to

1. Introduce the structure, union, and enumerated types
2. Introduce to linear lists, implementation using arrays and linked list.
3. Understand the classical approaches to sorting arrays: selection sort, bubble sort, insertion sort; sequential and binary searching algorithms.
4. Concepts and principles of stacks and queues and their applications.
5. Understand the basic characteristics of text, binary files and C implementation of file I/O using streams. Introduction to Non-linear data structures.

**Course Outcomes:** After completion of the course, student would be able to

CO1. Use the type definition, enumerated types, define and use structures, unions in programs using C language.

CO2. Understand the time and space complexity. Ability to implement linear lists.

CO3. Write programs that sort data using selection, bubble, insertion sort techniques and perform search mechanisms either by sequential or binary search techniques using C language program.

CO4. Demonstrate the basic operations of stacks and queues using C program.

CO5. Write programs that read and write text, binary files using the formatting and character I/O functions. Define basic non-linear list terminologies.

**UNIT – I: Enumerated Types**– The Type Definition (typedef), Enumerated types

**Structure and Union Types** – Declaration, initialization, accessing structures, operations on structures, Complex structures, Structures and functions, passing structures through pointers, self referential structures, unions, bit fields.

Command line arguments, Preprocessor commands.

**UNIT – II:** Basic concept of order of complexity through the example programs

**Linear list** - Singly linked list implementation, insertion, deletion and searching operations on linear list

**UNIT – III: Sorting** - Selection sort, bubble sort, insertion sort techniques (Using Arrays)

**Searching** - Linear search, binary search techniques (Using Arrays)

**UNIT – IV: Stacks** – Introduction, Principle, Operations: Push and Pop, In-fix to Post-Fix Conversion and Post-Fix evaluation. (Array implementation.)

**Queues** - Introduction, Principle, Operations: Enqueue and Dequeue. (Array implementation.)

**UNIT – V: File Input and Output**

Concept of a file, 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.

**Program Development** – Multi-source files, Separate Compilation of functions

**Basic Non-Linear Data Structures:** Introduction, Definition and terminology of Trees, Graphs.

**TEXT BOOK(S):**

1. Computer Science: A Structured Programming Approach Using C, B.A. Forouzan and R.F. Gilberg, Thompson Learning, 3rd Edition, 2007 Reprint.

**REFERENCE BOOKS:**

1. The C Programming Language, B.W. Kernighan and Dennis M.Ritchie, PHI.
2. Programming in C. P. Dey and M Ghosh , Oxford University Press.
3. Programming with C, B.Gottfried, 3rd edition, Schaum's outlines, TMH.
4. Problem Solving and Program Design in C, J.R. Hanly and E.B. Koffman, 7th Edition, Pearson education.
5. C & Data structures – P. Padmanabham, 3rd Edition, B.S. Publications.

## 18ME1201 – ENGINEERING MECHANICS - II

**B. Tech. ME. I Year, II Semester**

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

**Prerequisite(s):** None.

**Course Objectives:** Develop ability to

1. Understand connection of forces in trusses and in general frame structures.
2. Understand the principles of dynamics to engineering problems.
3. Understand principles of kinematics and kinetics of particles.
4. Understand the concepts of work energy principle.
5. Understand the concepts of mechanical vibrations.

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

**CO1:** Calculate and analyse the forces in members and structures by the method of joints and method of sections.

**CO2:** Apply the principles of dynamics to solve various engineering problems.

**CO3:** Apply the principles of kinematics, kinetics to find the solutions of various problems in straight and curvilinear motions.

**CO4:** Apply the concepts of work energy principle associated with dynamics to solve engineering problems.

**CO5:** Apply the concepts of mechanical vibrations associated with dynamics to solve engineering problems.

**UNIT-I: Analysis of structures:** Introduction, Elements of trusses, Types of Trusses, Assumptions for truss analysis, construction of trusses, Analysis of trusses - method of joints, method of sections.

**UNIT-II: Kinematics of a particle:** Review of particle dynamics- Rectilinear motion, Plane curvilinear motion (rectangular, path, and polar coordinates), Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work- kinetic energy, power, potential energy.

**UNIT-III: Kinetics of particles:** Introduction, Kinetics of Rigid Bodies -Basic terms, general principles in dynamics, Types of motion, D'Alembert's principle and its applications in plane motion and connected bodies

**UNIT-IV: Work Energy Method:** Introduction, Work Energy principle and its application in plane motion of connected bodies, Work energy equation for translation, Interpretation and computation of work, work energy applied to particle motion.

**UNIT-V: Mechanical Vibrations:**Introduction, Definitions and concepts, Simple Harmonic Motion, Free vibration, Simple Pendulum, Compound Pendulum, Torsion Pendulum, Free Vibrations with Damping General case.

**TEXT BOOKS :**

1. Engineering Mechanics, Ferdinand. L. Singer, Harper – Collins publishers, New Delhi, (1998).
2. Engineering Mechanics, S.S. Bhavikatti & J.G. Rajasekharappa, New Age International, India, (2012).

**REFERENCE BOOKS:**

1. Engineering Mechanics, Timoshenko & Young, McGraw Hill, India (2007).
2. Engineering Mechanics, A.K. Tayal, Umesh Publications, New Delhi (2010).
3. Engineering Mechanics, R.S. Khurmi,S. Chand & Company Limited, New Delhi, (2009).
4. Engineering Mechanics, K.L Kumar, Tata McGraw Hill, New Delhi (2009).
5. Engineering Mechanics, Irving. H. Shames, Prentice-Hall, India (1999).

## 18EN12L1 - ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB

**B. Tech. ME - I Year, II Semester**

| L | T | P/D | C |
|---|---|---|---|
| - | - | 3 | 1.5 |

**Prerequisite(s):** None**.**

**Course Objectives:** Develop ability to

1. Facilitate computer-assisted multi-media instruction enabling individualized and independent language learning.
2. Sensitize students to the nuances of English speech sounds, word accent, intonation and rhythm.
3. Bring about a consistent accent and intelligibility in students' pronunciation of English by providing an opportunity for practice in speaking.
4. Improve the fluency of students in spoken English and neutralize their Mother Tongue Influence.
5. Train students to use language appropriately for public speaking and interviews.

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

**CO1:** Listen actively, speak fluently and write accurately.

**CO2:** Speak with clarity and confidence reducing MTI and enhance Employability skills.

**CO3:** Demonstrate better understanding of nuances of English Language.

**CO4:** Communicate intelligibly at work place.

**CO5:** Perform effectively in Interviews.

**CO6:** Plan and present ideas explicitly.

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

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

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

**Module-I CALL Lab**:

Understand: Listening Skill-Its importance–Purpose-Process-Types-Barriers to Listening.

Practice: Introduction to Phonetics –Speech Sounds –Vowels and Consonants.

**ICS Lab**:

Understand: Communication at Work Place-Spoken vs. Written language. Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues Greetings– Taking Leave– making request and seeking permission. Introducing oneself and others.

**Module-II CALL Lab:**

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

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

**ICS Lab**:

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

Practice: Telephone Etiquette.

Descriptions- Places, Objects, Events and Process.

**Module-III CALL Lab:**

Understand: Intonation-Errors in Pronunciation-the Influence of Mother Tongue (MTI), Examples from different parts of the country.

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

**ICS Lab**:

Understand: How to make Formal Presentations.

Practice: Formal Presentations.

**Module-IV CALL Lab:**

Understand: Listening for General Details (2 practice exercises)

Practice: Listening Comprehension Tests (2 practice exercises).

**ICS Lab**:

Understand: Public Speaking-Debate– Exposure to Structured Talks (2 practice exercises).

Practice: Making a Short Speech– Extempore (2 practice exercises).

**Module-V CALL Lab:**

Understand: Listening for Specific Details (2 practice exercises).

Practice: Listening Comprehension Tests (2 practice exercises).

**ICS Lab**:

Understand: General Interview Skills. Practice: Mock Interview Skills.

**TEXT BOOKS :**

1. Speaking English Effectively 2nd Edition by Krishna Mohan & N. P Singh, Mac Millan Publishers, 2011.
2. ELCS Lab Manual by Faculty, Department of English, GCET.

**REFERENCE BOOKS:**

1. How to Prepare for Interviews by Shashi Kumar. V & Dhamija P. V.
2. English Pronunciation in Use, Hancock. M, Cambridge University Press.
3. English Language Communication Skills Lab Manual Cum Workbook by Cengage Learning India, 2013.
4. Creative Writing Skills by Ashraf Rizvi.

# 18CH12L1 - ENGINEERING CHEMISTRY LAB

**B. Tech. ME - I Year, II Semester**
**Prerequisite(s):** None.

| L | T | P/D | C |
|---|---|---|---|
| - | - | 3 | 1.5 |

**Course objectives:** Develop ability to

1. Estimate the hardness content in water to check its suitability for drinking purpose.
2. Use instrumental methods namely, Potentiometry and Conductometry to find the concentration of a given solution.
3. Measure physical properties like surface tension, adsorption and viscosity.
4. Know the synthesis of most effective drug molecules.
5. Determine the rate constant of reactions from concentrations as a function of time.

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

**CO1:** Determine parameters like hardness content in water.

**CO2:** Use instrumental methods like Potentiometry and Conductometry.

**CO3:** Determine physical properties like surface tension, adsorption, acid value and viscosity.

**CO4:** Use techniques which are fundamental in the synthesis of Aspirin, Paracetemol etc.

**CO5:** Estimate rate constant of a reaction from concentration – time relationships.

**List of Experiments**

**I. Titrimetry**

1. Determination of total hardness of water by complexometric method using EDTA.
2. Determination of acid value of coconut oil.

**II Instrumental Methods**

**A. Potentiometry**

3. Estimation of HCl by Potentiometric titrations.
4. Estimation of $Fe^{2+}$ by Potentiometry using $KMnO_4$.

**B. Conductometry**

5. Estimation of an HCl by Conductometric titrations.
6. Estimation of Acetic acid by Conductometric titrations.

**III. Physical Constants**

7. Determination of viscosity of a given liquid by using Ostwald's viscometer.
8. Determination of surface tension of a given liquid using stalagmometer.

**IV. Synthesis**

9. Synthesis of Aspirin and Paracetemol.

**V. Kinetics**

10. Determination of rate constant of acid catalysed hydrolysis of methyl acetate.

**VI. Additional Experiments**

11. Verification of Freundlich adsorption isotherm-adsorption of acetic acid on charcoal.
12. Determination of partition coefficient of acetic acid between n-butanol and water.

**REFERENCE BOOKS:**

1. Senior practical physical chemistry, B.D. Khosla, A. Gulati and V. Garg (R. Chand & Co., Delhi).
2. An introduction to practical chemistry, K.K. Sharma and D. S. Sharma (Vikas publishing, N. Delhi).
3. Vogel's text book of practical organic chemistry $5^{th}$ edition.
4. Text book on Experiments and calculations in Engineering chemistry – S.S. Dara.

# 18CS12L1 - DATA STRUCTURES LAB

**B. Tech. ME - I Year, II Semester**

| L | T | P/D | C |
|---|---|---|---|
| - | - | 2 | 1 |

**Pre-requisite(s):** None.

**Course Objectives:** Develop ability to

1. Introduce the structure, union, and enumerated types
2. Introduce to linear lists, implementation using arrays and linked list.
3. Understand the classical approaches to sorting arrays: selection sort, bubble sort, insertion sort; sequential and binary searching algorithms.
4. Concepts and principles of stacks and queues and their applications.
5. Understand the basic characteristics of text, binary files and C implementation of file I/O using streams. Introduction to Non-linear data structures.

**Course Outcomes:** After completion of the course, student would be able to

**CO1:** Use the type definition, enumerated types, define and use structures, unions in programs using C language.

**CO2:** Understand the time and space complexity. Ability to implement linear lists.

**CO3:** Write programs that sort data using selection, bubble, insertion sort techniques and perform search mechanisms either by sequential or binary search techniques using C language program.

**CO4:** Demonstrate the basic operations of stacks and queues using C program.

**CO5:** Write programs that read and write text, binary files using the formatting and character I/O functions. Define basic non-linear list terminologies.

| Week No | Name of the program |
|---|---|
| 1 | Write a C program to implement complex structures for the following operations.<br>i) Addition of two Complex numbers<br>ii) Multiplication of two Complex Numbers |
| 2 | a) Write a C program to implement arrays of structures?<br>b) Write a C program to implement bit fields in C? |
| 3 | a) Write a C Program to store the information (name, roll no, and branch) of a student using unions.<br>b) Write a C program to implement inter function communication by passing pointers to a structure. |
| 4 | Write a C program to implement singly linked list for the following operations.<br>a) Insertion b)Deletion c)Search |
| 5 | a) Write a C program to sort the elements using Selection sort<br>b) Write a C program to sort the elements using Bubble sort. |

| | |
|---|---|
| 6 | a) Write a C program to sort the elements using Insertion sort<br>b) Write a C program to search an element in a list of elements using linear search. If the element found display the position, otherwise print "element not present". |
| 7 | Write a C program to search an element in a list of elements using Binary search. If the element found display the position, otherwise print "element not present". |
| 8 | Write a C program convert infix to postfix notation and postfix evaluation using stack. |
| 9 | Write a C program implement Queue using arrays for the following operations.<br>i) Enqueue ii) Dequeue iii) Peek iv) Display |
| 10 | Write a C program open a new file and implement the following I/O functions.<br>i) fprintf(), fscanf()<br>ii) getw(), putw()<br>iii) getc(), putc() |
| 11 | a) Write a C program to copy data from one file to another.<br>b) Write a C program to merge two files, using command line arguments. |
| 12 | Write a C program to implement multi file programming for basic arithmetic operations |

## 18MC1201– INDIAN CONSTITUTION

**(Mandatory Course)**

**B. Tech. ME - I Year, II Semester**

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

**Pre-requisites: None**

**Course Objectives:** Develop ability to

1. Understand the need for a constitution
2. Appreciate the fundamental duties and rights of the citizens of India
3. Explain the role of constitution in a democratic society
4. Describe the Directive Principles of State Policy and their significance
5. List the key features of the constitution, Union Government, and State Governments.

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

**CO1:** Create awareness about the constitutional values and objectives written in the Indian Constitution.

**CO2:** List the fundamental rights and fundamental duties of Indian citizens

**CO3:** Identify the division of legislative, executive and financial powers between the union and the state governments

**CO4:** Understand the working of Indian democracy, its institutions and processes at the local, state and union levels

**CO5:** Explain the functions and responsibilities of Election commission of India and Union Public Service Commission

**UNIT - I: Introduction to Indian Constitution :** Meaning of the term Constitution, Preamble of the Constitution, Constituent Assembly, The Salient Features of Indian Constitution

**UNIT - II: Fundamental Rights of citizen:** Fundamental Rights of citizen, Fundamental Duties of citizen, The Directive Principles of State Policy

**UNIT - III: Union Government :** Union Government, Union Legislature (Parliament), Lok Sabha and Rajya Sabha (with Powers and Functions), Union Executive, President of India (with Powers and Functions) , Prime Minister of India (with Powers and Functions) , Union Judiciary (Supreme Court) , Jurisdiction of the Supreme Court.

**UNIT - IV: State Government :** State Government , State Legislature (Legislative Assembly / Vidhan Sabha, Legislative Council / Vidhan Parishad) , Powers and Functions of the State Legislature , State Executive, Governor of the State (with Powers and Functions) , The Chief Minister of the State (with Powers and Functions) State Judiciary (High Courts)

**UNIT - V: Local Self Government :** Election Commission of India (with Powers and Functions) , The Union Public Service Commission (with Powers and Functions)

**TEXT BOOKS :**

1. The Constitution of India, P.M. Bakshi, Universal Law Publishing co.,
2. Introduction to the Constitution of India, Dr Durga Das Basu, LexisNexis Publishers
3. Indian Constitution at work, NCERT

**REFERENCE BOOKS :**

1. Constitution of India, M. Laxmikanth, Cengage Publications.
2. The Indian Constitution, Granville Austin, Oxford India Paperback Edition.

# SYLLABUS

## B. Tech II YEAR I SEMESTER

## 18ME2101 - METALLURGY AND MATERIAL SCIENCE

**B. Tech. - ME - II Year I Semester**

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

**Prerequisite(s)**: **None**

**Course Objectives:** Develop ability to

1. Understand concept of crystal structures and grain and grain boundaries.
2. Understand concept of phase diagrams.
3. Understand Iron-Iron Carbon equilibrium Diagram and various heat treatment operations.
4. Understand various properties and applications of Ferrous, Non Ferrous metals and alloys.
5. Understand various properties and applications of Ceramics, Polymers and composites and powder metallurgy techniques.

**Course Outcomes (COs):** At the end of the course, the student would be able to

**CO1:** Apply fundamental knowledge of material science for selection of material for engineering applications.

**CO2:** Differentiate various phase diagrams in binary systems

**CO3:** Choose type of heat treatment to be given to any metal in order to improve mechanical properties.

**CO4:** Explain the composition of ferrous and Non-ferrous alloys in terms of their applications

**CO5:** Explain the composition of ceramics, polymers and composite materials, applications and powder metallurgy techniques.

**UNIT – I: Structure of Metals and Crystallization:** Bonds in solids**,** crystallography, packing factor, Density calculations, Imperfections in crystals, Crystallization of metals, Grain and grain boundaries, grain size and its effect on the properties of metals/alloys, Determination of grain size.

**UNIT – II: Constitution of Alloys:** Necessity of alloying, Types of solid solutions, Hume Rothery's rules and Intermediate alloy phases.

**Phase Diagrams:** Construction methods of phase diagram, Lever rule, Gibbs phase rule, Isomorphous, Eutectic, Eutectoid, Peritectic and Peritectoid Transformations with examples.

**UNIT – III: Iron-Iron Carbide Equilibrium Diagram:** Allotropy & Cooling curve of pure iron, definition of structures, critical points, lines, areas and temperatures in the Fe-Fe3C system, solidification and microstructures of slowly cooled steels.

**Heat Treatment of Steels**

Construction of TTT diagrams, continuous cooling transformation (CCT) diagrams, Annealing-Types, Normalizing, Hardening, Tempering, Austempering, Martempering, Hardenability of steels, Jominy end- quench test.

**UNIT IV: Engineering Materials – I:** Steels and Cast irons

**Steels:** Plain carbon steels, Alloy steels, tool steels and stainless steels, HSS, Maraging steels, Hadfield manganese steels, Effects of alloying elements on steels.

**Cast Irons:** Structure, properties and applications of White Cast iron, Malleable Cast iron, grey Cast iron, nodular cast iron.

**Engineering Materials - II: Non-Ferrous Metals:** Properties and Applications of Copper alloys, Aluminum alloys, Titanium alloys.

**UNIT – V: Engineering Materials-III: Ceramics:** Classification, properties and applications of ceramics

**Polymers:** Classification, properties and applications of polymers.

**Composites:** Classification, properties and applications of composites, Hybrid composites, Nano composites, Cermets.

**Powder Metallurgy:** Introduction, preparation of metal powders, mixing, compacting, sintering, Supplementary operations.

**TEXT BOOKS :**

1. Introduction to Physical Metallurgy/Sidney H Avener/2nd Edition, Tata McGraw-Hill Education, 1997.
2. Materials Science and engineering / William and Callister /5th edition, John Wiley sons.

**REFERENCE BOOKS:**

1. Material Science and Metallurgy/kodgire/12th Edition, Everest Publishing house.
2. Materials Science and Engineering/ V. Raghavan/4th Edition, Prentice Hall of India Ltd,. 2005.
3. Essentials of material science and engineering /Donald R. Askeland/ 2nd Edition, SI Version.
4. Engineering Metallurgy/Higgins R.A/6th Edition,Viva Books Pvt Ltd.

# 18ME2102 - MECHANICS OF SOLIDS

**B. Tech. - ME - II Year I Semester**

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

**Prerequisite(s):18ME1101- Engineering Mechanics –I,**
**18ME1201- Engineering Mechanics – II**

**Course Objectives:** Develop ability to

1. Understand concepts of stress, strain and their relationships based on elasticity, material behaviour under different types of loading.
2. Acquire knowledge to draw shear force and bending moment diagrams for various beams and loads.
3. Understand the concept of bending stress and shear stress for various configurations of the beams.
4. Understand combined stresses and strains at a point across any plane in a two dimensional system.
5. Understand torsion equation to compute torsional stresses in solid and hollow shafts and concepts of stresses in thin and thick cylinders.

**Course Outcomes (COs):** At the end of the course, student would be able to

**CO1:** Analyze and design structural members subjected to tension, compression, torsion and bending using fundamental concepts of stress, strain and elastic behaviour

**CO2:** Determine bending stress and shear stress for various configurations of the beams

**CO3:** Evaluate principal stresses, strains and apply the concept of failure theories for design

**CO4:** Apply the torsion equation to compute torsional stresses in solid and hollow shafts.

**CO5:** Analyse and design thin and thick cylinders.

**UNIT–I: Stresses and Strains:** Material properties, Definitions, types of stresses and strains, elasticity and plasticity. Hooke's law, stress-strain diagrams for engineering materials, modulus of elasticity. Poisson's ratio, relationship between elastic constants, linear and volumetric strains, bars of uniform strength, temperature stresses, compound bars. Strain energy – Resilience.

**UNIT–II: Shear Force and Bending Moment:** Definition of beam; Types of beams and loads, bending moment and shear force; relationship between intensity of loading, shear force and bending moment; bending moment and shear force diagrams for cantilever, simply supported and overhanging beams carrying point, uniformly distributed loads and uniformly varying load, point of contra flexure.

**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 in Beams:** Distribution of shear stresses in rectangular, I- section and T-section for solid and hollow sections, compound stresses.

**UNIT–IV: Torsion:** Derivation of torsion equation for circular sections, torsional stresses, angle of twist, power transmission.

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

**UNIT–V: Theories of Static Failure for Ductile Materials**: Rankine's theory, Tresca's theory, Von Mises theory

**Cylinders:** Stresses in thin and thick cylinders with internal and external pressures. Hoop and longitudinal stresses in cylinders. Volumetric strains – changes in diameter and volume of thin cylinders - Thin spherical shells.

**TEXT BOOKS :**

1. Strength of Materials A Practical Approach, D.S. Prakash Rao, Universities Press, Hyderabad, 1999.
2. Strength of Materials, S. Ramamrutham, Dhanpat Rai & Sons, 1993.

**REFERENCE BOOKS:**

1. Strength of Materials, S.S. Bhavakatti, Vikas Publication, 2003.
2.Strength of Materials, G.H. Ryder,3rd Edition in SI units, Macmillan India Limited, Delhi, 2002
3.Strength of Materials, Schaum Series,
4.Strength of Materials, R.K Rajput, S.Chand & Company Ltd.
5.Mechanics of materials, Beer and Jhonson, Mc Graw Hill
6.Engineering Mechanics of Solids, Egor P.Popov, Pearson

## 18EE2101 – BASIC ELECTRICAL ENGINEERING

**B. Tech. - ME - II Year I Semester**

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

**Pre requisites: 18PH1101-Engineering Physics**

**Course Objectives: Develop ability to**

1. Introduce the concepts of electrical circuits and its components
2. Understand magnetic circuits, DC circuits and AC single phase & three phase circuits
3. Study and understand the different types of DC/AC machines and Transformers.
4. Import the knowledge of various electrical installations.
5. Introduce the concept of power, power factor and its improvement.

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

**CO1:** Analyze and solve DC electrical circuits using network laws and theorems.

**CO2:** Analyze and solve electrical circuits using network laws and theorems.

**CO3:** Analyze basic Electric and Magnetic circuits.

**CO4:** Study the working principles of Electrical Machines

**CO5:** Introduce components of Low Voltage Electrical Installations.

**UNIT-I: D.C. Circuits :** Electrical circuit elements (R, L and C), voltage and current sources, KVL&KCL, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

**UNIT-II: A.C. Circuits :**Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor, Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance in series R-L-C circuit. Three-phase balanced circuits, voltage and current relations in star and delta connections.

**UNIT-III: Transformers:** Ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

**UNIT-IV: Electrical Machines:** Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

**UNIT-V: Electrical Installations:** Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important

Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

**TEXT-BOOKS:**

1. Basic Electrical Engineering - D.P. Kothari and I.J. Nagrath, 3rd edition 2010, Tata McGraw Hill.
2. Basic Electrical Engineering, D.C. Kulshreshtha, McGraw Hill, 2009.

**REFERENCE-BOOKS:**

1. Fundamentals of Electrical Engineering, L.S. Bobrow, Oxford University Press, 2011
2. Electrical and Electronics Technology, E. Hughes, 10th Edition, Pearson, 2010
3. Electrical Engineering Fundamentals, Vincent Deltoro, 2nd Edition, Prentice Hall India1989

## 18ME2103 - FLUID MECHANICS AND HYDRAULIC MACHINERY

**B. Tech. - ME - II Year I Semester**

| L | T | P/D | C |
|---|---|---|---|
| 3 | 1 | -/- | 4 |

**Prerequisite(s)**: **None**

**Course Objectives:** Develop ability to

1. Understand the fundamental fluid properties, understand basic concepts of conservation of mass, energy and momentum equations and application to simple problems.
2. Understand working principles of pressure, velocity and discharge measuring devices and momentum principles.
3. Understand concept of basic boundary layer theory and basic principles of turbo machinery.
4. Understand working of various turbines such as Pelton wheel, Francis and Kaplan turbines.
5. Understand working of centrifugal and reciprocating pumps.

**Course Outcomes (COs):** At the end of the course, student would be able to

**CO1:** Explain fluid properties, types of fluid flows and formulate one and three dimensional compressible fluid flow problems and solve the same

**CO2:** Apply conservation of mass, energy and momentum laws to fluid flow problems in engineering applications and study the losses in pipes

**CO3:** Compute drag and lift forces using theory of boundary layer and understand the basics of turbo machinery.

**CO4:** Analyze practical problems of various turbines used in Industry and hydro power plants.

**CO5:** Solve various engineering problems related to centrifugal and reciprocating pumps used in agriculture, domestic and industrial applications

**UNIT – I: Fluid Statics :** Dimensions and units: Concept of continuum physical properties of fluids- specific gravity, viscosity surface tension- vapour pressure and their influence on fluid motion Pascal's –law ,hydrostatic law , atmospheric, gauge and vacuum pressure –measurement of pressure- Piezometer, U-tube and differential manometers, Mechanical guages.

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

**UNIT – II: Fluid Dynamics:** Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend. Measurement of flow: Pitot tube, venturimeter, orifice meter and Flow nozzle.

**Closed Conduit Flow:** Viscous Flow**,** Reynolds's experiment- Darcy-Weisbach equation- minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line.

**UNIT – III: Boundary Layer Concepts: Viscous and Potential Flow:** Definition and thickness, laminar and turbulent boundary layers (no derivation) ,separation of boundary layer submerged objects –drag and lift

**Basics of Turbo Machinery:** Hydro dynamic 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.

**UNIT – IV: Hydraulic Turbines:** Classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design

**Performance of Hydraulic Turbines:** Draft tube theory functions and efficiency. Specific speed of turbine, 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- pumps in series and parallel-performance characteristic curves, Priming, NPSH.

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

**TEXT BOOKS :**

1. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH, Standard book house. Delhi 1991.volume 1.
2. Fluid Mechanics, Frank M. White, McGraw Hill

**REFERENCE BOOKS:**

1 Fluid Mechanics and Hydraulic Machines by Rajput, s. chand & company ltd. Delhi. 2008.
2 Fluid Mechanics & fluid power engineering by D.S. Kumar, S.K. Katiraia & Sons publications
3 Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
4 Fluid Mechanics and Machinery, Cengel & Cibala, New Age International.
5 Hydraulic Machines by Banga & Sharma, Khanna Publishers.
6 Fluid Mechanics and Hydraulic Machines by Bansal, Lakshmi publications.

# 18ME2104 - THERMODYNAMICS

**B. Tech. - ME - II Year I Semester**

| L | T | P/D | C |
|---|---|---|---|
| 3 | 1 | -/- | 4 |

**Prerequisite(s)**: **None**

**Course Objectives:** Develop ability to

1. Define basic concepts, energy transfers and importance of zeroth law of thermodynamics in temperature measurement.
2. Explain the laws of thermodynamics and its corollaries.
3. Apply laws of perfect gases in the analysis of thermodynamic processes
4. Apply laws of thermodynamics to analyze thermodynamic systems.
5. Develop thermodynamic relations and Choose properties of pure substances to analyze the performance of Thermodynamic cycles.

**Course Outcomes (COs):** At the end of the course, student would be able to

**CO1:** Define the concepts of thermodynamic systems, thermodynamic properties, thermodynamic equilibrium, and energy interactions

**CO2:** Outline the laws of thermodynamics and its corollaries.

**CO3:** Analyze thermodynamic processes and cycles by applying First laws of thermodynamics

**CO4:** Understand the concept of entropy and exergy and their relevance in the design of thermodynamic systems

**CO5:** Determine the properties of pure substances using thermodynamic relations

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

**Work and Heat Transfer**: Energy in State and in Transition, Types, Displacement and Other forms of Work transfer, Heat transfer, Point and Path functions

**Zeroth Law of Thermodynamics** - Concept of equality of Temperature - Principles of Thermometry - Reference Points - Const. Volume gas Thermometer – Temperature scales, Ideal Gas Scale, International temperature scale of 1990 (ITS-90)

**UNIT – II: First Law of Thermodynamics:** Joule's Experiments - First law of Thermodynamics –Energy: a property of a system-First law for a process- First law for a cycle - Corollaries: Energy of an isolated system - PMM of first kind.

**Properties of Perfect Gases -** 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 - Vander Waals Equation of State –law of corresponding states, compressibility factor and generalized compressibility chart.

**UNIT- III: Application of First Law of Thermodynamics:** First law applied to Non-flow Process - applied to a flow process - Steady Flow Energy Equation- Application of SFEE- Numericals

**Second Law of Thermodynamics:** 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 – irreversible process- Causes of irreversibility with examples-types, PMM of Second kind.

**Thermodynamic Cycle:** Carnot cycle-Carnot's theorem and its corollaries: Carnot's principle, Thermodynamic scale of Temperature-Equality of gas temperature and Kelvin Temperature

**UNIT - IV: Entropy:** Clausius Inequality, the property of entropy, Temperature-entropy plot-Entropy principle-Applications-Entropy generation in a closed system- Entropy generation in a open system- Combined consequences of first and second laws-Reversible adiabatic work in a steady flow system- Entropy and Direction- Entropy and Disorder-concept of Absolute entropy.

**Exergy**: Dead state- Availability and unavailability-Quality of energy-Law of degradation of energy-Irreversibility and Gouy-Stodola theorem-Second law efficiency.

**UNIT – V: Thermodynamic Relations:**Maxwell relations, T- ds Relations, Energy Equation – Joule-Thomson effect- Clausius - Clapeyron Equation- Elementary Treatment of the Third Law of Thermodynamics.

**Properties of Pure Substances** - Triple point at critical state, properties during change of phase, Dryness Fraction - Property tables. Mollier charts - Various Thermodynamic processes and energy Transfer - Steam Calorimetry.

**TEXT BOOKS :**

1. Engineering Thermodynamics- PK Nag / TMH/ 6th Edition
2. Fundamentals of Engineering Thermodynamics- R.Yadav /Central publishing house Allahabad/ Revised 7Th edition

**REFERENCE BOOKS:**

1. Thermodynamics - An Engineering Approach/ Yunus A. Cengel& Michael A. Boles/ TMH
2. Thermodynamics- J.P. Holman /TMH
3. Engineering thermodynamics- J.B. Jones & R.E. Dugan/ John Wiley and sons/ 1st Edition
4. Engineering Thermodynamics- P. Chattopadhyay/Oxford higher Education
5. Engineering Thermodynamics- DP Mishra/Cengage Learning

# 18ME21L1 – MMS AND MOS LAB

**B. Tech. - ME - II Year I Semester**

| L | T | P/D | C |
|---|---|---|---|
| - | - | 2 | 1 |

**Prerequisite(s)**: **None**

**Course Objectives:** Develop ability to

1. Acquire knowledge for testing the properties of engineering materials.
2. Understand methods of determining various types of hardness of materials.
3. Acquire knowledge for determining modulus of rigidity of engineering materials.
4. Understand metallographic study and analysis of various Ferrous and non-ferrous metals such as Stainless steel, cast iron, grey cast iron, White Cast iron, Malleable Cast iron and nodular cast iron.
2. Acquire knowledge for determining metallurgical hardness of metals before and after heat treatment.

**Course Outcomes (COs):** At the end of the course, student would be able to

**CO1:** Identify mechanical properties of materials under various load conditions.

**CO2:** Determine the modulus of rigidity of engineering materials

**CO3:** Perform Tension test, Compression test, shear test, torsion test and impact test, to predict failure of materials

**CO4:** Identify crystal structure of metals

**CO5:** Evaluate metallurgical hardness to correlate with microstructure

**List of Experiments:**

**(A) Metallurgy Lab:**

1. Preparation and study of the micro structure of pure material like iron Cu and Al.
2. Preparation and study of the Microstructure of mild steels, high Carbon
3. Steels.
4. Study of the Micro Structure of Stainless Steels.
5. Study of the Micro Structure of Cast Irons.
6. Study of the Micro Structure of Non – Ferrous Alloys.
7. Hardenability of Steel by Jominey End Quench Test.

**(B) Mechanics of Solids Lab (Any six of the following must be conducted)**

1. Tension test on Universal Testing Machine (UTM).
2. Double Shear Test on Universal Testing Machine (UTM).
3. Compression Test on Universal Testing Machine (UTM).
4. Rockwell and Brinell's Hardness Test.

5. Izod and Charpy Impact Test.
6. Torsion Test
8. Spring Test

**(C) Additional Experiments:**

1. Bending Test on Beams

b. Simply Supported Beam

c. Cantilever Beam

# 18EE21L1 – BASIC ELECTRICAL ENGINEERING LAB

**B. Tech. - ME - II Year I Semester**

| L | T | P/D | C |
|---|---|---|---|
| - | - | 2/- | 1 |

**Pre requisites: None**

**Course Objectives:** Develop ability to

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

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

**CO1:** Get an exposure to basic electrical laws

**CO2:** Obtain the response of different types of electrical circuits to different excitations

**CO3:** Measurement, calculation and relate the basic electrical parameters

**CO4:** Obtain the basic characteristics of DC machines.

**CO5:** Obtain the basic characteristics of transformers and other AC electrical machines.

**List of experiments/demonstrations:**

***Any 10 experiments from the following are to be conducted.***

1. Verification of Ohms Law
2. Verification of KVL and KCL
3. Transient Response of Series RL and RC circuits using DC excitation
4. Transient Response of RLC Series circuit using DC excitation
5. Resonance in series RLC circuit
6. Calculations and Verification of Impedance and Current of RL, RC and RLC series circuits
7. Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single Phase Transformer
8. Load Test on Single Phase Transformer (Calculate Efficiency and Regulation)
9. Three Phase Transformer: Verification of Relationship between Voltages and Currents (Star-Delta, Delta-Delta, Delta-star, Star-Star)
10. Measurement of Active and Reactive Power in a balanced Three-phase circuit
11. Performance Characteristics of a Separately/Self Excited DC Shunt/Compound Motor
12. Torque-Speed Characteristics of a Separately/Self Excited DC Shunt/Compound Motor
13. Performance Characteristics of a Three-phase Induction Motor
14. Torque-Speed Characteristics of a Three-phase Induction Motor
15. No-Load Characteristics of a Three-phase Alternator

## 18ME21L2 - Fluid Mechanics and Hydraulic Machinery Lab

**B. Tech. - ME - II Year I Semester**

| L | T | P/D | C |
|---|---|---|---|
| - | - | 2 | 1 |

**Prerequisite(s)**: **None**

**Course Objective:** Develop ability to

1. Understand fundamental principles of fluid mechanics to solve practical mechanical engineering problems of water conveyance in pipes and pipe networks.
2. Understand application of hydraulic machinery.
3. Learn to conduct performance tests on pumps and turbines.
4. Understand operating characteristics and factors affecting performance of hydraulic machinery (pumps and turbines).
5. Understand the Bernoulli's theorem

**Course Outcomes (COs):** At the end of the course, student would be able to

**CO1:** Demonstrate basic knowledge of fluid mechanics in solving problems and design of pressure pipe systems used in mechanical engineering

**CO2:** Verify Bernoulli's principle

**CO3:** Conduct experiment and interpret the data on major and minor losses

**CO4:** Calibrate flow discharge measuring device used in pipes, channels and tanks

**CO5:** Apply basics of hydraulic machinery and their operation in water systems

**List of Experiments:**

1. Impact of jet on vanes.
2. Calibration of venturimeter.
3. Calibration of orifice meter.
4. Determination of friction factor for a given pipe.
5. Determination of loss of head due to sudden contraction.
6. Verification of Bernoulli's theorems.
7. Performance test on Pelton wheel.
8. Performance test on Francis turbine.
9. Performance test on Kaplan turbine.
10. Performance test on single stage centrifugal pump.
11. Performance test on multi stage centrifugal pump.
12. Performance test on reciprocating pump.

## 18CH2101 - ENVIRONMENTAL SCIENCE

**(Mandatory Course)**

**B. Tech. - ME - II Year I Semester**

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

**Course Objectives:** Develop ability to

1. Identify the importance of ecosystem and its functions.
2. Understand the natural resources and their usage in day to day life.
3. Understand the concept of bio-diversity, its values and conservation.
4. Be aware of the causes of different types of pollution and its control.
5. Understand various environmental impacts, requirement of various policies, and legislations towards environmental sustainability.

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

**CO1:** Explain ecosystem and its functions namely, food chain, ecological pyramids etc.

**CO2:** Acquire knowledge about different types of natural resources such as land, water, minerals, non-renewable energy and their excessive usage leading to detrimental effects on environment.

**CO3:** Comprehend ecosystem diversity, its values and importance of hot spots to preserve the same.

**CO4:** Explain different types of pollution, its control and impact on global environment.

**CO5:** Recognize various environmental impacts and the importance of various acts and policies towards environmental sustainability.

**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, 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. Environmental effects of extracting and using mineral resources, Land resources: Forest resources, Energy Resources-renewable and non-renewable

**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. Hot spots of biodiversity. 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.

**Global Environmental Issues and Global Efforts:** Green House Gases And its effect ,Climate change and impacts on human environment. Ozone depletion and Ozone depleting substances (ODS). International conventions / Protocols: Earth summit, Kyoto protocol, and Montréal Protocol. NAPCC-GoI Initiatives.

**UNIT-V: Environmental Policy, Legislation and EIA:** Environmental Protection act, Legal aspects Air Act- 1981, Water Act, Forest Act, Wild life Act, Municipal solid 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-economic aspects. Strategies for risk assessment, Concepts of Environmental Management Plan (EMP). Towards Sustainable Future: Concept of Sustainable Development Goals, 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.

**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, 4th Edition, New age international publishers.
5. Text book of Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.
6. Introduction to Environmental Science by Y. Anjaneyulu, BS.Publications.

# SYLLABUS

## II YEAR B. Tech II SEMESTER

## 18ME2201 - THERMAL ENGINEERING -I

**B. Tech. - ME- II Year, II Semester**

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

**Prerequisite(s)**: **18ME2104 - Thermodynamics**

**Course Objectives:** Develop ability to

1. Understand thermodynamic analysis of different air standard cycles.
2. Understand engine components, working principles of Internal Combustion (IC) engines, auxiliary systems.
3. Understand combustion aspects of Spark Ignition (SI) and Compression Ignition (CI) engines in addition to the methods of improving performance.
4. Understand testing performance of Gasoline and Diesel Engines.
5. Understand working principle of fuel injection, spark ignition, cooling, and lubrication and fuel properties.

**Course Outcomes (COs):** At the end of the course, student would be able to

**CO1:** Explain working and performance of IC Engines through thermodynamic cycles.

**CO2:** Explain various components, principle of operation, working of different types of IC engines.

**CO3:** Develop the concepts of valve timing diagram and port timing diagram at different speeds for optimum performance

**CO4:** Evaluate performance of diesel and petrol engines and suggest suitable methods for remedy of abnormal combustion

**CO5:** Evaluate variables affecting performance of IC engines and methods to improve performance.

**UNIT – I: Air Standard Cycles:** Otto cycle, Diesel cycle, Dual combustion cycle, and its comparison, Stirling cycle, Ericsson cycle, Atkinson cycle and Lenoir cycle. Numericals for determining mean effective pressure and performance evaluation.

**UNIT – II: Fuel-Air Cycles and their Analysis:** Introduction- Fuel- air cycles and their significance-Composition of cylinder gases-Variable specific heats-Dissociation-Effect of Number of moles- Comparison of Air- Standard and Fuel-air cycles

**Actual Cycles and their Analysis:** Introduction, comparison of Air standard and Actual cycles, Time loss factor, Heat loss factor, Exhaust Blow Down, Loss Due to Gas Exchange Process, Volumetric Efficiency.

**UNIT – III: I.C. Engines:** Four and two stroke engine – SI and CI engines- Valve and Port Timing Diagrams, Fuel injection systems for SI engines- Fuel Injection Systems for CI engines,

Ignition, Cooling and Lubrication systems-Fuel properties and Combustion.

**Testing and Performance of Engines:** Measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – performance test-heat balance sheet and chart.

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

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

**TEXT BOOKS :**

1. I.C. Engines- V. Ganesan/ TMH/ 4$^{Th}$ Edition.
2. I.C. Engines- John B. Heywood/TMH/ 2015

**REFERENCE BOOKS:**

1. I.C. Engines-M. L. Mathur and Sharma/ Dhanpath Rai & Sons/Fifth Edition/ 2013
2. Thermal engineering- R Rudramoorthy/ TMH/2003
3. Thermal engineering- P.K.Nag/3 rd Edition.
4. Thermal engineering- R.K. Rajput/ Lakshmi Publications/Eighth edition/2010
5. I.C. Engines- K. K. Ramalingam/Scietech publishers/2$^{nd}$ Edition
6. Combustion engine processes- Lester C Lichty, Mc Graw Hill, New York

# 18MA2201 - COMPUTATIONAL MATHEMATICS

**B. Tech. - ME- II Year, II Semester**

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

**Prerequisite(s):** 18MA1101-Mathematics - I

**Course Objectives:** Develop ability to

1. To approximate a polynomial/curve to satisfy the given set of data.
2. To evaluate differentiation/integration for a given set of data using numerical techniques.
3. To compute approximate zeros of an algebraic/transcendental / system of equations using suitable numerical methods.
4. Apply various numerical techniques to compute approximate solution of a given ordinary differential equations with initial condition.
5. To apply the different methods to fit a curve for the set of data using method of least squares.

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

**CO1:** Estimate a polynomial/curve to satisfy the given set of data.

**CO2:** Apply various numerical techniques to evaluate differentiation/integration for a given set of data.

**CO3:** Apply suitable numerical methods to find the approximate root / solution of algebraic / transcendental equations.

**CO4:** Solve a given ordinary differential equations with the initial condition using suitable numerical techniques.

**CO5:** Estimate a curve for the set of data using method of least squares arise in engineering branches.

**UNIT – I: Interpolation:** Introduction-Errors in polynomial Interpolation - Finite Differences - Forward Differences - Backward Differences - Central Differences - Symbolic relations and separation of symbols – Difference equation - Differences of a polynomial - Newton's formulae for interpolation - interpolation with unevenly spaced points - Lagrange's interpolation formula.

**UNIT – II: Numerical Differentiation, Integration:** Numerical differentiation: Newton's forward and backward difference derivatives, Numerical integration – General quadrature formula, Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ Rule.

**UNIT – III**: **Root Finding Methods and Solution of System of Equations:** Solution of Algebraic and Transcendental Equations and Linear system of equations, Introduction – Graphical interpretation of solution of equations, The Bisection Method – The Method of False Position – The Iteration Method – Newton-Raphson Method, Solving system of non-homogeneous equations by L-U Decomposition method (Crout's Method), Jacobi's and Gauss Seidel Iteration method.

**UNIT – IV**: **Numerical Solutions of First Order Differential Equations :** Numerical solution of Ordinary Differential equations: Solution by Taylor's series method –Picard's method of successive Approximation- single step methods-Euler's method-Euler's modified method, Runge - Kutta fourth order method.

**UNIT-V: Curve Fitting**: Fitting of a straight line - Second degree curve –exponential curve - power curve by method of least squares.

**TEXT BOOKS :**

1. Higher Engineering Mathematics, B.S. Grewal, Khanna Publishers, 44th Edition, 2017.
2. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 10th Edition, 2011.

**REFERENCE BOOKS:**

1. Introductory Methods of Numerical Analysis by S.S. Sastry, PHI learning.
2. Advanced Engineering Mathematics, Michael Greenberg, Second Edition. Pearson Education.
3. A Text book of Higher Engineering Mathematics, Bali N P and Manish Goyal, Lakshmi Publications.

## 18ME2202 - KINEMATICS OF MACHINERY

**B. Tech. - ME- II Year, II Semester**

| L | T | P/D | C |
|---|---|---|---|
| 3 | 1 | -/- | 4 |

**Prerequisite(s)**: **18ME1101 - Engineering Mechanics-I**

**18ME1201 - Engineering Mechanics-II**

**Course Objectives:** Develop ability to

1. Define mechanisms and machines, classify Kinematic Pair and mechanisms.
2. Understand concepts of velocity and acceleration of various links in mechanisms using velocity diagram.
3. Understand concept of Instantaneous center of various mechanisms.
4. Understand classification of cams, design of cam profile using graphical synthesis for various followers such as Knife Edge, Roller and Flat faced Follower.
5. Understand various terms used in Gears and Compare various tooth forms.

**Course Outcomes (COs):** At the end of the course, student would be able to

**CO1:** Apply principles of kinematic pairs, chains, degree of freedom, inversions, equivalent chains and planar mechanisms for development of practical mechanisms

**CO2:** Demonstrate motion of mechanisms and develop kinematic constructions for engineering applications

**CO3:** Analyze the planar mechanisms to position, velocity and acceleration.

**CO4:** Apply basic mechanisms such as slider-crank linkages, four-bar linkage, gears and cams to perform motion analysis by graphical and analytical methods.

**CO5:** Design cams and followers for specified motion profiles

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

**Mechanisms 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, Intermittent motion mechanisms, Mechanical Advantage.

**UNIT – II: Straight-Line Motion Mechanisms:** Exact and approximate copied and generated types, Peaucellier, Hart, Scott Russel, Grasshopper, Watt, Tchebicheff's and Robert Mechanisms, Pantograph.

**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 – III: Velocity Analysis:** Absolute and Relative Motions, motion of a link, velocity of rubbing, velocity diagrams for four bar mechanism, single slider mechanism and quick return motion mechanisms, Instantaneous Centre, Kennedy's theorem, Instantaneous centre four bar and single slider mechanisms.

**Acceleration Analysis:** Acceleration diagrams for four bar and single slider mechanism, Coriolis Component of acceleration, acceleration diagrams for crank and slotted lever mechanism.

**UNIT – IV: Cams and Followers:** Types of cams and followers, displacement diagrams for followers, uniform motion, simple harmonic motion, cycloidal motion, cam profile with knife-edge follower, translating roller follower and translating flat follower, cams with specified contours, tangent cam with roller follower, circular arc cam with flat faced follower.

**UNIT – V: Gears :**Classification of Gears, gear terminology, law of gearing, velocity of sliding, path of Contact, arc of contact, number of pairs of teeth in contact, forms of teeth. Interference in involute gears, minimum number of teeth, interference between rack and pinion.

**Gear Trains:** Simple gear train, compound gear train, reverted gear train, planetary or epicyclic gear train, velocity ratio of epicyclic gear train (tabular method), torques in epicyclic trains. Simple problems on gear trains.

**TEXT BOOKS :**

1. Theory of Machines, S. S. Rattan, TMH Publishers, New Delhi. 2005
2. Theory of Machines, Sadhu Singh, Pearson Education, New Delhi.2006

**REFERENCE BOOKS:**

1. Theory of Machines, Ballaney, Khanna Publishers, New Delhi. [2003]
2. Theory of machines, R. S. Khurmi, J. K. Gupta, S. Chand Pub, New Delhi, India. (2010)
3. Theory of Machines, Thomas Bevan, CBS Publishers, New Delhi. [2002]
4. Mechanisms and Machine Theory, J.S. Rao and R.V. Dukkipati, NAI Publishers, New Delhi. [2006]
5. Theory of Machines and Mechanisms, J.E. Shigley, McGraw Hill Publishers, New York.
6. Theory of Mechanisms and Machines, Jagdish Lal, Metropolitan Publishers, New Delhi

## 18ME2203 - PRODUCTION TECHNOLOGY-I

**B. Tech. - ME- II Year, II Semester**

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

**Prerequisite(s)**: **18ME11L1 - Engineering Workshop**

**Course Objectives:** Develop ability to

1. Understand manufacturing processes such as casting, welding and forming along with their inherent merits, demerits and applications.
2. Understand principle, procedure and applications of various special casting methods.
3. Understand principle of operation, applications, advantages and limitations of various welding processes.
4. Understand principle of hot and cold working processes.
5. Understand fundamentals and applications of rolling, forging, extrusion, tube making, swaging, spinning, coining and wire drawing processes.

**Course Outcomes (COs):** At the end of the course, student would be able to

**CO1:** Choose appropriate manufacturing process for a given component

**CO2:** Choose appropriate casting method for an engineering component

**CO3:** Choose proper welding processes for given application

**CO4:** Identify various casting and welding defects and suggest remedy for the same.

**CO5:** Choose proper metal working processes for given application.

**UNIT – I: Metal Casting:** Advantages, limitations and applications, steps involved in making a casting, patterns and pattern making - allowances, materials, and types. Moulding materials and additives, moulding sand properties, sand properties testing, and types of sand moulds, cores, core prints, chaplets, elements of gating system, gating system design.

**UNIT - II: Melting and Casting Quality:** Melting practices - Cupola & other furnace, casting defects testing and inspection of casting.

**Special Casting Process:** Procedure, capabilities, limitations and applications of shell moulding, precession investment casting, permanent mould casting, die casting, centrifugal casting, and continuous casting.

**UNIT – III: Metal Joining:** Introduction, classification, types of joints, edge preparation methods. Gas welding, Gas cutting, Arc welding - principle, equipment and electrodes. Procedure, capabilities, limitations and applications of MMAW, GTAW, GMAW, SAW, Resistance welding - types, plasma arc welding, Thermit welding, Electron beam welding, Laser beam welding, friction welding, explosion welding. Brazing, soldering, welding defects, testing of welds.

**UNIT – IV: Metal Forming:** Plastic deformation - recovery, re- crystallization and grain growth. Hot working and cold working.

**Rolling:** Principle, rolling stand arrangement, rolling passes, forces and power requirements in rolling, rolling defects.

**Forging:** Forging operations - Drawing out & upsetting. Forging types - smith, drop, press, machine forging, defects in forging.

**UNIT – V: Extrusion:** Principle, Hot & Cold extrusion, forward and backward extrusion, impact extrusion, hydrostatic extrusion.

**Drawing:** Wire, Rod, and Tube drawing.

**Sheet Metal Operations:** Types of presses and press tools, Blanking, piercing, deep drawing, spinning, bending, stretch forming, embossing and coining, types of dies, HERF

**Processing of Plastics**: Types of moulding - Injection moulding & Blow moulding

**TEXT BOOKS :**

1. Manufacturing Technology, P. N. Rao (2011), Vol -1, 3rd edition, Tata McGraw- Hill education (P) Ltd, and New Delhi.
2. Workshop Technology (Vol 1)/Hajra Chowdary/Asia Publishing House/2nd Edition

**REFERENCE BOOKS:**

1. Production Technology, R. K. Jain (2010), 16th edition, Khanna publishers, New Delhi, India.
2. A course in workshop Technology, B. S. Raghuwanshi (2011), Vol - II, 3rd Edition, Dhanpat Rai & Co, New Delhi, India.
3. Manufacturing science, Ghosh and Mallik (2004), Affiliated East-west press (p) Ltd, New Delhi, India
4. Dieter, Mechanical Metallurgy, Mc Grew Hill

## 18CE2221 - GLOBAL WARMING AND CLIMATE CHANGE

**(Open Elective – I)**

**B. Tech. - ME- II Year, II Semester**

**Prerequisite(s): None.**

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

**Course Objectives:** Develop ability to

1. Understand the importance of Ozone layer in the atmosphere.
2. Comprehend composition of atmosphere.
3. Understand impacts of climate change on ecosystem.
4. Understand initiatives taken by different countries to reduce emission of greenhouse gases.
5. Know measures to mitigate greenhouse gases.

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

CO1. Define greenhouse gases and their influence on global warming.

CO2. Explain physical and chemical characteristics of atmosphere and structure of atmosphere

CO3. Explain impacts of climate change on agriculture, forestry and ecosystem.

CO4. Explain initiatives taken by countries to reduce global warming.

CO5. Suggest mitigation measures taken to reduce global warming and climate change.

**UNIT–I: Earth's Climate System :** Role of ozone in environment - Ozone layer – Ozone depleting gases – Green House Effect – Radioactive effects of Greenhouse gases – The Hydrological cycle – Green House Gases and Global Warming – Carbon Cycle.

**UNIT–II: Atmosphere and its Components:** Importance of Atmosphere – Physical and chemical characteristics of Atmosphere – Vertical structure of the atmosphere – Composition of the atmosphere – Atmospheric stability – Temperature profile of the atmosphere – Lapse rates – Temperature inversion – Effects of inversion on pollution dispersion.

**UNIT–III: Impacts of Climate Change:** Causes of Climate change: Changes of Temperature in the environment – Melting of ice pole – sea level rise – Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for different regions – Uncertainties in the projected impacts of Climate Change – Risk of Irreversible Changes.

**UNIT–IV: Observed Changes and its Causes:** Climate change and Carbon credits – CDM – Initiatives in India-Kyoto Protocol – Paris Convention - Intergovernmental Panel on Climate change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Global Climate Models (GCM) - Evidences of Changes in Climate and Environment- on a Global scale and in India.

**UNIT–V: Climate Change and Mitigation Measures:** Clean Development Mechanism – Carbon Trading – Examples of future clean technology – Biodiesel – Natural Compost – Eco-friendly plastic – Alternate Energy – Hydrogen – Bio-fules – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding. Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry – Carbon sequestration – Carbon capture and storage (CCS) – Waste (MSW & Bio-waste, Biomedical, Industrial waste) – International and Regional cooperation.

**TEXT BOOKS :**

1. Climate Change: An Indian Perspective (Environment and Development), Dr. Sushil Kumar Dash, Cambridge University Press India Pvt Ltd, 2007.
2. Adaptation and mitigation of climate change – Scientific Technical Analysis, Cambridge University Press, Cambridge, 2006.

**REFERENCE BOOKS:**

1. Atmospheric Science, J.M. Wallace and P.V Hobbs, Elsevier/ Academic Press, 2006.
2. "Climate Change and Climate Variability on Hydrological Regimes", Jan C. Van Dam, Cambridge University Press, 2003.
3. **http://www.ipcc.ch/**

# 18EE2222 – INDUSTRIAL SAFETY AND HAZARDS

**(Open Elective – I)**

**B. Tech. - ME- II Year, II Semester**

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

**Prerequisite(s): None**

**Course Objectives:** Develop ability to

1. Determine responsibility for safety in the workplace.
2. Learn to recognize workplace hazards.
3. Learn how to develop procedures to eliminate of lessen those hazards.
4. Apply basic Federal and State Safety Rules to the workplace.

**Course Outcomes (COs):** At the end of the course, student would be able to

**CO1:** Understand the fundamental concepts of accident prevention with a basic knowledge of safe work rules designed to promote an accident free workplace

**CO2:** Understand the relief systems

**CO3:** Understand the electrical hazards and safety handling of equipments.

**CO4:** Understand the effects of momentum and buoyancy.

**CO5:** Understand different case studies.

**UNIT - I: Fire and Explosion:** Introduction-Industrial processes and hazards potential, mechanical electrical, thermal and process hazards. Safety and hazards regulations, Industrial hygiene. Factories Act, 1948 and Environment (Protection) Act, 1986 and rules thereof. Shock wave propagation, vapour cloud and boiling liquid expanding vapours explosion (VCE and BLEVE), mechanical and chemical explosion, multiphase reactions, transport effects and global rates.

**UNIT - II: Relief Systems:** Preventive and protective management from fires and explosion-inerting, static electricity passivation, ventilation, and sprinkling, proofing, relief systems –relief valves, flares, scrubbers.

**UNIT - III: Electrical Hazards:** Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications excess energy-current surges-Safety in handling of war equipment's-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity –definition, sources, hazardous conditions, control, electrical causes of fire and explosion-ionization, spark and arc-ignition energy-national electrical safety code ANSI. Lightning, hazards, lightning arrestor, installation–earthing, specifications, earth resistance, earth pit maintenance.

**UNIT – IV: Leaks and Leakages:** Spill and leakage of liquids, vapors, gases and their mixture from storage tanks and equipment; Estimation of leakage/spill rate through hole, pipes and vessel burst; Isothermal and adiabatic flows of gases, spillage and leakage of flashing liquids, pool evaporation and boiling; Release of toxics and dispersion. Naturally buoyant and dense gas dispersion models; Effects of momentum and buoyancy; Mitigation measures for leaks and releases.

**UNIT - V: Case Studies:** Flixborough, Bhopal, Texas, ONGC offshore, HPCL Vizag and Jaipur IOC oil-storage depot incident; Oil, natural gas, chlorine and ammonia storage and transportation hazards.

**TEXT BOOKS :**

1. W., "Electrical Safety Engineering" Fordham Cooper, Butterworth and Company, London, 1986.

**REFERENCE BOOKS:**

1. "Chemical Process Safety: Fundamentals with Applications", Crowl D.A. and Louvar J.F., 2nd Ed., Prentice Hall.2001
2. "Lee's Loss Prevention in the Process Industries", Mannan S., Vol.I, 3rdEd, Butterworth-Heinemann.2004.
3. "Lee's Loss Prevention in the Process Industries", Mannan S., Vol.II, 3rdEd, Butterworth-Heinemann.2005.
4. Indian Electricity Act and Rules, Government of India.
5. Power Engineers –Handbook of TNEB, Chennai, 1989.
6. Electrostatic Hazards in powder handling, Martin Glov, Research Studies Pvt.LTd., England, 1988.

## 18EC2224 – ELECTRONIC MEASURING INSTRUMENTS

**(Open Elective - I)**

**B. Tech. - ME- II Year, II Semester**

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

**Prerequisite: None**

**Note: No detailed mathematical treatment is required.**

**Course Objectives:** Develop ability to

1. Understand various measuring systems and metrics for performance analysis.
2. Understand the principle of operation, working of different electronic signal generators
3. Learn the measuring methods of various electrical signal parameters.
4. Understand various recording method of signals.
5. Learn about various transducers used in measuring instruments.

**Course Outcomes:** At the end of the course, the Students would be able to

**CO1:** Identify the various electronic instruments based on their specifications for carrying out a particular task of measurement.

**CO2:** Explain the operation of various signal generators

**CO3:** Measure physical parameters of electrical signals

**CO4:** Explain the function of recording instruments

**CO5:** Analyze the responses of transducers for real time sign

**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, 2nd 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 5th Edition 2003.
3. "Electronic Measurements and Instrumentation", K. Lal Kishore, Pearson Education 2010.
4. "Industrial Instrumentation", T.R. Padmanabham, Springer 2009.

## 18CS2225 – JAVA PROGRAMMING

**(Open Elective - I)**

**B. Tech. - ME- II Year, II Semester**

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

**Prerequisite(s): None**

**Course Objectives:** Develop ability to

1. Understand basic concepts of object oriented programming.
2. Understand the primitive data types built into the Java language and features of strongly typed language.
3. Understanding scope, lifetime, and the initialization mechanism of variables and parameter passing mechanisms.
4. Understand file streams and database connectivity using Java language

**Course Outcomes (COs):** At the end of the course, the Students would be able to

**CO1:** Apply the concepts of OOPs in problem solving.

**CO2:** Use data abstraction, inheritance, polymorphism, encapsulation and method overloading principles in structuring computer applications.

**CO3:** Identify classes, objects, members of a class and relationships among them needed for a specific problem.

**CO4:** Use Java standard class library with necessary exception handling mechanisms in constructing computer applications.

**CO5:** Develop java programs using multi-threading, files and database concepts and their connectivity.

**UNIT-I: Object Oriented Characteristics:** 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.

**UNIT-II:** Operators, operator hierarchy, expressions, type conversion and casting, enumerated types, control flow block scope, conditional statements, loops break and continue statements. simple java program, arrays, console input and output, formatting output, constructors, methods, parameter passing, static fields and methods, access control, this keyword, overloading methods and constructors recursion, garbage collection, building strings, exploring string class.

**UNIT-III: Interfaces:** Interfaces vs. Abstract classes, defining an interface, implementing interfaces, accessing implementations through interface, extending interface.

**Inner Classes -** Uses of inner classes, local inner classes, anonymous inner classes, static inner classes, examples.

**Packages -** Definition, Creating and Accessing a package, understanding CLASSPATH, importing packages.

**UNIT –IV: 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, rethrowing exceptions, exception specification, built in exceptions, creating own exception sub classes.

**Multi-Threading** - Differences between multiple processes and multiple threads, thread states, creating threads, interrupting threads, thread priorities, synchronizing threads, inter thread communication, producer consumer pattern.

**UNIT –V: 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 data base, querying a data base and processing the results, updating data with JDBC.

**TEXT BOOK(S)**

1. Java fundamentals- A comprehensive Introduction, Herbert Schildt and Dale Skrien, TMH, 1st Edition, 2013.

**REFERENCE BOOK(S)**

1. Core Java 2–Volume1, Cay S. Horstmann and Gary Cornell
2. Java for Programmers, PJ. Dietel and H.M Deitel Pearson education.
3. Object Oriented Programming through Java. P.Radha Krishna. Universities Press.
4. Thinking in Java, Bruce Eckel, Pearson Education.

## 18MB2226 - INTELLECTUAL PROPERTY RIGHTS

**(Open Elective – I)**

**B. Tech. - ME- II Year, II Semester**

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

**Pre-requisites: None**

**Course objectives:** Develop ability to

1. Understand the various concepts, importance and types of intellectual property rights.
2. Discuss the purpose of trademarks.
3. Analyze the fundamental laws of copy rights and patents.
4. Understand trade secret laws, trade secret litigation and unfair completion.
5. Understand the latest developments in IPR.

**Course outcomes (COs):** At the end of the course, student would be able to

CO1: Acquire knowledge on intellectual property rights

CO2: Track the regulation process of trademark. Discuss the functions of trademark.

CO3: Identify the importance of copyrights, patents searching process and transfer of Ownership

CO4: Know about secret laws, unfair competition, false advertising.

CO5: Reciprocate to new developments of intellectual property rights.

**UNIT - I: Introduction to Intellectual Property:** Concepts, types of intellectual property, international organizations, agencies and treaties, and 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:** Fundamentals 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 laws.

**Law of Patents:** Foundation of patent law, patent searching process, ownership rights and transfer.

**UNIT - IV: Trade Secrets:** Trade secrete law, determination of trade secret status, liability for misappropriations of trade secrets, protection for submission, trade secret litigation. Unfair competition-misappropriation right of publicity, false advertising.

**UNIT - V: Latest Development of Intellectual Property Rights:** 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**

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.
3. Cornish, William Rodolph & Llewelyn, David. Intellectual property: patents, copyright, trademarks and allied rights. Sweet & Maxwell, 8/e, 2013.

**REFERENCE BOOKS:**

1. Cornish, William Rodolph. Cases and materials on intellectual property. Sweet & Maxwell, 5/e, 2006.
2. Lo, Jack and Pressman, David. How to make patent drawings: a patent it yourself companion. Nolo, 5/e 2007.

## 18ME22L1- THERMAL ENGINEERING-I LAB

**B. Tech. - ME- II Year, II Semester**

| L | T | P/D | C |
|---|---|---|---|
| - | - | 2 | 1 |

**Pre-Requisite: 18ME2104 - Thermodynamics.**

**Course Objective:** Develop ability to

1. Experiments connected with IC engines deals with performance charecteristics and determination of F.P. for different engines.
2. Concept of air compression using at two-stage reciprocating air compressor with inter cooling facility ton check/ verify the concepts developed in the theory is done in lab.
3. Model of IC engines for determination of valve opening with respect to crank shaft angles is used.
4. Model of IC engines for determinations of port opening with respect crank shaft angle is used.
5. Boiler models used to show the functioning of a boiler in industry.

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

**CO1:** Test the performance to improve the efficiency of the engines, develop mathematical models for study on computer systems.

**CO2:** Improve their techniques to compress air, by enhancing cooling procedures to adhere to isothermal compression process.

**CO3:** Develop the concepts of valve timing diagram and port timing diagram paves way for development of a computerized model to make a study at different speeds for optimum performance.

**CO4:** Understand the concepts of models of boilers which give picture as to what to expect in real life versus quantum of steam generated plus safety procedures to be followed, design and maintenance methods in vogue.

**CO5:** Test the performance of IC engines, develop the heat balance sheet of the same.

**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. Engines 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
10. Performance Test on Reciprocating Air – Compressor Unit
11. Dis-assembly / Assembly of I.C.Engines
12. Study of Boilers

**Additional Experiments**

1. Mechanical efficiency of 2-stage reciprocating compressor.
2. Performance test on three cylinder four stroke petrol engine.

# 18MA22L1 - COMPUTATIONAL MATHEMATICS LAB

**B. Tech. - ME- II Year, II Semester**

| L | T | P/D | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Prerequisite(s):** 18CS1101 - Programming for Problem Solving

**Course Objectives:** Develop ability to

1. Estimating the value of a function for any intermediate value of the independent variable.
2. Evaluate the solution of definite integrals for a given set of data using numerical integration methods.
3. Obtain the solution of a system of non-homogeneous equations using different methods: L-U decomposition and Gauss-seidel method.
4. To compute approximate zeros of an algebraic/transcendental equations using Bisection method.
5. Solve first order ordinary differential equations using numerical techniques.

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

**CO1:** Determine the values of $y$ corresponding to any value of $x = x_i$ between $x_0$ and $x_n$.

**CO2:** Apply Numerical integration techniques to find approximate area.

**CO3:** Determine the solution of system of non-homogeneous equations using various methods.

**CO4:** Apply suitable numerical methods to find the approximate root / solution of algebraic / transcendental equations.

**CO5:** Find the numerical solutions for a given first order initial value problem using various methods.

**List of Experiments**

1. Program to determine y for a given x, if two arrays of x and y of same size are given (using Newton's forward interpolation method).
2. Program to determine y for a given x, if two arrays of x and y of same size are given (using Lagrange's interpolation).
3. Program to evaluate definite integral using trapezoidal rule, Simpson's $1/3^{rd}$ rule and $3/8^{th}$ rule.
4. Program to find the solution of given system of linear equations using L-U decomposition method.
5. Program to find the solution of given system of equations using Gauss-seidel iteration method.
6. Program to find the root of algebraic / transcendental equations by using Bisection method.

7. Program to solve a given differential equation using modified Euler's method.
8. Program to solve a given differential equation using Runge-Kutta fourth order method.

# 18ME22L2 - MACHINE DRAWING WITH AUTOCAD LAB

**B. Tech. - ME- II Year, II Semester**

| L | T | P/D | C |
|---|---|---|---|
| - | - | 2 | 1 |

**Prerequisite(s)**:**18ME1102 - Engineering Graphics**

**Course Objectives:** Develop ability to

1. Acquire knowledge of AutoCAD software functions to create drawings using multiple lines, geometric shapes, and curves and use commands to save and print.
2. Acquire knowledge to locate and apply features of AutoCAD that automate the drafting process and facilitate creation of more accurate drawings with minimum time.
3. Acquire knowledge to locate and apply the features of AutoCAD that provide inclusion of accurate dimensions, tolerances, drawing notes and labels using symbols.
4. Understand the nomenclature associated with screw threaded fasteners, screw threads, use of keys, cotters and pins in temporary joints between two shafts or shaft and hub.
5. Understand and draw assembly of machine parts and its sectional views.

**Course Outcomes (COs):** At the end of the course, student would be able to

**CO1:** Apply knowledge of graphics and design competencies in developing engineering drawings.

**CO2:** Apply knowledge of AutoCAD software functions to create drawings using multiple lines, geometric shapes, and curves and use commands to save and print.

**CO3:** Apply features of AutoCAD that automate the drafting process and facilitate creation of accurate drawings with minimum time.

**CO4:** Identify and classify the functionalities of various machine elements such as vices, bearings, screw jacks, shafts, fasteners, keys, cotters, pins and their assembly.

**CO5:** Construct an assembly drawing using part drawings of machine components.

**List of Exercises**

Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.

1. Drawing of a Title Block with necessary text and projection symbol.
2. Drawing front view, top view and side view of objects from the given pictorial views (eg. Objects with hole and curves).
3. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3D- model.
4. Drawing of screw threaded fasteners & screw threads.
5. Drawing of of keys, cotters and pins in temporary joints

6. Assembly drawings: connecting rod, piston, screw jack, universal joint etc.

Note: Plotting of drawings with dimensioning must be made for each exercise and attached to the records written by students.

**REFERENCE BOOKS:**

1. Computer-aided Engineering Drawing-S Trymbaka Murthy, I. K. International
2. Engineering Graphics with AutoCAD 2002-James D Bethune, Pearson Education
3. Machine Drawing- K.L. Narayana, P. Kannaiah & K. Venkata Reddy, (2012), New Age Publishers / Third Edition.
4. Machine Drawing - Dhawan, (2010), A Text book of *Machine Drawing*, S. Chand Publications

# 18ME22L3 - PRODUCTION TECHNOLOGY - I LAB

**B. Tech. - ME- II Year, II Semester**

**Prerequisite(s)**: **18ME11L1 - Engineering Workshop**

| L | T | P/D | C |
|---|---|---|---|
| - | - | 2 | 1 |

**Course Objectives:** Develop ability to

1. Acquaint with the welding equipment, forming dies and sand casting process.
2. Gain hands on experience in the areas of welding, casting and forming.

**Course Outcomes (COs):** At the end of the course, student would be able to

**CO1:** Test the properties of moulding sands.

**CO2:** Design and making of wooden patterns.

**CO3:** Select the welding process for a given fabrication.

**CO4:** Fabricate joints using gas welding and arc welding.

**CO5:** Perform injection moulding, blow moulding using plastics.

**List of Experiments**

**I. Metal Casting**

1. Finding Grain Fineness Number of moulding sand.
2. Finding Permeability Number of moulding sand.
3. Finding of compressive and shear strength for Green sand and dry sand.
4. Pattern design and making.
5. Preparation of sand mould, Melting & Casting.

**II. Metal Joining**

1. Manual Metal Arc Welding (MMAW) - Preparation of Lap & Butt Joint.
2. Gas Metal Arc Welding - practice.
3. Gas Tungsten Arc Welding (GTAW) - practice.
4. Resistance Welding - Spot welding.
5. Gas Welding.
6. Plasma Welding & Cutting.
7. Brazing.

**III. Metal Forming**

1. Study of simple, compound and progressive dies
2. Blanking & piercing using fly press.
3. Bending using Hydraulic press.
4. Deep drawing using Hydraulic press.
5. Making of bottle cap using Injection moulding.
6. Making of bottle using blow moulding.

Note: Any four experiments from each group to be conduct.

# SYLLABUS

## B. Tech III YEAR I SEMESTER

# 18ME3101 - PRODUCTION TECHNOLOGY - II

**B. Tech ME- III Year, I Semester**

**Pre-requisites: 18ME11L1-Engineering Workshop**

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

**Course Objectives:** Develop ability:

1. To emphasize upon the prominent theories, concepts and various driving mechanisms of machine tools related to them.
2. To develop the concepts of various measurement systems & standards with regards to realistic applications.

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

**CO 1:** Apply the basic concepts of theory of metal cutting in order to choose appropriate cutting parameters for machining.

**CO 2:** Describe and illustrate the constructional and operational features of various Machine Tools such as Lathe machine, Milling machine, Drilling machine, Shaping machine, Planning machine and Slotting machine.

**CO 3:** Discuss the constructional features and the terminologies related to grinding, broaching and honing machines.

**CO 4:** Select an appropriate measuring instrument to check the dimensional and geometric features of a given component.

**CO 5:** Understand the methods of measurement, limits of size, fits geometric and position tolerances, and gauges with their functional requirement.

**UNIT- I: THEORY OF METAL CUTTING:** Elements of cutting process - Geometry of single point cutting tool, chip formation and types of chips, Mechanics of metal cutting - Merchant's Force diagram- Cutting forces, Tool wear and Tool life, Cutting fluids, Tool materials.

**UNIT- II: MACHINE TOOLS:** Principle of working, specifications, classifications, operations performed on Lathe machine, Milling machine, Drilling machine, Shaping machine, Planning machine and Slotting machine.

**UNIT- III: FINISH MACHINING:** Principle of working, specifications, classifications, operations performed and constructional features of Grinding machine. Different types of

abrasives - bonds specification of a grinding wheel and selection of a grinding wheel. Lapping, Honing and Broaching operations.

**UNIT- IV: LINEAR MEASUREMENT:** Length standard: line and end standard, slip gauges - calibration of slip gauges, Dial indicator, micrometers.

**MEASUREMENT OF ANGLES AND TAPERS:** Different methods - Bevel protractor - angle slip gauges - spirit levels - single bar - Sine plate used to determine the tappers.

**FLAT SURFACE MEASUREMENT:** Measurement of flat surfaces - instruments used; straight edges, surface plates, optical flat and auto collimator.

**UNIT- V: 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 - International Standard system for plane and screwed work

**LIMIT GAUGES:** Taylor's principle - Design of GO and NO GO gauge, plug, ring, snap, taper, profile and position gauges.

**TEXT BOOKS :**

1. Engineering Metrology / R. K. Jain / Khanna Publishers
2. A Course in Workshop Technology Vol II by B S Raghuvanshi, Dhanapat Rai & Co. Publishers.

**REFERENCE BOOKS:**

1. Bhattacharya A and Sen. G. C, Principles of Machine Tools, New Central Book Agency.
2. P.N. Rao.,Kundra, T.K.,And Tiwari,N.L.K., Numerical control and computer Aided Manufacturing,Tata McGraw-Hill,200
3. Hajra Choudary, Elements of Work Shop Technology - Vol. II , Media Promoters.
4. R. K. Jain and S. C. Gupta, Production Technology, Khanna Pulishers.

# 18ME3102 - DYNAMICS OF MACHINERY

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

**B Tech. –ME- III Year I Semester**

**Prerequisite(s): 18ME1101-Engineering Mechanics-I;**
**18ME1102-Engineering Mechanics-II**

**Course Objectives:** Develop ability to,

1. Impart basic knowledge about the motion, forces and torques involved in different machine members.
2. Facilitate to understand the theory involved in the analysis of brakes and dynamometers
3. Predict the dynamic behavior and principle of operation of flywheels and governors.
4. Create awareness on speed fluctuations, rotor imbalance and machine vibration in mechanical systems.
5. Demonstrate free and forced vibration of single and multi-degree of freedom systems.

**Course Outcomes (COs):** At the end of the course, student would be able to

**CO1:** Analyze the gyroscopic effect on ships, aero planes and road vehicles.
**CO2:** Apply basic laws of equilibrium, and analyze planar mechanisms, brakes and dynamometers for forces and torques.
**CO3:** Devise and design speed monitoring and controlling devises such as fly wheels and governors in steam engines and IC engines
**CO4:** Analyze for unbalanced forces and couples generated due to rotating and reciprocating masses and devise for counter masses
**CO5:** Evaluate natural frequency of vibration to avoid resonance in free and forced vibration circumstances.

**UNIT - I: Precession:** Gyroscopes – Relation between spin, precession and gyroscopic torque; Stability of moving vehicles - aeroplanes, ships, motorcar and motorcycle.

**UNIT - II: Static and Dynamic Force Analysis:** Static force analysis of planar mechanisms (Analytical and graphical Methods); D'Alembert's principle, Dynamic force Analysis of 4-link mechanism, Slider Crank Mechanism.

**Brakes and Dynamometers:** Brakes: Pivoted block or shoe brake- Band brake-Internal expanding shoe brake. Dynamometers: Absorption and transmission type dynamometers, 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

**Governors:** Centrifugal governors- Watt, Porter and Proell governors- Spring loaded Hartnell and Hartung governors with auxiliary springs; Sensitiveness, isochronisms and hunting; Effort and Power of the governors.

**UNIT - IV: Balancing:** Balancing of rotating masses- Primary and secondary balancing of reciprocating masses (Analytical and graphical methods)-Working of Wheel balancing machine-Unbalanced forces and couples; Locomotive balancing - Hammer blow, Swaying couple, Variation of tractive effort; Examination of "V", multi cylinder inline and radial engines for primary and secondary balancing;

**UNIT - V: Vibrations:** Classification- Free vibration of mass attached to vertical spring, Oscillation of pendulums; 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. Vibrations of spring mass damper system under harmonic excitation, magnification factor, phase difference between excitation and motion. Dependence of magnification factor and phase difference on frequency of excitation, vibration isolation and transmissibility

## TEXT BOOKS :

1. Theory of Machines, S. S. Rattan, TMH Publishers, Third Edition, 2009
2. Mechanical Vibrations, William W. Seto, Schaum's Outline Series

## Reference Books:

1. Theory of Machines, P.L.Ballaney, Khanna Publishers, 2001
2. Theory of Machines, Thomas Bevan, CBS Publishers, Third Editon, 2002
3. Mechanical Vibrations, G K Groover, Nem Chand and Bros.
4. Theory of Vibrations with Applications, William T Thomson, Pearson, 5th edition

**Web Links:**

1. https://nptel.ac.in/courses/112104114/
2. https://nptel.ac.in/downloads/112101096/
3. https://interestingengineering.com/
4. http://www.nptelvideos.in/2012/12/dynamics-of-machines.html

# 18ME3103-THERMAL ENGINEERING–II

**B. Tech, ME - III Year, I Semester**

| L | T | P/D | C |
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**Pre-requisite**: **18ME2104- Thermodynamics**

**Course Objective**:

1. To apply the laws of Thermodynamics to analyze steam turbine plant and boilers.
2. To apply the laws of Thermodynamics to analyze gas turbine plant.
3. To perform analysis of the major components of steam turbine plants and their applications.
4. To perform analysis of the major components of gas turbine plants, condensers and their applications.
5. To apply the laws of Thermodynamics to analyze jet propulsions and rocket engines.

**Course Outcomes**:

At the end of the course, the student should be able to

**CO1:** Establish state – space diagrams based on the schematic diagrams of process flow of steam and gas turbine plants

**CO2:** Apply the laws of Thermodynamics to analyze thermodynamic cycles

**CO3:** Differentiate between vapour power cycles and gas power cycles

**CO4:** Apply the data for the evaluation of performance parameters of the steam and gas turbine plants using property charts and tables

**CO5:** Understand the functionality of major components of steam and gas turbine plants and to do the analysis of these components

**UNIT – I : BASIC CONCEPTS:** Steam Power Plant, Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration & reheating.

**UNIT – II: BOILERS** – Classification – Working principles with sketches including H.P.Boilers – Mountings and Accessories – Working principles- Boiler horse power, Equivalent Evaporation, Efficiency and Heat balance – Draught- Classification – Height of chimney for given draught and discharge- Condition for maximum discharge- Efficiency of chimney.

**Steam Condensers**: Requirements of steam condensing plant – Classification of condensers – Working principle of different types – Vacuum efficiency and Condenser efficiency – Air leakage, sources and its affects, Air pump- Cooling water requirement

**UNIT – III: STEAM NOZZLES :** Stagnation Properties- Function of nozzle – Applications and Types- Flow through nozzles- Thermodynamic analysis – Assumptions -Velocity of nozzle at exit-Ideal and actual expansion in nozzle- Velocity coefficient- Condition for maximum discharge- Critical pressure ratio- Criteria to decide nozzle shape- Super saturated flow, its effects, Degree of super saturation and Degree of under cooling - Wilson line.

**UNIT – IV: 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.

**UNIT – V: GAS TURBINES:** Simple gas turbine plant – Ideal cycle, essential components – Parameters of performance – Actual cycle – Regeneration, Inter cooling and Reheating –Closed and Semi-closed cycles – Merits and Demerits- Combustion chambers and turbines of Gas Turbine Plant- Brief Concepts.

**Jet Propulsion :** Principle of Operation –Classification of jet propulsive engines – Working Principles with schematic diagrams and representation on T-S diagram - Thrust, Thrust Power and Propulsion Efficiency – Turbo jet engines – Needs and Demands met by Turbo jet – Schematic Diagram, Thermodynamic Cycle, Performance Evaluation Thrust Augmentation – Methods.

**TEXT BOOKS :**

1. Thermal Engineering - Rajput -Lakshmi Publications – 2016 - 9th Edition.
2. Fundamentals of Thermal-Fluid Sciences by Yunus A. Cengel, Robert H. Turner, John M. Cimbala

.

**REFERENCE BOOKS:**

1. Gas Turbines and Propulsive Systems - P. Khajuria & S. P. Dubey - Dhanpatrai Publications – 2012.
2. Thermodynamics and Heat Engines - R. Yadav - Central Book Depot – 2002.
3. Gas Turbines – V. Ganesan - TMH – 2010.
4. Thermal Engineering - M.L.Mathur & F S Mehta- Jain Bros – 2001. .

# 18ME3104– DESIGN OF MACHINE ELEMENTS –I

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

**B. Tech-ME-III Year I Semester**

**Pre-requisites: 18ME1101-Engineering Mechanics-I,**
**18ME1201-Engineering Mechanics-II,**
**18ME2101-Metallurgy and Material science,**
**18ME2102-Mechanics of solids.**

**Course Objectives:** Develop an ability,

1. To apply knowledge of mathematics, science, and engineering
2. To develop an ability to design a mechanical system, or its components, or processes to meet desired needs within realistic constraints.
3. To develop an ability to identify, formulate, and solve engineering problems.
4. 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:

**CO1:** Illustrate the application of engineering materials and design the machine members subjected to practical loading conditions.

**CO2:** Choose fasteners used in mechanical members such as rivet, welds, bolts and nuts and design the structural systems.

**CO3:** Utilize the design principles and design members subjected to axial mechanical loads

**CO4:** Design machine members subjected to torsion and combined loads

**CO5:** Design springs to withstand specified loads, limiting deflections, capacity to store energy, and permissible induced stresses under practical loads

**UNIT-I: INTRODUCTION:** General considerations in the design of Engineering Materials & their properties – selection – Manufacturing consideration in design, Tolerances and fits – BIS codes of steels.

**Stresses in Machine Members:** Simple stresses – Stress strain relations - Impact stresses Complex stresses – Torsion and Bending stresses – Torsion, bending and axial stresses- Various theories of elastic 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

**Fatigue Loading:** Stress concentration – Theoretical stress concentration Factor – Fatigue stress concentration factor, notch sensitivity – Design for fluctuating stresses - Endurance limit – Estimation of Endurance strength–Mean and variable stresses –Theories of fatigue failure-Goodman's line – Soderberg's line – Modified Goodman's line.

**UNIT-II:**

**Riveted Joints:** Riveted joints: modes of failure of riveted joints, strength equations – efficiency of riveted joints – design of boilers joints- eccentrically loaded riveted joints.

**Welded joints**: Design of fillet welds – axial loads – circular weld joints- stresses due to bending and torsion in welded joints

**Bolted joints** – Design of bolts with pre-stresses-Design of bolted joints under eccentric loading-locking devices-bolts of uniform strength, different seals

**UNIT-III: AXIALLY LOADED JOINTS:** Keys, Cotters and Knuckle Joints: Design of Keys – stresses in keys – cotter joints – spigot and socket, sleeve and cotter, jib and cotter joints – Knuckle joints.

**UNIT-IV: DESIGN OF SHAFTS:** Design of solid and hollow shafts for strength and rigidity – Design of shafts for combined bending, Torsion and axial loads – shaft sizes – BSI codes

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

**UNIT-V: MECHANICAL SPRINGS:** Stresses and deflections of helical springs-Wahl's stress factor-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. Design of Machine Elements, V.B.Bhandari, 2nd Ed 2007, Tata McGraw Hill
2. Shigley's Mechanical Engineering Design, Richard G Budynas, J Keith Nisbett, McGraw Hill

**REFERENCE BOOKS :**

1. Machine design, P V Soundararajan Murthy and N Shanmugam, Anuradha publishers.
2. Machine design, R. L. Nortan, Mc Graw Hill
3. Design of machine elements (vol.1), T Krishna rao, IK International publishing house/2nd Edition.
4. Machine design, Pandya and Shah , Charotar publishing house pvt ltd.

## 18ME3105 – ADVANCED WELDING TECHNOLOGY
**(Professional Elective - I)**

**B. Tech ME- III Year, I Semester**

**Pre-requisites: 18ME2101-Metallurgy & Material Science, 18ME2203-Production Technology. – I.**

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**Course Objectives:** Develop ability to

1. Understanding of metallurgical fundamentals of welding with regard to heat flow, and phase transformations during welding.
2. Impart Knowledge on welding of ferrous metals and alloys.
3. Impart Knowledge on welding of non ferrous metals and alloys.
4. Gain knowledge about quality control methods in welded joints.

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

**CO1:** Demonstrate heat affected zone and its effects.

**CO2:** Understand various advanced welding processes and its applications.

**CO3:** Apply theoretical & practical knowledge of welding of ferrous metals and alloys.

**CO4:** Apply theoretical & practical knowledge of welding of non ferrous metals and alloys.

**CO5:** Conduct quality control tests on welded joints.

**UNIT- I:** Heat flow - temperature distribution-cooling rates - influence of heat input, joint geometry, plate thickness, preheat, calculation of heat input and heat affected zone width.

**UNIT- II:** Flux assisted GTAW process, friction welding processes, friction stir welding and friction surfacing, microwave Joining and hybrid welding.

**UNIT- III:** Weld metal solidification - Phase transformations- weld CCT diagrams - carbon equivalent -preheating and post heating- weldability of carbon steels and low alloy steels.

**UNIT- IV:** Welding of stainless steels use of Schaffler and Delong diagrams, welding of cast irons, welding of aluminum alloys.

**UNIT -V:** Welding of titanium alloys and welding of dissimilar metals. Weld defects: Causes and remedial measures, Weldability tests - effect of metallurgical parameters.

**TEXT BOOKS :**

1. Linnert G. E.,'Welding Metallurgy', Volume I and II, 4th Edition, AWS, 1994.
2. Granjon H., 'Fundamentals of Welding Metallurgy', Jaico Publishing House, 1994.

**REFERENCE BOOKS:**

1. Kenneth Easterling, 'Introduction to Physical Metallurgy of Welding', 2nd Edition,
2. Butterworth Heinmann, 1992.
3. Saferian D., 'The Metallurgy of Welding', Chapman and Hall, 1985.
4. Jackson M. D., 'Welding Methods and Metallurgy', Griffin, London, 1967.
5. Mishra. R.S and Mahoney. M.W, Friction Stir Welding and Processing, ASM, 2007.
6. Welding Metallurgy – Sindo Kour, 2nd edition, published by Wiley.

# 18ME3106- MECHANICAL VIBRATIONS

**(Professional Elective-I)**

**B. Tech.-ME-III Year I Semester**

| L | T | P/D | C |
|---|---|---|---|
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**Pre-requisites: 18ME1101-Engineering Mechanics-I,**

**18ME1201-Engineering Mechanics-II**

**Course objectives:**

1. To understand various levels of vibrations and devise remedies for each of them.
2. To learn fundamentals of design for quietness

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

**CO1:** Understand the causes and effects of vibration in mechanical systems and develop schematic models for physical systems and formulate governing equations of motion.

**CO2:** Identify the role of damping, stiffness and inertia in mechanical systems' vibration

**CO3:** Analyze rotating and reciprocating systems and compute critical speeds.

**CO4:** Calculate natural frequency of vibration in strings, beams and shafts.

**CO5:** Apply basic mathematics to solve higher order governing equations and to measure vibration parameters

**UNIT – I: SINGLE DEGREE OF FREEDOM SYSTEMS – I:** Un-damped and damped free vibrations; forced vibrations coulomb damping; Response to excitation; rotating unbalance and support excitation; vibration isolation and transmissibility.

**UNIT – II: SINGLE DEGREE OF FREEDOM SYSTEMS – II:** Response to Non Periodic Excitations: UNIT- Impulse, unit step and unit Ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

**UNIT – III: TWO DEGREE FREEDOM SYSTEMS:** Principal modes- un-damped and damped free and forced vibrations; un-damped 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, Lagrangian's Method, 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.

**UNIT – V: NUMERICAL METHODS:** Rayleigh's stodola's, Matrix iteration, Rayleigh-Ritz Method and Holzer's methods.

**Vibration measuring instruments:** Vibrometer, velocity meters & accelerometers

**TEXT BOOKS :**

1. Mechanical Vibrations, G K Groover, Nem Chand and Bros.
2. Elements of Vibration Analysis, Meirovitch, Mc Graw Hill

**REFERENCE BOOKS:**

1. Mechanical Vibrations, SS Rao, Pearson
2. Mechanical Vibration, Rao V. Dukkipati , J Srinivas, PHI
3. Theory of Vibrations with Applications, William T Thomson, Pearson, 5th edition

# 18ME3107-AUTOMOBILE ENGINEERING

**(Professional Elective-I)**

**B. Tech, ME - III Year, I Semester**

| L | T | P/D | C |
|---|---|---|---|
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**Pre-requisites: 18ME2104-Thermodynamics**

**18ME2201-Thermal Engineering-I**

**Course Objectives:**

1. To impart basic knowledge about the automobiles and their sub-systems.
2. To facilitate to understand the engineering principles to automotive parts.
3. To understand the different types of engines and automobile bodies.
4. To create awareness on the automotive industry and its terminology.
5. To Develops an idea of utilization of resources duly reducing emission levels for achieving eco-friendly environment.

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

**CO1:** Analyze the basic lay-out of an automobile.

**CO2:** Understand the operation of the engine cooling, lubrication, ignition, electrical and air conditioning systems.

**CO3:** Apply the principles of transmission, suspension.

**CO4:** Analyze for latest developments in automobiles like steering and braking systems.

**CO5:** Evaluate the recent emission stands in automobile fuels and safety systems.

**UNIT – I: INTRODUCTION:** History of Automobiles, Classification of Automobiles. chassis and body building, Engine Terminology, Types of Cycles, working principle of an IC engine, advanced classification of Engines- Multi cylinder engines, Engine balance, firing order, Engine service.

**UNIT-II: FUEL SYSTEM:** spark Ignition engines-Fuel tank, fuel filter, fuel pump, air cleaner/filter, carburetor types, injection of petrol engines. Compression Ignition engines, Fuel Injection System- air & solid injection system, Pressure charging of engines, super charging and turbo charging, **Alternative fuels**: Importance, engine modifications (LHR engines), Pollution Effects.

**UNIT-III: 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

**COOLING SYSTEM :** Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System, Radiators, Cooling Fan - water pump, thermostat, evaporating cooling, pressure sealed cooling, antifreeze solutions.

**UNIT-IV: TRANSMISSION SYSTEM :** Clutch principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel, gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box , over drive torque converter. Propeller shaft, Hotch Kiss drive, Torque tube drive, universal joint, differential, live and dead axles, wheels and tyres.

**Suspension System:** Objects of suspension systems, rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

**Braking System:** Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder, tandem master cylinder, Requirement of brake fluid, Pneumatic and vacuum brakes.

**UNIT-V: STEERING SYSTEM:** Steering geometry, camber, castor, king pin rake, combined angle toe in, center point steering. Types of steering mechanism, Ackerman steering mechanism, Davis steering mechanism, steering gears, types, steering linkages.

**Emissions:** Pollution standards National and international, Pollution Control Techniques.

**TEXT BOOKS :**

1. A Text Book Automobile Engineering–Manzoor,. Nawazish Mehdi & .Yosuf Ali, Frontline Publications.
2. Internal Combustion Engine Fundamentals, J.B. Heywood, McGraw Hill Co.1988

**REFERENCE BOOKS:**

1. Automobile Engineering Kindle Edition by Gupta S.K. ,S Chand publications.2016
2. Automobile Engineering by A K Babu (Author), Ajit Pal Singh 2013,S Chand
3. Automobile Engineering by Sudhir Kumar Saxena **,** Laxmi Publications; I edition ,2015,
4. A Text Book of Automobile Engineering by R K Raj put. Laxmi Publications.

**Web Links:**

1. https://www.automotiveengineeringhq.com/automotive-engineering-terminology-list/
2. https://study.com/directory/category/Engineering/Mechanical_Engineering/Automotive_Engineering.html
3. http://www.emae.eu/downloads-and-links/practical-links

# 18ME3108 – MATERIALS MANAGEMENT

**(Professional Elective –I)**

**B. Tech ME- III Year, I Semester**

**Pre-requisites: None**

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**Course Objectives:** Develop ability to

1. Understand how material management should be considered for profitability.
2. Provide students with analytical skills those are necessary for the understanding of invent and warehousing management knowledge and principles.

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

**CO1:** Gain knowledge on effective utilization of materials in manufacturing and service organization

**CO2:** Demonstrate the importance of optimum inventory and efficient warehousing management in business. Inventory control procedures.

**CO3:** Evaluate quantitative and qualitative methods and software applications in purchasing management and strategic sourcing. Codification of materials

**CO4:** Demonstrate the importance of optimum inventory and efficient warehousing management in business. Purchase policies and procedures.

**CO5:** Solve inventory and warehousing issues in an integrated logistics flow which reflects sound business practices.

**UNIT- I: INTRODUCTION:** Materials objectives, Policy manual: A to Z items, UNIDO Recommendations, Purchase policy, Purchasing cycle, A to Z purchase order, Materials Intelligence (MIS), Specification and standardization in Materials management, Make or buy decision, buying process.

**UNIT- II: MATERIALS PLANNING AND CONTROL:** Material forecasting, Selective inventory control, EOQ models, Spare parts management, Inventory systems; Flow charting techniques to reduce various types of lead time, Materials requirement planning, Aggregate inventory management.

**UNIT- III: STORAGE AND DISTRIBUTION:** Codification of materials, Storage design, Stores layout, Storage systems and equipment, Stores preservation, Stores procedures, Stock valuation and verification ware housing, Distribution management.

**UNIT- IV: PURCHASE FUNCTION:** Purchasing policies and procedures, Legal aspects of

purchasing, Selection of sources of supply, Vendor evaluation and rating end or development, Price, Cost analysis.

**UNIT- V: MATERIALS ACCOUNTING AND BUDGETING:** Ethical buying, Performance indicators, Materials management controls, Budgetary control, Computer in materials management, Software and hardware, Materials information system, Reports and information needs, Application and limitations of computers

**TEXT BOOKS :**

1. Purchasing and Materials Management, Gopala krishnan. P, Tata McGraw Hill, 1990.
2. Purchasing and Material Management, Learnerr Lee Jr. and Donald. M.Dobbler, Tata McGraw Hill, 1996.

**REFERENCE BOOKS:**

1. Purchasing and Materials Management, Camer Lee and Donald M Dubbler, Text and cases, Tata McGraw Hill, 1997.
2. Operations Management, Mark.J.V, McGraw Hill Publishers, 1984.
3. Purchasing Management Principles, Westing.J.K, Fine, E.V. and Zone.C.T, John Wiley & Sons, New York, 1986.

## 18ME31L1- PRODUCTION TECHNOLOGY-II LAB

**B. Tech ME- III Year, I Semester**

**Pre-requisites: 18ME11L1-Engineering Workshop**

| L | T | P/D | C |
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**Course Objectives:**

1. Impart hands on experience on various machine tools.
2. Demonstrate the usage of metrology lab equipment.

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

**CO1:** Operate different machine tools with an understanding of work holders and operating principles to produce different part features to the desired quality.

**CO2:** Identify the appropriate production process and machines.

**CO3:** Describe the use of various measuring instruments.

**CO4:** Create awareness on various mechanical measuring instruments.

### Section - A: Machining

1. Introduction of machine tools - Lathe, Drilling machine, Milling machine, Shaper, Planing machine, slotting machine, Cylindrical Grinder, surface grinder and tool and cutter grinder.
2. Step turning and taper turning on lathe machine.
3. Thread cutting and knurling on -lathe machine.
4. Drilling and Taping.
5. Shaping and Slotting
6. Planing
7. Milling
8. Cylindrical and Surface Grinding.

### Additional Experiments

1. Grinding of tool angles.
2. Slotting using Indexing.

## Section - B: Metrology

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

## Additional Experiments

1. Surface finish Measurement.
2. Machine tool alignment - test on the lathe.

# 18ME31L3 - KINEMATICS AND DYNAMICS LAB

**B Tech.-ME- III Year I Semester**

| L | T | P/D | C |
|---|---|---|---|
| - | - | 2/- | 1 |

**Prerequisite(s)**: **18ME2202-Kinematics of Machinery**

**18ME3102-Dynamics of Machinery**

**Course Objectives:** Develop ability to,

1. Understand the basic principles of motion and inertia.
2. Understand the formation and functioning of various mechanisms.
3. Understand the importance of static and dynamic balancing.
4. Acquire knowledge for evaluating stability of dynamic systems.

**Course Outcomes (COs):** At the end of the course, student would be able to,

**CO1:** Analyze mechanisms for specific type of motion in machines

**CO2:** Familiarize with various belt drives, nomenclature, and analyze for belt tensions to design the belt drives.

**CO3:** Analyze various gears and gear trains and select the appropriate for practical applications.

**CO4:** Acquire basic knowledge in vibration of different machine components.

**CO5:** Analyze the forces and torques generated in spinning masses

**List of Experiments**

1. To study various types of kinematic links, pairs, chains and mechanisms
2. To study various kinds of belts drives
3. To study various types of Cams and Followers
4. To study different types of Gears
5. To study Different types of Gear Trains
6. Determination of damped natural frequency of a vibrating system with different viscous oils
7. Determination of steady state amplitude of a forced vibrating system.
8. Static balancing using steel balls
9. Determination of the magnitude and orientation of the balancing mass in dynamic balancing
10. Field balancing of the thin rotors using vibration pickups

11. Determination of the magnitude of gyroscopic couple, angular velocity of precession and representation of vectors
12. To determine coefficient of friction between a belt and pulley

**Additional Experiments**

13. Measurement of vibration characteristics using vibration pickups

# 18EN31L1-ADVANCED ENGLISH COMMUNICATION SKILLS LAB

| L | T | P/D | C |
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**B Tech.-ME- III Year I Semester**
**Prerequisite(s)**: None

**Course Objectives:** Develop ability to,

1. Improve students' fluency in spoken English.
2. Enable them to acquire behavioural skills required for their personal and professional life.
3. Help students develop their vocabulary.
4. Read and comprehend texts and respond appropriately in different socio-cultural contexts.
5. Communicate their ideas.

**Course Outcomes:** At the end of the Course the students would be able to,

**CO1:** Acquire vocabulary and use it contextually

**CO2:** Demonstrate effective Listening and Speaking Skills

**CO3:** Develop proficiency in academic reading and writing

**CO4:** Establish employability skills thereby increasing Job prospects

**CO5:** Communicate confidently in formal and informal contexts

**CO6:** The following Course Content with activities/tasks is proposed for the Advanced English

**Communication Skills (AECS) Lab sessions:**

1. **Activities on Fundamentals of Inter-Personal Communication and Vocabulary Building:**

   Responding appropriately and relevantly using the right body language, Discourse skills, Word Roots, One Word Substitutes, Business Vocabulary, Analogy, Collocations and uses of vocabulary, Resilience and Personal Management, Managing stress, time, anger and other emotions, Assertiveness and Culture shock.

2. **Reading Skills:**

   Reading for facts, specific information, Reading between the lines, Negative facts, Inferential Reading, Critical Reading.

3. **Activities on Writing:**

Writing Process, Gathering Information, Analyzing the content, Formatting, Editing, Resume Writing and C.V preparation, Writing SOP, Letter Writing, email Writing.

4. **Activities on Presentation Skills:**

   Oral Presentations (Individual and Group), Seminars, PPTs and Written Presentations through posters, Projects, Portfolio Writing, Brochures and Reports.

5. **Activities on Group Discussion and Interview Skills:**

   Dynamics of Group Discussions, intervention, summarizing, body language, relevance and organization of ideas and rubrics for evaluation, Pre-Interview Planning, opening strategies, answering strategies, Interview through Tele-Conference and Video Conference and Mock Interviews, Videos of Mock Interviews.

**Book(s) Recommended:**

1. Technical Communication, Meenakshi Raman & Sangeetha Sharma, Oxford University Press, 2009.
2. English Vocabulary in Use series, Cambridge University Press 2008.
3. Communication Skills, Leena Sen , PHI Learning pvt ltd, New Delhi 2009.
4. Communication Skills, Sanjay Kumar and Pushp Lata, 2nd edition, Oxford
5. University Press.

# SYLLABUS

## B. Tech III YEAR II SEMESTER

# 18ME3201 – FINITE ELEMENT ANALYSIS

**B. Tech -ME- III Year II Semester**

| L | T | P/D | C |
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**Pre-requisites: 18ME2102-Mechanics of Solids**
**18MA1101- Mathematics-I**

**Course Objectives:**

1. To apply matrix methods and finite elements approach to solve structural and thermal problems.
2. To solve problems of indeterminate nature by discretization approach.
3. To analyze for dynamic systems with FEA.

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

**CO1:** Define shape of the object by discretized elements and formulate a stress- strain relation between the elements to solve 1 D problem.

**CO2:** Analyze the truss and beam for stress-strain-displacement

**CO3:** Evaluate for stresses and strains in 2D plane elements and axi-symmetric Solids.

**CO4:** Perform steady state heat transfer Analysis of 1D and 2D elements to assess heat flow parameters.

**CO5:** Formulate dynamic Analysis and solve the problems using softwares.

**UNIT- I: INTRODUCTION OF FEA** for solving field problems. Stress and equilibrium, Boundary conditions, General description, comparison of FEA with other methods; Basic equations of elasticity, Strain displacement relations, Stress strain relations for 2D and 3D Elastic problems

**One dimensional problem**: Finite Element modeling coordinates and shape functions. Stiffness equations for axial bar element using potential energy approach, Assembly of global stiffness matrix and load vector, Finite Element equations. Quadratic shape functions

**UNIT- II: ANALYSIS OF TRUSS:** Stiffness matrix for plane truss elements, stress calculations and problems.

**Analysis of Beams:** Shape functions, Element stiffness matrix for two noded, two degree of freedom per node beam element and simple problems.

**UNIT- III: 2D-PROBLEMS:** Finite element modeling of two dimensional stress analysis with CST, 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.

**UNIT- IV: STEADY STATE HEAT TRANSFER ANALYSIS:** One dimensional analysis of Slab, fin and two dimensional analysis of thin plate.

**UNIT- V: DYNAMIC ANALYSIS:** Formulation of finite model, Element mass matrices**,** equations of Eigen values and Eigen vectors for a stepped bar, truss.
Finite element Formulation of 3D problems in stress analysis, convergence requirements, mesh generation, techniques such as semi automatic and fully Automatic use of software's such as ANSYS, ABACUS, NASTRAN, etc.

**TEXT BOOKS :**

1. Introduction to The Finite Elements in Engineering, Chandrapatla, Ashok and Belegundu, prentice-Hall.
2. An Introduction to Finite Element Method, J N Reddy, TMH.

**REFERENCE BOOKS:**

1. The Finite Element Method: Its Basis and Fundamentals, O C Zeinkiewicz, R L Taylor, J Z Zhu, Butterworth-Heinemann
2. Concepts and Applications of Finite Elements Analysis, Malkus, Plesha, Witt Robert D. Cook, Wiley, 4ed, 2007
3. The Finite Element Methods in Engineering, SS Rao, Pergamon.
4. Finite Element analysis, C.S. Krishnamurthy, TMH

## 18ME3202 - DESIGN OF MACHINE ELEMENTS-II

**B Tech-ME, III Year II Semester**

**Prerequisite(s)**: **18ME2102-Mechanics of Solids**
**18ME3104-Design of Machine Elements-I**

| L | T | P/D | C |
|---|---|---|---|
| 3 | 1 | -/- | 4 |

**Course Objectives:** Develop ability to

1. Provide enough hands on experience with the usage of design data book to design standard machine elements like bearings, gears and other elements.
2. Apply the concepts of stress analysis, theories of failure and material science to analyze, design and/or select commonly used machine components.
3. Develop an ability to design a system, component or process to meet desired needs within realistic constraints.
4. Identify, formulate and solve engineering problems.
5. Apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems.

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

- **CO1:** Analyze and design journal bearings and select anti friction bearings.
- **CO2:** Design IC engine parts and calculate forces in piston and crank shaft.
- **CO3:** Select and design power transmission systems and pulleys.
- **CO4:** Design the different gears against static and dynamic loads and their analysis.
- **CO5:** Design power screws under specified practical loads.

**UNIT – I: BEARINGS**: Types of Journal bearings – Lubrication – Bearing Modulus – Full and partial bearings – Clearance ratio – Heat dissipation of bearings, bearing materials – journal bearing design – **Ball and roller bearings**: – Static loading of ball & roller bearings, bearing life, selection of bearings.

**UNIT – II: DESIGN OF IC ENGINE PARTS**: Design of Connecting Rod: Thrust in connecting rod – stress due to whipping action on Connecting rod ends; Cranks and Crank shafts- strength and proportions of over hung and center cranks – Crank pins, Crank shafts; Pistons- Forces acting on piston, Design and proportions of piston. Cylinder, Cylinder Liners

**UNIT –III: POWER TRANSMISSION SYSTEMS AND PULLEYS**: Transmission of power by Belt drives, Transmission efficiencies, Belts – Flat and V types – Ropes - pulleys for belt drives, Materials, Chain drives

**UNIT – IV: SPUR AND HELICAL GEAR DRIVES**: Spur gears- Helical gears – Load concentration factor – Dynamic Load factor. Surface compressive strength – Bending strength – Design analysis of spur gears – Estimation Of centre distance, module and face width, check for plastic deformation, Check for dynamic and wear Considerations, Brief introduction to Bevel and worm gear drives.

**UNIT – V: DESIGN OF POWER SCREWS**: Design of screw- Square, ACME, Buttress screws; design of nut, compound Screw, Differential screw, and ball screw- possible failures.

**TEXT BOOK:**

1. Design of Machine Elements, V.B.Bhandari, Tata McGraw hill, 2nd Ed 2007
2. Maleev and Hartman's Machine Design, O P Grover, C B S Publications

**Design Data Hand Books:**

1. Design Data Hand book: V.B.Bhandari, Tata McGraw hill
2. Design Data Hand book: S MD Jalaludin, Anuradha Publishers.

**REFERENCE BOOKS :**

1. Machine Design, Pandya and shah, Charotar publishing house Pvt., ltd.19th Ed, 2014
2. Machine Design, Robert L.Norton, Pearson Education, 2001.
3. Mechanical Engineering Design, Joseph E Shigley and Charles R Mischke, 8th Ed Tata McGraw Hill-2008

## 18ME3203– CAD/CAM

**B. Tech. –ME- III Year II Semester**

**Pre-requisites: 18ME3101-Production Technology-II.**

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

**Course Objectives:** Develop ability to,

1. Understand the basic analytical fundamentals that are used to create and manipulate geometric models in a computer program.
2. Understand the possible applications of the CAD/CAM systems in kinematic analysis, structure analysis, optimization, rapid prototyping, reverse engineering and virtual engineering.
3. Create a computer aided manufacturing (CAM) model and generate the machining codes automatically using the CAM system and manual part programming.
4. Combine the CAD system and the CAM system by using the CAD system for modeling design information and converting the CAD model into a CAM model for modeling the manufacturing information.

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

**CO1:** Describe the fundamental concepts on CAD/CAM and Geometric modeling

**CO2:** Develop the concepts of modeling and identify the usage of surface and solid models in different engineering applications.

**CO3:** Apply computer programming for CNC manufacturing

**CO4:** Organize storage, retrieval of tools/ material and prepare process planning for industrial manufacturing

**CO5:** Describe the basic concepts on CAPP, MRP and CIM.

**UNIT- I: INTRODUCTION:** 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:** 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, parameterization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Coons Patch, 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, NC 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, 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 (ERP), and Capacity Requirements Planning (CRP).

**UNIT- V: FLEXIBLE MANUFACTURING SYSTEM:** FMS 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 (CMM).

**Computer Integrated Manufacturing:** CIM system, Benefits of CIM.

**TEXT BOOKS :**

1. CAD/CAM, Groover M, Zimmers E, Pearson education, 1st edition, 2003.
2. CAD /CAM Theory and Practice, Ibrahim Zeid, TMH, 2nd edition, 2 009.

**REFERENCE BOOKS:**

1. CAD/CAM Concepts and Applications, Alavala, PHI, 2013.
2. CAD/CAM Principles and Applications, P.N.Rao, TMH, 3rd edition, 2013.
3. CAD / CAM / CIM, P. Radhakrishnan and Subramanian, New Age, 4th edition 2016
4. Computer Numerical Control Concepts and programming, Warren S Seames, Thomson, 2001.

## 18ME3204–HEAT TRANSFER

**B. Tech, ME - III Year, II Semester**

| L | T | P/D | C |
|---|---|---|---|
| 3 | 1 | -/- | 4 |

**Pre-requisite(s): 18ME2104 - Thermodynamics**

**Course Objectives:**

1. To demonstrate basic knowledge by understandingdifferent modes of heat transfer.
2. Estimate the effectiveness of extended surfaces.
3. Estimate the relation between various dimensionless numbers for free and forced convection
4. Student will come to knowthedifference of condensation, boiling phenomena and basic principles of radiative heat transfer
5. Student will understand the working principle of heat exchanger and their effectiveness.

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

**CO1:** Explain the basic modes of heat transfer.

**CO2:** Predict time dependent heat transfer in solids for engineering applications.

**CO3:** Interpret convective heat transfer coefficients in free and forced convection for internal flows & external flows.

**CO4**: Estimate radiation heat transfer between black and non-black bodies using laws of radiation.

**CO5**.Design of heat exchangers using the LMTD and ε-NTU approaches for industrial applications.

**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.

**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.

**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.

**UNIT – IV: 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, Kirchhoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

**UNIT– V: 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.

**TEXT BOOKS :**

1. Heat Transfer- P.K. Nag, TMH publications,2011.
2. Heat transfer - A basic approach, M. Necati Ozisik, McGraw-Hill, New York, 2005.

**REFERENCE BOOKS:**

1. Heat Transfer -A Practical Approach, Yunus A Cenegal, Tata McGraw Hill, 2nd Edn.1998.
2. Heat transfer, J.P. Holman, Tata McGraw Hill Publication, New Delhi, 2010.
3. Heat and Mass Transfer, R S Yadav, Center publishing House, 1992.
4. Heat Transfer- P.K. Nag , TMH publications,2011

**WEB RESOURCES:**

1. http://nptel.ac.in/courses/112101097/
2. http://freevideolectures.com/Course/2366/Heat-and-Mass-Transfer
3. http://textofvideo.nptel.iitm.ac.in/112101097/
4. http://www.nptelvideos.in/2012/11/heat-transfer.html

## 18ME3205 – UN-CONVENTIONAL MACHINING PROCESSES

**(Professional Elective - II)**

**B. Tech ME- III Year, II Semester**

**Pre-requisites: 18ME3101-Production Technology-II**

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**Course Objectives:** Develop ability to

1. Differentiation between convention and unconventional machining process and need of unconventional machining in the current scenario.
2. State the modern machining process and process selection.
3. Discuss the Metal Removal Rate and surface finish of different materials using different process parameters.
4. Classify the various thermal & non thermal machining processes.
5. Justify the conventional machining process.

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

**CO1:** Identify the selection of processes and design the components of Abrasive Jet machining process. Match the material & tool with respect to process.

**CO2:** Illustrate the chemical, electrical & mechanical machining process and develop the economic aspects of the different unconventional machining process.

**CO3:** Demonstrate the thermal aspects of EDM and Wire EDM.

**CO4:** Explain the basic principle of LBM and PAM machining process.

**CO5:** Analyze surface properties after machining without destructing the material.

**UNIT- I: INTRODUCTION:** Need for Unconventional machining (UCM) methods-Classification of UCM – considerations in process selection, Materials, Applications.

**Abrasive Jet Machining, Water Jet Machining and Abrasive Water Jet Machining:** Basic principles, equipments, process variables, mechanics of metal removal, MRR, application and limitations.

**UNIT- II: ULTRASONIC MACHINING:** Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent development

**ELECTRO CHEMICAL MACHINING PROCESSES:** Fundamentals of ECM, metal removal rate in ECM, Tool design, economic aspects of ECM, Applications of ECM. Electro-Chemical Grinding (ECG), Electro Chemical Honing and deburring process.

**CHEMICAL MACHINING:** principle-mask ants-etchants-applications.

**UNIT- III: THERMAL METAL REMOVAL PROCESSES**: General Principle of Electric Discharge Machining (EDM) – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, surface finish and machining accuracy, applications of EDM. Wire EDM-principle and applications. Generation and control of Electron Beam for Machining (EBM), theory of electron beam machining, Applications of EBM

**UNIT- IV: LASER BEAM MACHINING (LBM):** General Principle and Generation of laser beam – Classification and applications of LBM, thermal features, cutting speed and accuracy of cut.

**PLASMA ARC MACHINING (PAM):** Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries.

**UNIT- V:** Magnetic abrasive finishing, Abrasive Flow Finishing, Electro Stream drilling, Shaped tube Electrolytic machining.

**TEXT BOOKS:**

1. Advanced machining processes, VK Jain, Allied publishers
2. Modern Machining Process, Pandey P.C and Shah H.S., TMH

**REFERENCE BOOKS:**

1. New Technology, Bhattacharya A, the Institution of Engineers, India 1984.
2. Unconventional Machining Processes, C. Elanchezhian, B. VijayaRamnath and M Vijayan, Anuradha Publications, 2005.
3. Unconventional manufacturing processes, M.K. Singh, New Age International Publishers.

# 18ME3206- GAS DYNAMICS

**(Professional Elective – II)**

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

**B. Tech, ME- III Year – II Semester**

**Prerequisite: 18ME2103 - Fluid Mechanics and Hydraulic Machinery**

**Course Objectives:**

1. The course aims to provide students understanding in compressible flow problems commonly encountered in basic engineering applications
2. Able to understand nozzle flows, shock wave motion, moving and oblique shocks, natural gas flow in pipelines.
3. The course builds concepts learned in basic courses in thermodynamics and fluid mechanics.

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

**CO1:** Understand the basic foundation in integral and differential formulations of equations of continuity, momentum and energy.

**CO2:** Evaluate the effect of compressibility aspects in practical applications.

**CO3: A**nalytically solve the fluid flow and heat transfer problems in compressible flows.

**CO4:** Describe the irreversibility mechanisms of a moving compressible fluid.

**CO5:** Analyze the concept and design of multi stage turbine

**UNIT-I : BASIC EQUATIONS OF FLUID FLOW**, Reynolds transport equation, Integral and differential formulations - Integral form of the equations of continuity - Momentum - energy equations - use of the integral equations, Differential form of these equations, Stokes postulates and constitutive equations, Navier-Stokes equations and energy equations for Newtonian fluids.

**UNIT-II: INTRODUCTION TO COMPRESSIBLE FLOWS:** Basic concepts - equations for one-dimensional flow through stream tubes - variation of pressure - temperature - density in the atmosphere, Speed of sound , Mach number, Qualitative difference between incompressible, Subsonic and Supersonic flows, Karman's rules of supersonic flows, Characteristic velocities, Isentropic flow through a duct - criterion for acceleration and deceleration -stagnation quantities -isentropic relations.

**UNIT-III: NORMAL SHOCKS IN ONE-DIMENSIONAL FLOW** - occurrence of shocks - analysis of normal shocks - Prandtl's equation - Rankine - Hugoniot equation and other normal

shock relations -moving shocks, Oblique shocks and expansion -M relations -oblique shock relations - - Prandtl- Meyer function -intersection of shocks - detached shocks - Mach deflection

**UNIT-IV: EFFECT OF FRICTION ON PROPERTIES** -choking, isothermal flows, Flow with simple heat transfer - Rayleigh lines -effect of heat addition -thermal choking, Generalized on dimensional flows - One-dimensional flow with several effects like mass addition -friction and heat transfer.

**UNIT-V: STUDY OF GAS TURBINE:** Concept of gas turbine - analysis of turbine stage - velocity triangles and characterization of blades - Designing of multistage axial folw turbine - Performance analysis of turbine

**TEXT BOOKS :**

1. Modern Compressible Flow (With Historical Perspective), J.D. Anderson, McGraw-Hill (2ndEdition)- 1990
2. Fundamentals of Compressible Flow, S M Yahya , New Age International -2010
3. Steam and Gas Turbine and Power Plant Engineering, Yadav R.Central Publishing House

**REFERENCE BOOKS:**

1. Modern Compressible Flow with Historical Perspective, Anderson, J.D. 2nd edition, McGraw Hill-1990.
2. Dynamics and Thermodynamics of Compressible Fluid Flow, Shapiro A.H., Zuckrow
3. Gas Dynamics, M.J. and Hoffman. J.D., New York-1976.
4. Fundamentals of Gas Dynamics, Zucker,R.D, and Biblarz.O, 2nd edition, John Wiley & Sons, 2002.

# 18ME3207 – ROBOTICS
**(Professional Elective - II)**

**B. Tech.-ME-III Year II Semester**

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

**Pre-requisites: 18ME2202-Kinematics of Machinery**

**Course Objectives:** Develop ability to

1. Practice in applying their knowledge of mathematics, science, and Engineering and to expand this knowledge into the vast area of robotics.
2. Expose to the concepts of robot kinematics, Dynamics and Trajectory planning.
3. Use mathematical approach to explain how the robotic motion can be described.
4. Understand the functioning of sensors and actuators.

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

**CO1:** Identify various robot configuration and components

**CO2:** Analyze for kinematics of robots and formulate equations of motion

**CO3:** Analyze for differential kinematics and robot dynamics

**CO4:** Perform trajectory planning and select sensors and actuators

**CO5:** Identify the application of robots for different industrial applications

**UNIT-I: INTRODUCTION:** An Overview of Automation and Robotics, Classification by coordinate system and control systems, Components of the Industrial robotics, Degrees of freedom, end effectors, General considerations on gripper selection and design.

Precision of movement, Resolution, Accuracy, Repeatability, Compliance, Load carrying capacity, speed of response

**UNIT-II: MOTION ANALYSIS:** Basic rotation matrices, Composite rotation matrices, Euler Angles, Equivalent angle and Axis, Homogeneous transformation matrices.

**Manipulator Kinematics**: D-H notation, Joint coordinates and world coordinates, Forward and inverse kinematics.

**UNIT-III: DIFFERENTIAL KINEMATICS:** Differential kinematics of planar and spherical manipulators, Manipulator Jacobian.

**Robot Dynamics**: Lagrange-Euler formulations, Newton-Euler formulations.

**UNIT-IV: TRAJECTORY PLANNING:** Joint space scheme, Cubic polynomial fit, Avoidance of obstacles. Types of motion- Slew motion, Joint interpolated motion, Straight line motion.

**Robot Actuators and Feedback Components:** Actuators- Pneumatic, Hydraulic and Electric Actuators, DC servo motors, stepper motors.

**Feedback Components:** Sensors- Position Sensors- Potentiometers, Resolvers and encoders, Velocity 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, Pearson Edu.
2. Robotics and Control, Mittal R K & Nagrath, I J, TMH.

## REFERENCES:

1. Robotics, Fu K s, McGraw Hill
2. Introduction to Robotic Mechanics and Control, JJ Craig, Pearson, 3rd edition.
3. Robot Dynamics & Control, Mark W. Spong and M. Vidyasagar, John Wiley & Sons, (ASIA) Pvt. Ltd.

# 18ME3208 - TOOL DESIGN
**(Professional Elective - II)**

**B. Tech, ME- III Year- II Semester**

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

**Pre-requisites: 18ME1101-Engineering Mechanics –I**
**18ME1201-Engineering Mechanics – II**
**18ME2102-Mechanics of Solids**

**Course Objectives:** This subject gives a deep insight of

1. Types of tools for machining processes and their design aspects
2. Design elements used in sheet metal operation
3. Use of jigs and fixtures for automation in industries
4. Design of forming dies and tools

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

**CO1:** Design a single point cutting tool based on material, machine and machining process.

**CO2:** Design a multi point cutting tool based on material, machine and machining process.

**CO3:** Design work holding and tool holding devices for automation.

**CO4:** Design tools and dies required for sheet metal operations.

**CO5:** Design tools and dies for bending and drawing.

**UNIT- I: INTRODUCTION TO TOOL DESIGN:** Tooling requirements of a tool designer, general tool design procedure. Design of Single point Cutting Tools: Design of single point lathe tool: Design of shank dimension using strength and rigidity considerations for rectangular, square and round cross section and selection of tool geometry. Solid type tool, brazed tip tool, long index able insert, throwaway index able insert types and chip breakers.

**UNIT- II: DESIGN OF MULTI POINT CUTTING TOOLS:** Drill bit design of elements like back taper, web thickness, land width, margin, flute length and cross section and selection of tool geometry. Design of milling cutter: Design of elements like number of teeth and height circular pitch, body thickness, chamfer width, fillet radius and selection of tool geometry.

**UNIT- III: DESIGN OF JIGS AND FIXTURES:** Functions and differences between jigs and fixtures, advantages in mass production, design principles, economics of jigs and fixtures; Principles of location-3-2-1 and 4-1-1 types of locations, different types of locating elements; Clamping-Principles of clamping, types of clamping including power clamping devices. Drill jigs-Types, Drill bushes, simple exercise of designing jigs for given components; Fixture Design

Turning fixtures, milling fixtures, grinding and broaching fixtures, indexing fixtures. Design of fixtures for simple components.

**UNIT- IV: DESIGN OF SHEET METAL:** Working of a power press and classification of presses; Components of a simple die, press tool operation, die accessories, shearing action in punch & die, clearance, shear on punch and die, Centre of pressure and problems, scrap strip layout. Simple, progressive, compound, combination and inverted dies. Design problems on blanking and piercing dies for simple components.

**UNIT- V: BENDING AND DRAWING:** Bending dies – Introduction, bend allowance, spring back edge bending die design. Drawing dies-Single action, double action and triple action dies, factors affecting drawing, drawing die design.

**TEXT BOOKS :**

1. Tool Design, C. Donaldson, G.H.Le Cain V.C. Goold, Tata McGraw Hill pub.1976.
2. Fundamentals of tool design, ASTME Prentice Hall India.2000

**REFERENCE BOOKS:**

1. Introduction to jigs and fixture design, M H A Kempster, Elbs, Edn. 1974.
2. Tool engineering and design, Nagpal Khanna pub.Edn. 1998.
3. Metal cutting theory & cutting tool design, V. Arshinow and G. Alfseev MIR pub. Mascow Edu 1976
4. Metal cutting and tool design, DR,B,J, Ranga, Vikas Pub. Edn. 1993.

# 18ME32L1 – FINITE ELEMENT ANALYSIS LAB

**B. Tech, ME- III Year II Semester**

**Pre-requisites: 18ME2102-Mechanics of Solids**

**18MA1101- Mathematics-I**

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| 0 | 0 | 2/- | 1 |

**Course objectives:** Develop ability to

1. Analyze and solve heat transfer, mechanics of materials and machine design problems with finite element analysis.
2. Understand the need of Finite Element Method in the Design processes
3. Analyze and solve indeterminate problems.

**Course outcomes:**

**CO1:** Understand the applications of FEM in CAE
**CO2:** Analyze the one, two and three dimensional objects in static loading conditions.
**CO3:** Analyze axi symmetric problems
**CO4:** Perform the thermal analysis of structures in static and dynamic loading conditions
**CO5:** Formulate the Modal analysis of structures in dynamic loading conditions.

**LIST OF EXPERIMENTS:**

1. Displacement and stress analysis of one dimensional problems. (Rod or bar)
2. Displacement and stress analysis of beam problem.
3. Displacement and stress analysis of Truss
4. Stress and deflection analysis in beams with different support conditions.
5. Stress analysis of flat plates and simple shells.
6. Stress analysis of axi-symmetric components.
7. Thermal stress and heat transfer analysis of plate.
8. Thermal stress analysis of cylindrical shells.
9. Thermal stress analysis of composite wall problems.
10. Modal analysis of beams.
11. Harmonic, transient and spectrum analysis of simple systems
12. Vibration analysis of spring-mass systems.

## 18ME32L2 – CAD/CAM LAB

| L | T | P/D | C |
|---|---|---|---|
| - | - | 2/- | 1 |

**B. Tech. -ME -III Year II Semester**

**Pre-requisites: 18ME22L2 - Machine Drawing with AutoCAD lab**

**Course Objectives:** Develop ability to,

1. Prepare detailed geometric 3D models using parametric solid modeling
2. Machine physical components using CNC programming

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

**CO1:** Apply knowledge of 3D software tools and design competencies in developing engineering drawings into 3D models.
**CO2:** Draw various orthographic projections and models (2D and 3D) to describe the Engineering components.
**CO3:** Understand the CNC control in modern manufacturing system.
**CO4:** Prepare CNC part programming and perform manufacturing.
**CO5:** Illustrate the process planning capabilities

**Section A: Part Modeling:**

1. Generation of various 3D Models through Protrusion (four models)
2. Generation of various 3D Models through Revolve (four models)
3. Generation of various 3D Models through Sweep (four models)

**Section B: Modeling, Assembly and kinematics (with part detailing)**

1. Generation of individual components of Connecting Rod and its Assembly.
2. Generation of individual components of Screw Jack and its Assembly.
3. Generation of IC engine mechanism and kinematic interference checking.

**Section C: Computer Aided Manufacturing (CAM)**

1. Development of computer numerical control part program for step turning and machining of a component.
2. Development of computer numerical control part program for taper turning and machining of a component.
3. Development of computer numerical control part program for slot milling and machining of a component.
4. Development of computer numerical control part program for profile milling and machining of a component.

## 18ME32L3–HEAT TRANSFER LAB

**B. Tech - ME - III Year II Semester**

| L | T | P/D | C |
|---|---|---|---|
| - | - | 2/- | 1 |

**Pre-requisite(s): 18ME2104-Thermodynamics**

**Course Objectives:**

1. Heat transfer is the one of the important subjects which is commonly applied in Renewable energy, industrial, commercial and domestic systems.
2. Experiments are designed to provide exposure of practical aspects of the various theoretical concepts developed under the course heat and mass transfer.
3. The laboratory consists of experiments on conduction, convection, radiative boiling and condensing mechanisms of heat transfer.
4. Understand the basic concepts of radiation heat transfer.
5. Understand the effectiveness of parallel and counter flow heat exchangers.

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

**CO1:** Perform steady state conduction experiments to estimate thermal conductivity of different materials.

**CO2:** Obtain variation of temperature along the length of the pin fin under forced and free convection.

**CO3:** Perform transient heat conduction experiment.

**CO4:** Determine Stefan and Boltzman constant and emissivity in radiation heat transfer.

**CO5:** Estimate heat transfer coefficients in forced convection, free convection, condensation and correlate with theoretical values.

**List of Experiments:**

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 in 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 Boltzman Apparatus.
12. Heat transfer in drop and film wise condensation.
13. Critical Heat flux apparatus.
14. Study of heat pipe and its demonstration.

**Additional Experiments:**

1. Heat transfer in pin-fin (Natural convection)
2. Heat transfer in natural convection(Vertical type)

## 18MB3203–PROFESSIONAL ETHICS

**B. Tech - ME - III Year II Semester**

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

**Pre-requisite(s):** None

**Course Objective:** Develop the ability to,

1. Imbibe and internalize the Values and Ethical behavior
2. Understand the basic theories of Ethics
3. Practice as a professional engineer.
4. Identify work place ethics.
5. Understand international ethical practices.

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

**CO1:** Understand the importance of Values and Ethics in their personal lives

**CO2:** Understand ethics in professional careers.

**CO3:** Learn the rights and responsibilities as an employee.

**CO4:** Understand work ethics

**CO5:** Understand Global ethics

**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.

**REFERENCE BOOKS:**

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.

# SYLLABUS

# B. Tech IV YEAR I SEMESTER

## 18ME4110 – OPERATIONS RESEARCH

**B. Tech ME, IV Year - I Semester**

**Pre-requisites:** None

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

**Course Objectives:** Develop ability to

1. Understand the significance of Operations Research and formulation of LPP models.
2. Understand the Algorithms of Graphical and Simplex Methods.
3. Understand the Transportation and Assignment techniques.
4. Understand the concepts of sequencing and replacement models.
5. Understand the concepts of Game theory and Inventory Control.
6. Students will understand the concepts of queuing theory and DPP.

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

**CO1:** Describe the importance of Operations Research, Formulate a managerial decision problem into a mathematical model to solve by simplex method;

**CO2:** Formulate and apply transportation and assignment problems for engineering and managerial situations.

**CO3:** Apply sequencing and replacement concepts in industry applications

**CO4:** Apply game theory and inventory concepts in industry applications

**CO5:** Apply dynamic programming technique and queuing theory in industry applications

**UNIT-I: INTRODUCTION:** Definition– Characteristics and Phases – Types of models – Scope and applications, limitations.

**Linear Programming Problem:** Formulation – Graphical solution – Simplex method – Artificial variables techniques: Big M Method, Two–phase method, Duality Principle.

**UNIT-II : TRANSPORTATION PROBLEM:** Finding an initial feasible solution - North West Corner Method, Least Cost Method, Vogel's Approximation Method, Finding the optimal solution, Special cases in Transportation problems - Unbalanced Transportation problem, Degeneracy in Transportation, Profit Maximization in Transportation.

**Assignment Problem:** Introduction, Hungarian technique of Assignment problems, unbalanced problems, problems with restrictions, Maximization in Assignment problems. Travelling salesman problem

**UNIT-III: JOB SEQUENCING:** Introduction – Flow Shop sequencing, n jobs through 2

machines, n jobs through 3 machines, Job shop sequencing, 2 jobs through 'm' machines-graphical model.

**Replacement Model:** 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 and 2 x n games - graphical method, m x n games, dominance principle.

**Inventory Models:** Introduction – Concept of EOQ, 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: QUEUING THEORY:** 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-An Introduction, Hamdy, A.Taha, Sixth Edition, Prentice Hall of India Pvt. Ltd., 1997
2. Operations Research, S.D.Sharma, Kedarnath, Ramnath & Co., Meerut, 2009

**REFERENCE BOOKS:**

1. Operations Research, A. M. Natarajan, P. Balasubramaniam, A. Tamilarasi, Pearson Education,2009

2.Operations Research, V. K. Kapoor, S. Chand Publishers, New Delhi, 2004

## 18MB4102 – ENGINEERING ECNOMICS AND ACCOUNTING

**B. Tech ME, IV Year - I Semester**

**Pre-requisites:** None

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

**Course Objective:** Develop ability to,

1. Learn the basic Business types
2. Understand the impact of the Economy on Business and Firms specifically.
3. Analyze the Business from the Financial Perspective.
4. Understand the importance of handling Capital.
5. Learn fundamental concepts of accounting.

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

**CO1:** Understand Business and the impact of economic variables on them.

**CO2:** Understand the Demand, Supply concepts.

**CO3:** Analyze the Production, Cost, Market Structure, Pricing aspects.

**CO4:** Understand capital structure.

**CO5:** Study 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: Capital Budgeting:** Capital and its significance, Types of Capital, Estimation of Fixed and Working capital requirements, Methods and sources of raising capital – Trading Forecast, Capital Budget, Cash Budget. Capital Budgeting: features of capital budgeting proposals, Methods of Capital Budgeting: Payback Method, Accounting Rate of Return (AR A) and Net Present Value Method (simple problems).

**UNIT – V: 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.

**TEXT BOOKS:**

1. Managerial Economics, Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, 2e, Tata McGraw Hill Education Pvt. Ltd. 2012.

2. Financial Management, S.N.Maheswari & S.K. Maheswari, Vikas, 2012.

**REFERENCE BOOKS:**

1. Financial Accounting for Management, Paresh Shah, 2e, Oxford Press, 2015.

2. Financial Accounting, S. N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, 5e, Vikas Publications, 2013.

# 18ME4101-MECHATRONICS

**(Professional Elective-III)**

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

**B.TECH-ME-IV Year I Semester**
**Course Pre-Requisite(s):** None

**Course Objectives:** Develop ability to

1. Understand the functioning of Sensors and Actuators.
2. Understand key elements of Mechatronics system, representation into block diagram and concept of Transfer function, reduction and analysis.
3. Understand principles of sensors, its characteristics, interfacing with DAQ microcontroller.
4. Understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application.
5. Understand the system modeling and analysis in time domain and frequency domain.

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

**CO1:** Study the measurement characteristics and apply sensors and actuators based on measurement characteristics.
**CO2:** Identification of the key elements of Mechatronics system and its representation in terms of block diagram.
**CO3:** Describe the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O and interface the Sensors, Actuators using appropriate DAQ micro-controller.
**CO4:** Illustrate PLC programming and implement the same for real life system.
**CO5:** Evaluate stability of mechanical systems through time and Frequency domain analysis

**UNIT – I: INTRODUCTION TO SENSORS & ACTUATORS:** Introduction to Mechatronics, Measurement characteristics, Static and Dynamic Sensors, Position Sensors- Potentiometer, LVDT, Encoders; Proximity sensors- Optical, Inductive, Capacitive; Motion Sensors- Variable Reluctance; Temperature Sensor- RTD, Thermocouples; Force/Pressure Sensors- Strain gauges; Flow sensors: - Electromagnetic; Actuators: Stepper motor, Servo motor, Solenoids.

**UNIT – II : BLOCK DIAGRAM REPRESENTATION:** Open and Closed loop control

system, identification of key elements of mechatronics systems and represent into block diagram (Electro-Mechanical Systems); Concept of transfer function, Block diagram reduction principles, Applications of mechatronics systems- Household, Automotive, Shop floor (industrial).

**UNIT – III: DATA ACQUISITION & MICROCONTROLLER SYSTEM:** Interfacing of Sensors / Actuators to DAQ system, Bit width, Sampling theorem, Aliasing, Sample and hold circuit, Sampling frequency, ADC (Successive Approximation), DAC (R-2R), Current and Voltage Amplifier.

**UNIT – IV: PLC PROGRAMMING:** Introduction, Architecture, Ladder Logic programming for different types of logic gates, Latching, Timers, Counter, Practical Examples of Ladder Programming, Introduction to SCADA system

**UNIT –V: MODELLING AND ANALYSIS OF MECHATRONICS SYSTEM:** System modeling (Mechanical, Thermal and Fluid), Stability Analysis via identification of poles and zeros, Time Domain Analysis of System and estimation of Transient characteristics: % Overshoot, damping factor, damping frequency, Rise time, Frequency Domain Analysis of System and Estimation of frequency domain parameters such as Natural Frequency, Damping Frequency and Damping Factor.

**TEXT BOOKS :**

1. Integrated Mechanical Electronic Systems, K.P. Ramchandran, G.K. Vijyaraghavan, M.S. Balasundaram, Mechatronics, Willey Publication, 2008
2. Mechatronics - A Multidisciplinary approach, Bolton, , 4th Edition, Prentice Hall, 2009

**REFERENCES BOOKS:**

1. Introduction to Mechatronics and Measurement system, Alciatore &Histand, 4th Edition, Mc-Graw Hill publication, 2011
2. Mechatronics – An Introduction, Bishop CRC Press, 2006.
3. Mechatronics – Principles, concepts and applications, Mahalik, Tata Mc-Graw Hill publication, New Delhi.

# 18ME4102- REFRIGERATION AND AIR CONDITIONING

**(Professional Elective-III)**

**B. Tech- ME -IV Year I Semester**

**Pre-requisites: 18ME2104 - Thermodynamics**
**18ME2201 - Thermal Engineering –I**
**18ME3103 - Thermal Engineering-II**

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

**Course Objectives:** The course content enables students to:

1. Provide the basics of refrigeration cycles and performance calculations.
2. Provide the basics of air conditioning
3. Provide the knowledge on different types refrigerants used.
4. Provide the basic principles of psychrometry.
5. Develop knowledge on the different air conditioning systems and components.

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

**CO1:** Illustrate of vapour compression, air refrigeration and vapour absorption system operations and how it works.
**CO2:** Describe the analysis of sub cooled, super heat, sensible, latent heat and COP calculations, different types of refrigeration systems.
**CO3:** Choose various types of refrigerants and its applications, global warming, Ozone depletion potential
**CO4:** Identify different types of air properties (DBT, WBT, DPT, and Humidity) and predict relative cooling load calculations in Air conditioning system.
**CO5:** Design and understand the function of each of the major refrigeration system components: evaporator, compressor, condenser, and metering device

**UNIT-I: INTRODUCTION TO REFRIGERATION:** - Necessity and applications – Unit of refrigeration and C.O.P. – Mechanical Refrigeration – Types of Ideal cycle of refrigeration.

**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.

**Air Refrigeration**: Bell Coleman cycle and Brayton Cycle, Open and Dense air systems – Actual air refrigeration system – Refrigeration needs of Air craft's - Air systems – Actual Air refrigeration system–Refrigeration needs of Air craft's – Application of Air

Refrigeration – Types of systems – Problems

**UNIT-III: REFRIGERANTS –** Desirable properties – common refrigerants used – Nomenclature – Ozone Depletion – Global Warming – Azeotropes and Zeotropes.

**System Components: Compressors –** General classification – comparison – Advantages and Disadvantages. Condensers – classification – Working Principles Evaporators – classification – Working Principles - Expansion devices – Types – Working Principles

**UNIT-IV: VAPOR ABSORPTION SYSTEM –** Calculation of max COP – description and working of NH3 – 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

**TEXT BOOKS :**

1. Refrigeration and Air Conditioning, CP Arora, TMH,2008
2. Refrigeration & Air- conditioning , Manohar Prasad , New age international publications, 2015

**REFERENCE BOOKS:**

1. Refrigeration & Air conditioning , W. Stoecker, McGraw Hill Higher education,1989
2. Principles of Refrigeration, Roy. J.Dossat , PEARSON publications,1989
3. Carrier, Hand Book of Air conditioning system design –McGraw, 2009.
4. Refrigeration & Air conditioning, F.Stoecker & Jerold. W.Jones, McGraw Hill, 1982

# 18ME4103- ADVANCED MECHANICS OF SOLIDS

**(Professional Elective-III)**

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

**B. Tech, ME-IV Year I Semester**

**Pre-requisites: 18ME1101-Engineering Mechanics-I**
**18ME1201-Engineering Mechanics-II**
**18ME2102-Mechanics of Solids**

**Course objectives:** Develop ability to,

1. Apply scientific formulae to structural members, simulating practical situations
2. Assess stresses, strains and displacements of practical systems more realistically by extended analysis.

**Course outcomes:** By the end of successful completion of this course, a student will be able to:

**CO1:** Assess the effect of asymmetry of loads and beam cross sections and devise the corrective actions

**CO2:** Analyze the stresses and strains in curved beams and design curved beams for specified conditions

**CO3:** Analyze for torsional stresses in non circular and thin circular sections

**CO4:** Evaluate stresses, strains and displacements in plates under practical loading conditions

**CO5:** Select appropriate phenomena and calculate contact stresses

**UNIT – I: SHEAR CENTRE AND UNSYMMETRICAL BENDING:** Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections. Unsymmetrical bending: Bending stresses in Beams subjected to Nonsymmetrical bending; Deflection of straight beams due to nonsymmetrical bending.

**UNIT – II: CURVED BEAM THEORY:** Winkler Bach formula for circumferential stress – Limitations – Correction factors – Radial stress in curved beams – closed ring subjected to concentrated and uniform lads-stresses in chain links.

**UNIT – III : Torsion:** Torsion of a cylindrical bar of Circular cross Section; Saint-Venant's semi-inverse methods; Linear elastic solution; Prandtl elastic membrane ( Soap-Film) Analogy; Narrow rectangular cross Section; Hallow thin wall torsion members, Multiply connected Cross

section, Thin wall torsion members with restrained ends Axi-Symmetric Problems: Rotating Discs – Flat discs, Discs of uniform thickness, Discs of Uniform Strength, Rotating Cylinders.

**UNIT – IV: THEORY OF PLATES:** Introduction; Stress resultants in a flat plate; Kinematics: Strain- Displacement relations for plates; Equilibrium equations for small displacement theory of flat plates; Stress – Strain – Temperature relation for Isotropic plates: Strain energy of a plate; Boundary conditions for plate; Solution of rectangular plate problem; Solution of circular plate problem. Beams on Elastic Foundation: General theory; Infinite Beam subjected to concentrated load; boundary conditions; Infinite beam subjected to a distributed lad segment; Semi-infinite beam with concentrated load near its end; Short Beams.

**UNIT – V : CONTACT STRESSES:** Introduction, problem of determining contact stresses; Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Methods of computing contact stresses; Deflection of bodies in point contact; Stresses for two bodies in contact over narrow rectangular area (Line contact), Loads normal to area; Stresses for two bodies in line contact.

**TEXT BOOKS :**

1. Advanced Mechanics of solids, L S Srinath, Mc Graw Hill
2. Strength of materials, Sadhu singh, Khanna Publishers

**REFERENCE BOOKS:**

1. Advanced Mechanics of Materials, Richard J. Schmidt Arthur P. Boresi, Wiley publications, 6ed – 2009
2. Theory of Elasticity, S Timeshenko, Mc Graw Hill
3. Mechanics of Materials, Beer & Jhonson, McGraw Hill
4. Theory of Plates & Shells, Timoshenko, McGraw Hill,2nd Edition

# 18ME4104 – AUTOMATION IN MANUFACTURING

**(Professional Elective –III)**

**B. Tech -ME- IV Year I Semester**

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

**Pre-requisites: 18ME3101-Production Technology-II**
**18ME3203-CAD/CAM**

**Course Objectives:** Develop ability to:

1. Describe the basic concepts of automation in manufacturing systems.
2. Acquire the fundamental concepts of automated flow lines and their analysis.
3. Classify automated material handling, automated storage and retrieval systems.
4. Illustrate automated assembly systems and.
5. Understand the automated inspection methods and quality control systems.

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

**CO1:** Explain the concept of automation, its principles, basic elements, hardware components used for process control and PLC.

**CO2:** Analyze various manufacturing systems and automated flow lines.

**CO3:** Describe the importance of automated material handling and automated storage and retrieval systems.

**CO4:** Explain various automated assembly systems.

**CO5:** Interpret the importance of automated inspection systems and quality control.

**UNIT- I:** Over View of Manufacturing and Automation: Production systems, Automation in production systems, Automation principles and strategies, Manufacturing operations, production facilities. Basic elements of an automated system, levels of automation; Hardware components for automation and process control, programmable logic controllers and personal computers.

**UNIT- II: MANUFACTURING SYSTEMS AND AUTOMATED PRODUCTION LINES:** Manufacturing systems: components of a manufacturing system, Single station manufacturing cells. Automation in machine tools, automation principles, mechanical feeding and tool changing, machine tool control, elements in product realization.

**AUTOMATED FLOW LINES:** Methods of work part transport, transfer mechanisms, buffer storage, control systems, analysis of transfer lines with and without buffer storage, partial automation, implementation of automated flow lines.

**UNIT- III: MATERIAL HANDLING EQUIPMENT:** Types, functions, analysis and design of material handling systems: conveyor systems, automated guided vehicle systems.

**AUTOMATED STORAGE SYSTEMS:** Storage systems, performance and location strategies, automated storage and retrieval systems, types. Automatic identification methods, Barcode technology, RFID.

**UNIT- IV: AUTOMATED ASSEMBLY SYSTEMS:** Fundamentals, Analysis of Assembly systems. Cellular manufacturing, part families, cooling, production flow analysis. Group Technology and flexible Manufacturing systems.

**UNIT- V: QUALITY CONTROL SYSTEMS:** Quality in Design and manufacturing, inspection principles and strategies, Automated inspection, contact Vs non contact, CMM- types and methods of CMM.

**TEXT BOOKS :**

1. Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover, PE/PHI.
2. CAD/CAM/CIM, P. Radha Krishnan, S. Subrahamanyarn, Raju, New Age.

**REFERENCE BOOKS:**

1. System Approach to Computer Integrated Design and Manufacturing, Singh, John Wiley 96
2. Computer Aided Manufacturing, Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang, Pearson, 2009.
3. Manufacturing and Automation Technology, R Thomas Wright and Michael Berkeihiser , Good Heart, Willcox Publishers.

# 18ME4105- ADDITIVE MANUFACTURING

**(Professional Elective IV)**

**B. Tech ME- IV Year, I Semester**

**Pre-requisites: 18ME2203-Production Technology-I , 18ME3101- Production Technology-II**

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

**Course Objectives:** Develop ability to,

1. Educate students with fundamental knowledge in manufacturing strategies
2. Gain advanced knowledge in the field of Additive manufacturing technology
3. Foresee the associated Aerospace, Architecture, Art, Medical and industrial applications

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

**CO1:** Demonstrate variety of Additive Manufacturing (AM) technologies.

**CO2:** Understand its potential to support design and manufacturing.

**CO3:** Illustrate SLA and FDM concepts.

**CO4:** Explain powder based additive manufacturing systems.

**CO5:** Discuss basic principles of 3D printing ,SDM,BPM and etc.

**UNIT- I: INTRODUCTION:** Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM - Classification of AM processes-Benefits Applications.

**UNIT- II: REVERSE ENGINEERING AND CAD MODELING:** Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.

**UNIT- III: LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS:** Stereo lithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, Recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

**UNIT- IV: POWDER BASED ADDITIVE MANUFACTURING SYSTEMS:** Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials,

post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies.

**UNIT- V: OTHER ADDITIVE MANUFACTURING SYSTEMS:** Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballistic Particle Manufacturing (BPM), Selective Laser Melting, Electron Beam Melting.

**TEXT BOOKS :**

1. Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Gibson, I., Rosen, D.W. and Stucker, B., Springer, 2010.
2. Rapid prototyping: Principles and applications, Chua, C.K., Leong K.F. and Lim C.S., second edition, World Scientific Publishers, 2010.

**REFERENCE BOOKS:**

1. Rapid prototyping, Gebhardt, A., Hanser Gardener Publications, 2003.
2. Rapid Prototyping and Engineering applications: A tool box for prototype development, Liou, L.W. and Liou, F.W., CRC Press, 2011.
3. Rapid Prototyping: Theory and practice, Kamrani, A.K. and Nasr, E.A., Springer, 2006.
4. Rapid Tooling: Technologies and Industrial Applications, Hilton, P.D. and Jacobs, P.F., CRC press, 2005.

# 18ME4106 – MECHANICS OF COMPOSITE MATERIALS
## (Professional Elective-IV)

**B. Tech ME- IV Year, I Semester**

**Pre-requisites: 18ME2102-Mechanics of Solids**
**18ME3104-Design of Machine Elements-I**

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

**Course Objectives:** Develop ability to

1. Get an insight on necessity of composite materials,
2. Synthesize of composite materials and influence of composite constituents on properties of composite substrate.
3. Understand the role of reinforcement in the enhancement of mechanical properties of composite material.

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

**CO1:** Identify the need for a composite based on application.

**CO2:** Select an appropriate reinforcement for the synthesis of composite.

**CO3:** Apply the concepts of mechanics of solids to analyze the mechanical properties of the composite lamina.

**CO4:** Analyze for stress, strain and elastic behavior of composite laminates

**CO5:** Comprehend on application and failure analysis of composite laminates.

**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.

**UNIT- II: REINFORCEMENTS:** Fibers- Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibers. Particulate composites, Polymer composites, Thermoplastics, Thermosets, Metal matrix and ceramic composites.

**UNIT- III: MACRO MECHANICAL ANALYSIS OF A LAMINA:** Introduction, Definitions- Stress, Strain, Elastic Moduli, Strain Energy. Generalized Hooke's Law for Different Types of Materials, Hooke's Law for a Two-Dimensional Unidirectional Lamina, Plane Stress Assumption, Relationship of Compliance and Stiffness Matrix to Engineering Elastic Constants of a Lamina.

**UNIT- IV: MACRO MECHANICAL ANALYSIS OF LAMINATES:** Introduction,

Laminate Code Stress—Strain Relations for a Laminate, In-Plane and Flexural Modulus.

**UNIT- V: FAILURE ANALYSIS OF LAMINATES:** Introduction, Special Cases of Laminates, Applications, Failure Criterion for a Laminate.

**TEXT BOOKS :**

1. Mechanics of Composite Materials/ R. M. Jones/ Mc Graw Hill Company, New York, 1975.
2. Engineering Mechanics of Composite Materials/Isaac and M Daniel/ Oxford University Press, 1994.

**REFERENCE BOOKS:**

1. Analysis and performance of fiber Composites, B. D. Aggarwal and L. J. Broutman, Wiley- Inter science, New York, 1980.
2. Mechanics of Composite Materials, Second Edition (Mechanical Engineering), Autar K. Kaw, CRC Publisher.
3. Advanced Mechanics of Composite Materials, Vasiliev &Morozov, Elsevier, Second Edition.

# 18ME4107 – PRODUCTION PLANNING AND CONTROL

**(Professional Elective –IV)**

**B. Tech ME- IV Year, I Semester**

**Pre-requisites: None**

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

**Course Objectives:** Develop ability to

1. Understand the importance of Production planning & control.
2. 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, student would be able to:

**CO1:** Apply the systems concept for the design of production and service systems.

**CO2:** Develop forecasts in the manufacturing and service sectors using selected quantitative and qualitative techniques.

**CO3:** Solve routing and scheduling problems

**CO4:** Apply routing and scheduling techniques to production systems and Summarize various aggregate production planning techniques.

**CO5:** Understand theory of constraints for effective management of production systems.

**UNIT- I: INTRODUCTION:** Definitions — objectives of production planning and control-functions of production planning and control-elements of production control- types of production- organization of production planning and control — internal organizations department.

**UNIT- II: FORECASTING —** Importance of forecasting — types of forecasting, their uses-general principles of forecasting techniques- Qualitative methods and quantitative methods.

**UNIT- III: INVENTORY MANAGEMENT —** Functions inventory- Relevant inventory cost-ABC analysis- VED Analysis- EOQ model — Inventory control systems — P- Systems and Q — Systems Introduction to MRP And ERP, LOB( Line of balance ), JIT inventory, Japanese concepts.

**UNIT- IV: ROUTING** – Definition – routing procedure – Route sheets – Bill of material – Factors affecting routing procedure. Scheduling – Definition – Difference with loading, Scheduling polices – techniques, standard scheduling methods – Job shop, flow shop. Line balancing, aggregate planning – methods for aggregate planning – Chase planning, expediting, control aspects.

**UNIT- V: DISPATCHING –** Activities of dispatcher – Dispatching procedure – follow up – definition – reasons for existence of functions – types of follow up, applications of computer in production planning and control

**TEXT BOOKS :**

1. Production Planning and Control! M. Mahajan/ Dhanpati ral & Co.
2. Production Planning and Control/ Jam & Jam! Khanna publications

**REFERENCE BOOKS:**

1. Production Planning and Control- Text & cases! SK Mukhopadhyaya/PHI.
2. Production and operations Management U R.Panneer Selvam/PHI.
3. Operations management U Heizer/Pearson. Production and Operations Management (Theory and Practice)/Dipak.
4. Elements of Production Planning and Control / Samuel Eilon.

## 18ME4108– POWER PLANT ENGINEERING

**(Professional Elective – IV)**

**B. Tech - ME- IV Year I Semester**

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

**Pre-requisite(s): 18ME2104-Thermodynamics**

**Course objectives:**

1. Basic knowledge of different types of power plants, site selection criteria of each one of them.
2. Understanding of thermal power plant operation, turbine governing, boilers including supercritical and supercharged boilers, fluidized bed combustion systems.
3. Design of chimney in thermal power plants, knowledge of cooling tower operation, numerical on surface condenser design.
4. Basic knowledge of different types of nuclear power plants including pressurized water reactor, boiling water reactor, gas cooled reactor, liquid metal fast breeder reactor.
5. Understanding of power plant economics, energy storage including compressed air energy and pumped hydro etc.

**Course outcomes:**

**CO1:** Explain the basics of Power Plants.

**CO2:** Illustrate the power generation by renewable and non-renewable energy resources.

**CO3:** Explain different types of cycles and natural resources used in power plants and their applications.

**CO4:** Express the concept and design of the Nuclear reactors and safety precautions.

**CO5:** Compose the power plant economics.

**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. By P. C. Sharma / S. K. Kataria Pub.
2. Power Plant Engineering. by P. K. Nag/ II Edition /TMH

**REFERENCE BOOKS:**

1. Power Plant Engineering. By Rajput / Laxmi Publications
2. Power plant Engineering. By Ramalingam/ Sci-tech Publishers
3. Power Plant Engineering. By Arora and S. Domkundwar / Dhanpat Rai & co
4. An Introduction to Power Plant Technology. By G.D. Rai

# 18CE4131 – BUILDING TECHNOLOGY

**(Open Elective – II)**

**B. Tech. ME-IV Year, I Semester**

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

**Pre Requisites**: **None.**

**Course Objectives:** Develop ability to,

1. Know the various materials used in the buildings.
2. Understand the building by-laws and ventilation required in the buildings.
3. Estimate the repairs and transportation systems required in buildings.
4. Know the prefabrication and Air condition requirements.
5. Know the plumbing systems required in building.

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

**CO 1:** Explain characteristics of building materials.

**CO 2:** Describe the building Bye laws and plan the building.

**CO 3:** Estimate the repairs in building and types of transportation in building.

**CO 4:** Assess the prefabrication systems and air conditioning required in buildings.

**CO 5:** Explain principles of acoustics in building and plumbing.

**UNIT – I: STONES:** Uses of stones as building materials, Characteristics of good building stones. Types of stones and their significance

**BRICKS:** Characteristics of good building bricks. Types of bricks and their significance

**CEMENT AND CONCRETE:** Ingredients of cement – Types of cement, properties and uses of cement. Overview on concrete

**UNIT – II: BUILDING:** Basic definitions, Types, components, economy and design, principles of planning of buildings and their importance, building bye-laws.

**VENTILATION:** Definitions and importance of circulation; Lighting and ventilation; how to consider these aspects during planning of building.

**UNIT – III: REPAIRS IN BUILDINGS:** Inspection, control measures and precautions for various construction defects, General principles of design of openings, and various types of fire protection measures to be considered while planning a building.

**VERTICAL TRANSPORTATION IN BUILDINGS:** Types of vertical transportation, Stairs, different forms of stairs, planning of stair cases, other modes of vertical transportation – lifts, ramps, escalators.

**UNIT – IV: PREFABRICATION SYSTEMS:** Prefabrication systems in residential buildings – walls, openings, cupboards, shelves, etc., planning and modules and sizes of components in prefabrication.

**AIR CONDITIONING**: Process and classification of air conditioning, Dehumidification. Systems of air conditioning, ventilation, functional requirements of ventilation

**UNIT – V: ACOUSTICS:** Acoustics, effect of noise, properties of noise and its measurements, Principles of acoustics of building. Sound insulation – Importance and measures.

**PLUMBING SERVICES:** Water supply system, maintenance of building pipe line, Sanitary fittings, principles governing design of building drainage.

**TEXT BOOKS :**

1. Building Materials, P.C. Varghese, Prentice Hal India Learning Pvt. Ltd., 2015.
2. Building Construction, B.C.Punmia, Er. Ashok Kumar Jain and Dr. Arun Kumar Jain, Laxmi Publications, 2016.

**Reference Books:**

1. Building Materials, S.K. Duggal, New Age, 2016.
2. Building Materials, S.S. Bhavikatti, Vikas Publishers, 2016.
3. Engineering Materials and Building Construction, Rangwala, Charotar Publishing House, 2015.
4. A Text book of Building Construction, Arora and Bindra, Dhanpat Rai Publications, 2014.

# 18EE4132 – ENERGY CONSERVATION AND MANAGEMENT
**(Open Elective – II)**

**B. Tech. ME-IV Year, I Semester**

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

**Prerequisite(s): None**

**Course Objectives:** Develop ability to

1. Understand different basic terms related to Indian Energy Scenario and Energy Conservation Act.
2. Understand the principles of energy conservation, audit and management.
3. Understand energy conservation in different mechanical utilities.
4. Understand efficient heat and electricity utilization, saving and recovery in different thermal and electrical systems.
5. Understand different basic terms related to Energy economy, Financial Management and to understand the role of Energy Service Companies.

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

**CO1:** Perform energy accounting and balancing

**CO2:** Prepare energy audit report for different energy conservation instances.

**CO3:** Suggest energy saving methodologies.

**CO4:** Evaluate the energy saving and conservation in different mechanical utilities.

**CO5:** Evaluate the energy saving and conservation in different electrical utilities.

**UNIT-I: ENERGY SCENARIO, CONSERVATION ACT AND RELATED POLICIES:** Energy Scenario of India. Present Nonrenewable Energy Scenario, Present Energy Consumption, Energy security, Energy strategy for the future.

**UNIT-II: ENERGY MANAGEMENT AND AUDIT-** Principles of Energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting – Energy management qualities and functions, language Questionnaire – check list for top management. Definition, energy audit, need, types of energy audit. Energy management (audit) approach – understanding energy costs, Bench marking.

**UNIT-III: ENERGY EFFICIENT SYSTEMS-I -**Classification of motors - factors affecting efficiency – Energy conservation in motors – Energy efficient motors.

**Lighting and Energy Instruments-** Good lighting system design and practice, lighting control, lighting energy audit – energy instruments – wattmeter, data loggers, thermocouples, pyrometers, lux meters, tongue testers.

**UNIT-IV**: **ENERGY EFFICIENT SYSTEMS-II- THERMAL UTILITIES AND SYSTEMS:** Boilers – types, combustion in boilers, performances evaluation, analysis of losses, feed water treatment, blow down, energy conservation opportunities.

**UNIT-V: FINANCIAL ANALYSIS:** Simple Payback, Return on Investment, net present value and internal rate of return, life cycle cost method, Sensitivity analysis, Project-financing options, Energy monitoring and targeting.

**TEXT BOOKS :**

1. Handbook of Energy Audit, Sonal Desai, McGraw Hill. 2018
2. Energy Management Handbook, W.C. Turner John Wiley and Sons, A Wiley Inter-science publication.

**REFERENCE BOOKS:**

1. Handbook of Energy Audits, Albert Thumann, 6th Edition, The Fairmont Press
2. Bureau of Energy Efficiency Reference book: Vol No.1, 2, 3 4
3. Energy Management, W.R. Murphy and G. Mckay, Butter Worth Publications
4. Energy Manager Training Manual (4 Volumes) available at https://beeindia.gov.in administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004

## 18EC4134 – PRINCIPLES OF COMMUNICATION SYSTEMS
**(Open Elective - II)**

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

**B. Tech. ME-IV Year, I Semester**
**Pre requisite(s):** None

**Note: Only Block Diagram Approach with Qualitative Treatment of the topics is required. Detailed mathematical treatment is not required.**

**Course Objectives:** Develop ability to,

1. Introduce the students to modulation and various analog and digital modulation schemes.
2. They can have a broad understanding of satellite, optical, cellular, mobile, wireless and telecom concepts.

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

**CO1:** Distinguish various types of modulations.

**CO2:** Explain different communication modules and their implementation.

**CO3:** Distinguish 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, AM Radio, FM Radio, Transmitters and Receivers

**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, WCDMA.

**Wireless Technologies:** Wireless LAN, PANs and Bluetooth, ZigBee 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. Kennedy, Davis, Electronic Communications Systems, 4e, TMH, 1999

**REFERENCE BOOKS:**

1. Tarmo Anttalainen, Introduction to Telecommunications Network Engineering, Artech House
2. Theodore Rappaport, Wireless Communications-Principles and practice, Prentice Hall, 2002.
3. Roger L. Freeman, Fundamentals of Telecommunications, 2e, Wiley publications.
4. Wayne Tomasi, Introduction to data communications and networking, Pearson Education,2005.

# 18CS4135 - KNOWLEDGE MANAGEMENT
**(Open Elective II)**

**B. Tech. ME-IV Year, I Semester**

**Prerequisites: 18CS1201 - Data Structures**

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

**Course Objectives:** Develop ability to

1. Understand Knowledge Management Systems for access and coordination of Knowledge assets.
2. Understand technologies namely intranet, group-wares, weblog, instant messaging, content management systems and email in both individual and organizational contexts.
3. Use case studies, research methods of Knowledge organization.
4. Understand and implement various knowledge capturing techniques.
5. Test the captured knowledge and to deploy the knowledge.

**Course Outcomes:**

At the end of the course, student would be able to:

**CO1:** Evaluate and Implement Knowledge Management Systems to facilitate individual and group work.

**CO2:** Develop a thorough review of Knowledge Management Concepts, both historical and speculative.

**CO3:** Originate and distribute research on a Knowledge Management System topic.

**CO4:** Analyze and design KM processes and Systems.

**CO5:** Apply Knowledge Management objectives in projects across diverse fields.

**UNIT I: KNOWLEDGE MANAGEMENT:** KM Myths –KM Life Cycle-Understanding Knowledge-Knowledge, Intelligence-Experience-Common Sense-Cognition and KM-Types of Knowledge-Expert Knowledge-Human Thinking and Learning.

**UNIT II: KNOWLEDGE MANAGEMENT SYSTEM LIFE CYCLE:** Challenges in Building KM Systems –Conventional KM System Life Cycle(KMSLS) – Knowledge Creation and Knowledge Architecture – Nonaka's Model of Knowledge Creation and Transformation. Knowledge Architecture

**UNIT III: CAPTURING KNOWLEDGE:** Evaluating the Expert – Developing a Relation Ship with the Experts – Fuzzy Reasoning and Quality of Knowledge – Knowledge Capturing Techniques , Brain Storming – Protocol Analysis – Consensus Decision Making – Report Grid – Concept Mapping – Black Boarding

**UNIT IV: KNOWLEDGE CODIFICATION:** Modes of Knowledge Conversion – Codification Tools and Procedures – Knowledge Developers Skill Sets – System Testing and Deployment – Knowledge Testing - Approaches to Logical Testing, User Acceptance Testing – KM Systems Deployment Issues – User Training – Post Implementation.

**UNIT V : KNOWLEDGE TRANSFER AND SHARING:** Transfer Methods - and Role of the Internet – Knowledge Transfer in the e-World – KM System Tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Decision Making Architecture – Data Management – Knowledge Management Protocols – Managing Knowledge Workers.

**TEXT BOOKS :**

1. Knowledge Management, Elias.M.Awad & Hassan.M.Ghaziri, Pearson Edition.

**REFERENCE BOOK:**

1. Knowledge Engineering and Management, Guus Schreiber, Hans Akkermans, AnjoAnjewierden, Robert de Hoog, Nigel Shadbolt, Walter Van de Velde and Bob Wielinga, Universities Press, 2001.
2. Handbooks On Knowledge Management, C.W.Holsapple, International Handbooks on Information Systems, Vol 1 and 2, 2003.

## 18MB4136- SUPPLY CHAIN MANAGEMENT
**(Open Elective - II)**

**B. Tech. ME-IV Year, I Semester**

**Pre requisites:** None

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

**Course Objectives:** Develop ability to:

1. Distinguish the different functional areas in businesses management; understand the cross functional integrations and map supply chains of various business sectors.
2. Identify different types of distribution/ modes of transport/ network design.
3. Analyze the operational issues in SCM.
4. Recognize the drivers of supply chain.
5. Interpret the importance of relationships with suppliers and customers.

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

**CO 1:** Understand the role of an Engineer as well as Manager in Supply chain management
**CO 2:** Appreciate the importance of logistics in integrating different functional areas.
**CO 3:** Integrate operations with functional areas.
**CO 4**: Visualize the role of logistics and distribution as supply chain drivers
**CO 5:** Understand the importance of supplier and customer relationship management.

**UNIT I: INTRODUCTION TO SUPPLY CHAIN MANAGEMENT :**Understanding the Supply Chain, Supply Chain Performance: Achieving Strategic Fit and Scope including: Customer and Supply Chain Uncertainty, Competitive and Supply Chain Strategies, Product development strategy, Marketing and sales strategy, Supply chain strategy, Scope of strategic fit; Supply Chain Drivers and Metrics.

**UNIT II: LOGISTICS MANAGEMENT:** Designing distribution networks and applications to e-Business, Network design in the Supply Chain, Designing global supply chain, network design, 3 PL, 4 PL, Transportation in supply chain management.

**UNIT III: PLANNING AND MANAGING INVENTORIES:** Managing Economies of Scale in a Supply Chain: Cycle Inventory, Managing Uncertainty in a Supply Chain: Safety Inventory, Determining the Optimal Level of Product Availability. Demand Forecasting in a Supply Chain,

Aggregate Planning in a Supply Chain, Sales and Operations Planning: Planning Supply and Demand in a Supply Chain, Coordination in a Supply Chain. E- Procurement, Global alliances.

**UNIT IV: MANAGING CROSS-FUNCTIONAL DRIVERS IN A SUPPLY CHAIN :**
Importance of sourcing decisions in Supply Chain Management, Price and Revenue management, role of Information Technology in a Supply Chain, Sustainability and the Supply Chain. Customer Relationship management

**UNIT V: LOGISTICS AND SUPPLY CHAIN RELATIONSHIPS:** Identifying logistics performance indicators- channel structure- economics of distribution- channel relationships- logistics service alliance. Managing global logistics and global supply chains: Logistics in a global economy- Views of global logistics- global operating levels interlinked global economy. Global supply chain, Supply chain management in Global environment Global strategy- Global purchasing- Global logistics- Global alliances- Issues and Challenges in global supply chain management.

**TEXT BOOKS :**

1 Sunil Chopra, Peter Meindle, D.V Kalra, Supply Chain Management 6/e, Pearson.
2 Donald J. Bowersox and David J. Closs, Logistics Management: The Integrated Supply Chain Process, TMH, 2006.

**REFERENCE BOOKS:**

1. The Toyota Way Paperback by Jeffrey Liker.

# 18ME41L1 – DIGITAL FABRICATION LAB

| L | T | P/D | C |
|---|---|---|---|
| - | - | 2 | 1 |

**B. Tech. –ME- IV Year I Semester**

**Pre-requisites: 18ME32L2-CAD/CAM Lab**

**Course Objectives:** Develop ability to

1. Program for digital fabrication.
2. Make a prototype from digital data.
3. Recognize the implications of mass manufacturing when designing a prototype.
4. Operate the machines to produce prototypes.
5. Identify the role of digital fabrication in other fields.

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

**CO1:** Interpret the relationship between geometric modeling software tools and digital fabrication tools

**CO2:** Develop hands-on skills for free style 3D modeling

**CO3:** Learn to measure, manipulate and print 3D physical models.

**CO4:** Create prototypes of physical components through scanned/ digital data

**CO5:** Develop prototyping skills through a project involving ideation.

**Experiments**

1. Basic 3D modeling techniques
2. Free style modeling using 3D modeling software
3. 3D modeling of machine components using parametric design concepts( 2 experiments)
4. Creating geometric model of physical component using 3D modeling software(2 Experiments)
5. 3D Printing of the modeled components (2 Experiments)
6. 3D Scanning using laser scanners( 2 Experiments)
7. 3D Printing concepts for conversion of CAD model into real part: slicing, effect of part orientation(2 Experiments)

**Additional Experiments**

1. Project involving ideation, design and final fabrication using 3D printing.

# 18ME41L2 - PRODUCTION DRAWING PRACTICE WITH AUTOCAD LAB

| L | T | P/D | C |
|---|---|---|---|
| - | - | 2/- | 1 |

**B. Tech ME- IV Year, I Semester**
**Pre-requisites: 18ME1102-Engineering Graphics**
**18ME22L2-Machine Drawing with AutoCAD Lab**

**Course Objectives:** Develop ability to

1. Acquire knowledge of AutoCAD software functions to create production drawings using multiple lines, geometric shapes, and curves and use commands to save and plot.
2. Acquire knowledge to locate and apply features of AutoCAD that automate the drafting process and facilitate creation of more accurate drawings with minimum time.
3. Acquire knowledge to locate and apply the features of AutoCAD that provide inclusion of accurate dimensions, tolerances, drawing notes and labels using symbols.
4. Understand the process sheets of various production drawings.
5. Understand and create production drawings of machine parts and its process sheets using AutoCAD.

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

**CO1:** Apply knowledge of graphics and design competencies in developing production drawings.

**CO2:** Apply knowledge of AutoCAD software functions to create drawings using multiple lines, geometric shapes, and curves and use commands to save and print.

**CO3:** Apply features of AutoCAD that automate the drafting process and facilitate creation of accurate drawings with minimum time.

**CO4:** Identify and classify the process sheets of various production drawings such as production drawing of mating parts, production drawing of assemblies..etc

**CO5:** Construct an production drawing with appropriate process sheet using AutoCAD

**Experiments**

1. Creation of a Production Drawing Process sheets with Title box using AutoCAD.
2. Dimensioning in AutoCAD and components of Dimensioning Panel.
3. Creation of Standard Mechanical components with specifications using AutoCAD.
4. Production Drawing of Bevel Gear with process sheet using AutoCAD.
5. Production Drawing of Helical Gear with process sheet using AutoCAD.
6. Production Drawings of Mating Components : Tappet in Guide,Flange on shaft using AutoCAD

7. Production Drawings of Mating Components : Tappet in Guide,Flange on Bush Bearing etc., using AutoCAD
8. Production Drawings of Assemblies: Footstep bearing using AutoCAD.
9. Production Drawing of Forging using AutoCAD
10. Creation of Jigs for drilling machine using AutoCAD
11. Creation of Jigs for shaper using AutoCAD
12. Creation of Fixture for drilling machine using AutoCAD

**Note:** Plotting of drawings with dimensioning must be made for each exercise and attached to the records written by students.

**TEXT BOOKS :**

1. Production Drawing- K.L. Narayana, P. Kannaiah & K. Venkata Reddy, (2012), New Age Publishers / Third Edition.
2. Engineering Graphics with AutoCAD 2002-James D Bethune, Pearson Education

**REFERENCE BOOKS:**

1. Machine Drawing with AutoCAD – Goutam Pohit,Goutam Ghosh
2. AutoCAD 2018 Training Guide – Linkan Sagar BPB Publications.

## 18ME41L3- OPERATIONS RESEARCH LAB

**B. Tech- ME- IV Year I Semester**

| L | T | P/D | C |
|---|---|---|---|
| - | - | 2/- | **1** |

**Pre-requisites:** None

**Course Objectives:** Develop ability to

1. Students will understand the significance of Operations Research concept and techniques and formulation of LPP models.
2. Students will understand the Algorithms of Graphical and Simplex Methods.
3. Students will understand the Transportation and Assignment techniques.
4. Students will understand the concepts of sequencing and Replacement.
5. Students will understand the concepts of Game theory and Inventory Control.
   Students will understand the concepts of queuing theory and DPP.

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

**CO1:** Write and execute programs related to managerial decision problem into a mathematical model

**CO2:** Write and execute programs related to engineering and managerial situations as Transportation and Assignment problems.

**CO3:** Write and execute programs related to sequencing and replacement concepts in industry applications

**CO4:** Write and execute programs related to game theory and inventory concepts in industry applications

**CO5:** Write and execute programs related to multi-stage applications into a dynamic programming framework and Apply queuing theory concepts in industry applications

**LIST OF EXPERIMENTS:**

1. Write a program to solve a given graphical linear programming problems using Excel solver/C
2. Write a program to solve a given simplex problems using Excel solver/C
3. Write a program to solve a given transportation problems using Excel solver/C
4. Write a program to solve a given assignment problems using Excel solver/C
5. Write a program to solve a given n job 2 machine Sequencing problem

6. Write a program to solve a given n job 3 machine Sequencing problem
7. Write a program to solve a given n job m machine Sequencing problem
8. Write a program to solve a given replacement problem when money value change with time.
9. Write a program to solve a given group replacement problem.
10. Write a program to solve a given Two-Person Zero-Sum pure and mixed strategy game
11. Write a program to solve a given theory of game problems without saddle point
12. To determine the performance measures for M/M/1 queuing model.
13. To determine the performance measures for M/M/1/N queuing model.
14. To determine the performance measures for M/M/C/∞ queuing model.
15. To determine the performance measures for M/M/C/N queuing model.
16. Write a program to solve a given dynamic programming problem

# SYLLABUS

## B. Tech IV YEAR II SEMESTER

# 18ME4201 INDUSTRIAL MANAGEMENT

**(Professional Elective - V)**

**B. Tech ME- IV Year, II Semester**

**Pre-requisites: None**

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

**Course Objectives:** Student able to:

1. Identify and implement effective solutions to real problems by applying contemporary industrial engineering tools and cutting-edge technology in various domains of the business operations.
2. Perform as industry leaders in the global marketplace, capable of successfully, Planning, controlling, and implementing large-scale projects.
3. Flourish and work effectively in diverse, multicultural environments emphasizing the application of teamwork and communication skills.
4. Understand and apply the principles of Management, science, technology, engineering, and mathematics involving industry-relevant problems.
5. Maintain high standards of professional and ethical responsibility.

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

**CO1:** Design, develop, implement, and improve integrated systems that include people, materials, information, equipment, and environments.

**CO2:** Manage business operations, project management teams.

**CO3:** Analyze and adopt suitable Quality and Inventory control models and techniques.

**CO4:** Derive knowledge on contemporary and emerging issues important to professional practice.

**CO5:** Identify, formulate, and provide optimal solutions to Engineering problems.

**UNIT- I: DESIGNING ORGANIZATIONAL STRUCTURES:** Departmentalization 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- II: INTRODUCTION TO INDUSTRIAL ENGINEERING:** work-study; productivity; role of work study in improving productivity. Introduction to ergonomics; Method study: techniques, various types of charts and diagrams, flow and handling of materials, tools for recording the movement of workers.

**UNIT- III: WORK MEASUREMENT**: basic procedure, techniques, work sampling, time

study: allowances, standard time, introduction predetermined time standards; job analysis: job evaluation, merit rating, wage and incentive plans.

**UNIT- IV: 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- V: QUALITY MANAGEMENT:** Variables-attributes, Shewart control charts for variables, chart, R chart, Attributes, Defective, Defect- Charts for attributes, p-chart, c- chart (simple Problems), Acceptance Sampling, Single sampling, Double sampling plans, OC curves.

**TEXT BOOKS :**

1. Industrial Engineering and Management, Dr. O P Khanna, 2nd Edition, Dhanpat Rai, 2014.
2. Industrial Engineering and Management, Martand Telsang, 2nd Edition, S. Chand & Company, 2008.

**REFERENCE BOOKS:**

1. Industrial Engineering and Management, N.V.S. Raju, 1st Edition, Cengage Learning India, 2013.
2. Industrial Engineering and Management, Dr. I Ravi Shankar, 2nd Edition, Galgotia Publications, 2009.
3. Motion and Time Study, Ralph M. Barnes, 7th Edition, John Willey & Sons, 1980.
4. Reliability Engineering & Quality Engineering, Dr. C. Nadha Muni Reddy and Dr. K Vijaya Kumar Reddy, 1st Edition, Galgotia Publications, 2008.

# 18ME4202 - ADVANCED METAL FORMING

**(Professional Elective - V)**

**B. Tech ME- IV Year, II Semester**

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

**Pre-requisites: 18ME2203- Production Technology - I**
**18ME3101-Production Technology-II**
**18ME2101-Metallurgy and Material Science**

**Course Objectives:** To impart a deeper knowledge about metal forming under different conditions and in various processes.

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

- **CO1:** Recognize the various metal forming techniques and associated fundamentals
- **CO2:** Apply and analyze principles of rolling and stresses developed under rolling loads.
- **CO3:** Analyze extrusion and drawing processes and associated stresses developed.
- **CO4:** Identify various forging techniques and defects in forging.
- **CO5:** Evaluate various process parameters and applied loads in sheet metal working.

**UNIT- I: FUNDAMENTALS OF METAL FORMING:** Classification of forming processes – Mechanics of metal working – Flow stress determination methods– Effect of temperature, Strain rate and metallurgical factors in metal working – Friction and lubrication – Residual stresses.

**UNIT- II: ROLLING OF METALS**: Rolling processes, forces and geometrical relationship in rolling, simplified analysis, rolling load, rolling variables, theories of cold and hot rolling, problems and defects in rolling.

**UNIT- III: EXTRUSION:** Classification, Hot Extrusion, Analysis of Extrusion process, defects in extrusion, extrusion of tubes, and production of seamless pipes.

**DRAWING:** Drawing of tubes, rods, and wires: Wire drawing dies, tube drawing process, analysis of wire, deep drawing and tube drawing.

**UNIT- IV: FORGING**: Classification of forging processes, forging of plate, forging of circular discs, open die and closed-die forging, forging defects, and powder metallurgy forging.

**UNIT- V: SHEET METAL FORMING:** Formability studies – Conventional processes – H E R F techniques – Super plastic forming techniques – Hydro forming – Stretch forming – Water hammer forming – Principles and process parameters – Advantage, Limitations and application.

**TEXT BOOKS :**

1. Metal Forming Technology, Dr. R. Narayanswamy, Ahuja Book Company
2. Mechanical Metallurgy, G.E. Dieter, Tata McGraw Hill, 1998. II edition

**REFERENCE BOOKS:**

1. Metal Forming: Processes and Analysis, Avitzur , TMH
2. Fundamentals of Metal Forming Processes, B.L. Juneja
3. An introduction to the principles of Metal Working, Rowe, Geoffrey W., TMH
4. Technology of Metal Forming Processes, Surender Kumar, Prentice Hall, Inc., 2008

# 18ME4203 - ENGINEERING ACOUSTICS

**(Professional Elective – V)**

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

**B Tech-ME-IV Year II Semester**
**Prerequisite(s): 18PH1101-Engineering Physics**
**18MA1101-Mathematics –I**
**18MA1201-Mathematics-II**

**Course Objectives:** Develop ability to

1. Conceptualize sound and its propagation in environments
2. Analyze acoustical problems to determine the need for noise - control measures
3. Assess the results of acoustical measurements or calculations
4. Perform acoustical measurements in the lab and in the field, discussing the measurement principles and results in reports submitted for marking
5. Apply the conceptual, theoretical and experimental knowledge gained in the lectures and experimental sessions to execute an individual course project

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

**CO1:** Describe, quantify, predict, measure and analyze noise and vibration signals

**CO2:** Describe the physiological and subjective responses of humans exposed to noise and vibration, quantify the exposure and assess the response

**CO3:** Apply engineering and other methods for controlling exposure to noise and vibration

**CO4:** Assess and control the noise and vibration by using legislation, statutory regulations, standards and codes of practice related to acoustics

**CO5:** Devise sound absorbing material for the control of noise

**UNIT– I: Introduction-** review of concepts, terminology, etc. Wave equation (1-D, 3D, spherical 1D) and its solutions, Transmission line equations, waveguides, 1D plane waves, interferences

**UNIT– II: Generalized sound concepts:** Distributed parameters, illustrations, PSWR, simple source arrays, energy flow, power, intensity, attenuation thru mass, spatial damping. Generalized elements, laws on inter connect, electrical, mechanical and acoustic elements.

**UNIT– III: Transportation concepts:** Wave Theory, Characteristics, Real Sound Sources, Transportation noise, Sound propagation in different fields; source sound - power determination. Outdoor sound: Outdoor sound propagation, Noise control by barriers, screens

**UNIT– IV: Applications 1** – Electro dynamic transducers, and microphones. Sound in ducts and pipes, HVAC ‐ system noise, Noise control by silencers,

**UNIT– V: Applications 2-** Introduction to sound in rooms, Diffuse ‐ field theory Noise control in rooms;

**Sound absorption:** Sound in real rooms; prediction model Sound transmission into/out of rooms;

**Noise control measures:** Sound absorbing materials, Partition sound transmission

**TEXT BOOKS :**

1. Noise and Vibration Control, M. L. Munjal, 2014, World Scientific Press: Singapore
2. Fourier Acoustics: Sound Radiation and Near Field Acoustic Holography, E. G. Williams, 1999, Academic Press: New York

**REFERENCE BOOKS :**

1. Fundamentals of Acoustics, Lawrence E. Kinsler, Austin, R. Frey, Alan B. Coppens, James V. Sanders, 4th edition, Wiley, 2000
2. Acoustics, Berarek – Mc Graw Hill
3. An Introduction to Its Physical Principles and Applications, A. D. Pierce, Acoustics: Acoustical Society of America, ISBN-10: 0883186128, 1989
4. Vibration and Acoustics, C Sujatha, Mc Graw Hill

# 18ME4204-COMPUTATIONAL FLUID DYNAMICS

**(Professional Elective –II)**

**B. Tech, ME- IV Year II Semester**

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

**Pre-requisites: 18ME2103 - Fluid Mechanics and Hydraulic Machinery**

**Course Objectives:**

1. Equip students with the knowledge base essential for application of computational fluid dynamics to engineering flow problems
2. Provide the essential numerical background for solving the partial differential equations governing the fluid flow
3. Develop students' skills of using a commercial software package

**Course outcomes:**

**CO1:** Understand solution of aerodynamic flows. Appraise & compare current CFD software. Simplify flow problems and solve them exactly

**CO2:** Define and setup flow problem properly within CFD context, performing solid modelling using CAD package and producing grids via meshing tool

**CO3:** Understand both flow physics and mathematical properties of governing Navier-Stokes equations and define proper boundary conditions for solution

**CO4:** Write CFD software to model relevant engineering flow problems. Analyse the CFD results. Compare with available data, and discuss the findings

**CO5:** Develop flow simulation code for fluid flow and heat transfer problems.

**UNIT – I : Methods** to solve a physical problem-Numerical Methods-Brief comparison between FDM, FEM and FVM-Applied Numerical Methods: Solution of a system of simultaneous Linear Algebraic Equations, iterative schemes of Matrix Inversion, Direct Methods for Matrix inversion, Direct Methods for banded matrices. Finite Differences, discretization, consistency, stability, and Fundamentals of fluid flow modeling:

**UNIT – II: Finite Difference Applications in Heat conduction and Convention** – Heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer, closure.

Introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods

**UNIT – III: Errors and stability analysis**- introduction, first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modeling, conservative property, the upwind scheme.

Introduction, conservation of mass Newton's second law of motion, expanded forms of Navier-stokes equations, conservation of energy principle, special forms of the Navier-stokes equations. Review of Equations Governing Fluid Flow and Heat Transfer

**UNIT – IV: Steady flow**, dimensionless form of Momentum and Energy equations, Stokes equation, and conservative body force fields, stream function- Vorticity formulation, Boundary-layer theory, Buoyancy – Driven Convection and stability.

**UNIT – V: Simple CFD Techniques**, viscous flows conservation form space marching, relovation techniques, viscous flows, conservation from space marching relovation techniques, artificial viscosity, the alternating direction implicit techniques, pressure correction technique, computer graphic techniques used in CFD.

Quasi one dimensional flow through a nozzle, turbulence models, standard and high Reynolds number models and their applications.

**Text Books**

1. Computational Fluid Flow and Heat Transfer/ Muralidharan & Sundarajanan/ Narosa Publications
2. Numerical Methods –E.Balaguruswamy/TMH

**Reference Books:**

1. Computational Fluid Dynamics basics with applications- John.D, Anderson / Mc graw hill.
2. Computational Methods for Fluid Dynamics –Firziger & peric/springer.
3. Numerical methods for Engineer – Chapra & Canale/TMH.

# 18ME4205 – TOTAL QUALITY MANAGEMENT

**(Professional Elective - VI)**

**B. Tech ME- IV Year, II Semester**

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

**Pre-requisites:** None

**Course Objectives:** Develop ability to

1. Identify and explain the basic concepts and processes in Total Quality Management.
2. Overcome general barriers in implementation of TQM.

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

**CO1:** Infer the quality; identify the framework and the role of external and internal constraints in setting quality parameters.

**CO2:** Develop an understanding on quality management and device control charts for analysis and acceptance/ rejection

**CO3**: Develop analytical skills for investigating and analyzing quality management issues in the industry and suggest implementing the solutions.

**CO4:** Acquire an in-depth knowledge on statistical tools

**CO5:** Apply scientific strategies for prevention of loss by implementation of quality concepts.

**UNIT- I: INTRODUCTION:** Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention**.**

**UNIT- II: QUALITY CONTROL:** Quality Statements, Strategic quality planning, Quality Councils- Statistical Quality Control, Control Charts and Acceptance Sampling

**UNIT- III: TQM PRINCIPLES:** Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating. Role of Marketing and Sales, Buyer – Supplier relationships.

**UNIT- IV: TQM TOOLS AND TECHNIQUES I:** The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing,

service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

**UNIT- V: TQM TOOLS AND TECHNIQUES II:** Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

**TEXT BOOK:**

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield, Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.

**REFERENCE BOOKS :**

1. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. ISO 9001-2015 standards
4. Total Quality Management/P. N. Mukherjee/PHI

# 18ME4206 - RENEWABLE ENERGY SOURCES

**(Professional Elective – VI)**

**B. Tech- ME – IV Year II Semester**

**Prerequisite**: **18ME4108- Power plant engineering**

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

**Course Objectives:**

1. Distinguish between non-renewable and renewable energy systems
2. Outline utilization of renewable energy sources for both domestic and industrial applications
3. Analyze the environmental and cost economics of renewable energy sources in comparison with fossil fuels.

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

**CO1:** Understand the importance and Utilization of solar power.

**CO2:** Determination of different kind of techniques for storing solar power

**CO3:** Obtain the knowledge about Wind energy and Bio-mass energy.

**CO4**: Distinguished between the geothermal energy and Ocean energy

**CO5**: Evaluate the Direct Energy Conversion and its principles.

**UNIT-I: Principles of Solar Radiation:** Role and potential of new and renewable source, the solar energy option. Environmental impact of solar power – Physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, Instruments for measuring solar radiation and sun shine, solar radiation data.

**UNIT-II: Solar Energy Collection:** Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

**Solar Energy Storage and Applications:** Different methods, sensible, latent heat and stratified storage, solar ponds. Solar applications – solar heating, cooling techniques, solar distillation and drying, photovoltaic energy conversion.

**UNIT-III: Wind Energy:** Sources and potentials, horizontal and vertical axis windmills, performance characteristics.

**Bio-Mass:** Properties of biogas (Calorific value and composition) biogas plant technology status, Bio energy system, design and constructional features. Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, direct combustion, biomass gasification, paralysis and liquefaction, biochemical

conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass, bio diesel production.

**UNIT-IV: Geothermal Energy:** Resources, types of wells, methods of harnessing the energy, potential in India. OTEC: Principles, utilization, setting of OTEC plants, thermodynamic cycles. Tidal and Wave Energy: Potential and conversion techniques, mini-hydel power plants, their economics.

**UNIT-V:Direct Energy Conversion:** Need for DEC. Carnot cycle, limitations, Principles of DEC. Thermo-electric generators, See back, Politer and Joule Thompson effects, figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principle, faraday's laws, thermodynamic aspects, selection of fuels and operating conditions.

**TEXT BOOKS:**

1. Renewable Energy Sources, I T widell & Weir , Taylor and Francis, 2nd Special Indian Edition.
2. Non- conventional Energy Sources, G.D. Ray, Dhanpat Rai and Sons.

**REFERENCE BOOKS:**

1. Energy Resources Utilization and Technologies, Anjaneyulu & Francis, BS Publications, 2012.
2. Principles of Solar Energy, Frank Krieth & John F Kreider , Hemisphere Publications.
3. Non-Conventional Energy, Ashok V Desai, Wiley Eastern.
4. Non-Conventional Energy Systems, K Mittal, Wheeler.

## 18ME4207- TRIBOLOGY
**(Professional Elective –VI)**

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

**B. Tech- ME-IV Year, II Semester**

**Pre-requisite(s): 18ME1101-Engineering Mechanics-I,**
**18ME1201- Engineering Mechanics-II**
**18ME3202-Design of Machine Elements-II,**
**18ME3101-Production Technology-II**
**18ME2101-Metallurgy and Material Science**

**Course Objectives:** Develop ability to

1. Understand the effect and importance of friction between different surfaces and should know to calculate the friction.
2. Know the phenomenon of wear between surfaces in contact and its implications.
3. Understand the principles, methods, purpose and selection of lubricants for the reduction of friction.
4. Understand the lubrication theory and the flow of lubricants with different applications.
5. Know the surface treatment methods to improve the wear resistance and friction properties and Material selection for different types of bearings could be understand

**Course Outcomes (COs):** At the end of the course, the student would be able to,

**CO1:** Identify the characteristics of engineering surfaces, sources of friction, friction characteristics of metals and non metals and measure the friction

**CO2:** Infer the wear and group the types of wear based on wear mechanism.

**CO3:** Devise means and ways for obviating friction through lubrication.

**CO4:** Design bearing surfaces under thin film lubrication through scientific/ experimental data.

**CO5:** Improve bearing surfaces for reduced friction through surface treatment.

**UNIT-I: SURFACES AND FRICTION :** Topography of Engineering surfaces- Contact between surfaces, Sources of sliding Friction - Adhesion ploughing, Energy dissipation mechanisms, Friction Characteristics of metals, Friction of non metals; Friction of lamellar solids, friction of ceramic materials and polymers, Rolling Friction - Source of Rolling Friction - Stick slip motion ; Measurement of Friction.

**UNIT-II: WEAR:** Types of wear - Simple theory of Sliding Wear, Mechanism of sliding wear of metals - Abrasive wear - Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture wear - Wear of Ceramics and Polymers - Wear Measurements.

**UNIT-III: LUBRICANTS AND LUBRICATION TYPES:** Types, properties, Requirements of Lubricants - Testing methods - Hydrodynamic Lubrication - Elasto hydrodynamic lubrication- Boundary Lubrication, Mist lubrication, Requirements of lubrication, Solid Lubrication, Hydrostatic Lubrication

**UNIT-IV: FILM LUBRICATION THEORY:** Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings - Reaction torque on the bearings - Virtual Co-efficient of friction - The Sommerfeld diagram.

**UNIT-V: SURFACE ENGINEERING AND MATERIALS FOR BEARINGS:** Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes - Surface coatings - Plating and anodizing - Fusion Processes - Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

**TEXT BOOKS :**

1. Tribology, Friction and Wear of Engineering Material, I.M. Hutchings, Edward Arnold, London, 1992.
2. Introduction to Tribology bearings, B.C. Majumdar, S. Chand

**REFERENCE BOOKS:**

1. Tribology in Machine Design , T.A. Stolarski, Industrial Press Inc., 1990.
2. Friction, Wear, Lubrication: A textbook in Tribology, Kenneth C Ludema, CRC Press, 1996.
3. Basic Lubrication theory, Cameron, Longman, U.K.., 1981.
4. Tribology Handbook, M. J. Neale (Editor), Newnes, Butter worth, Heinemann, U.K., 1975.

# 18ME4208 – FLUID POWER SYSTEMS

**(Professional Elective –VI)**

**B. Tech, ME- IV Year II Semester**

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

**Pre-requisites: 18ME2103 - Fluid Mechanics and Hydraulic Machinery**

**Course Objectives:**

1. understand the fundamental theoretical concepts governing fluid power
2. Be familiar with common hydraulic and pneumatic components (pumps, actuators, motors, valves, etc.), their use, symbols, and their performance characteristics;
3. To formulate and analyze mathematical models of hydraulic and pneumatic circuits;
4. Design and implement simple fluid power systems common in industrial applications using commercial components: circuits for directional, speed, pressure, force, and flow control.
5. Through practical/demo lectures and design project students will gain familiarity with the actual components and fluid power circuits found in common industrial applications.

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

**CO1:** Discuss about hydraulic power systems, valves and accessories.

**CO2:** Illustrate pneumatic power systems, valves.

**CO3:** Formulate and analyze mathematical models of hydraulic and pneumatic circuits.

**CO4:** Design and implement simple fluid power systems common in industrial applications using commercial components: circuits for directional, speed, pressure, force, and flow control.

**CO5:** Understand the maintenance and trouble shooting of fluid power systems.

**UNIT-I : HYDRAULIC SYSTEMS:** Introduction to fluid power system-Pascal's Law-Hydraulic fluids-Hydraulic pumps-Gear, Vane and Piston pumps-Pump Performance-Characteristics and Selection-actuators-valves-pressure control-flow control and direction control valves-Hydraulic accessories-Hydraulic Accumulator.

**UNIT-II: PNEUMATIC COMPONENTS:** Introduction to Pneumatics-Compressors-types-Air treatment-FRL unit-Air dryer-Control valves-Logic valves-Time delay valve and quick exhaust valve-Pneumatic Sensors–types-characteristics and applications.

**UNIT-III: FLUID POWER CIRCUITS:** Reciprocating circuits ,pressure dependant circuits, speed control circuits, pilot operated circuits, simple sequencing circuits, synchronizing circuits, circuits using accumulator, time delay circuits, logic circuits, cascading circuits, feedback control circuits.

**UNIT-IV: DESIGN OF FLUID POWER SYSTEMS:** Speed, force and time calculations, Calculation of pressure and pressure drop across components size of actuators. pumps, reservoirs and accumulators. Calculations of heat generation in the fluids.

**UNIT-V: APPLICATION, MAINTENANCE AND TROUBLE SHOOTING:** Development of hydraulic / pneumatic circuits applied to machine tools, presses, material handling systems" Automotive systems, packaging industries, manufacturing automation. Maintenance in fluid power systems- preventive and break down. Maintenance procedures. Trouble shooting of fluid power systems- fault finding process, equipments/ tools used, causes and remedies. Safety aspects involved.

**TEXT BOOKS**

1. Oil Hydraulics, Majumdar S R., Tata Mc GRaw HllL2003.
2. Pneumatic systems- principles and maintenance, Majumdar S .R.,P Tata McGraw-Hill, New Delhi, 2017

**REFERENCE BOOKS**

1. Introduction to Fluid power, Thomson, Prentice Hall, 2004.
2. Hydraulics and pneumatics, Andrew Parr. Jaico Publishing House, 2003.
3. Fluid Power with Applications, A. Esposito, Prentice Hall, 7th ed., 2008.

**WEB LINKS:**

1. https://nptel.ac.in/courses/112106175/
2. https://openoregon.pressbooks.pub/hydraulics/chapter/1-1-introduction-to-fluid-power-systems/

# 18CE4241 – DISASTER MANAGEMENT
## (Open Elective – III)

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

**B. Tech. ME- IV Year, II Semester**

**Prerequisite(s): None.**

**Course objectives:** Develop ability to,

1. Gain knowledge on disasters and assess their impact.
2. Understand disaster management mechanisms.
3. Understand capacity building concepts and planning of disaster managements.
4. Assess various coping strategies during disasters.
5. Understand disaster management acts and policies in India.

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

**CO1:** Explain the basic concepts of disasters, hazards, risks and vulnerabilities.

**CO2:** Develop disaster management mechanisms to protect society.

**CO3:** Perform capacity assessment and explain legislative support at state and national levels.

**CO4:** Develop coping strategies at the time of disasters.

**CO5:** Prepare disaster risk reduction and management plans.

**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:** Concept – Structural and Non-structural 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 process – 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. Disaster Management, Dr. Mrinalini Pandey, Wiley India Pvt Ltd., 2014.
2. Disaster Science and Management, Tushar Bhattacharya, McGraw Hill Education, 2015.
3. Manual on Disaster Management in India, Ministry of Home Affairs, Government of India https://www.undp.org/content/dam/india/docs/disaster_management_in_india.pdf

**REFERENCE BOOKS:**

1. Disaster Mitigation: Experiences and Reflections, Pardeep Sahni, PHI Learning, 2010.
2. Disaster Management Global Challenges and Local Solutions, Rajib, S and Krishna Murthy, R.R, Universities Press Hyderabad, 2012.
3. Earth and Atmospheric Disaster Management: Nature and Manmade, Navale Pandharinath & C.K. Rajan, B.S. Publications, Hyderabad, 2009.
4. Manual on National Disaster Management Plan, National Disaster Management Authority, Ministry of Home affairs, Government of India
(http://ndma.gov.in/images/policyplan/dmplan/National%20Disaster%20Management%20Plan%20May%202016.pdf)

https://ndma.gov.in/images/pdf/NDMP-2018-Revised-Draft-1-2018OCT16-A.pdf

## 18EE4242 – MICO-ELECTRO-MECHANICAL SYSTEMS

**(Open Elective – III)**

**B. Tech. ME - IV Year II Sem.**

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

**Prerequisite(s): None**

**Course Objectives:** Develop ability to

1. Understand semiconductors and solid mechanics used to fabricate MEMS devices.
2. Understand basics of Micro fabrication techniques.
3. Understand various sensors and actuators
4. Understand different materials used for MEMS
5. Understand applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

**Course Outcomes (COs):** At the end of the course, student would be able to

**CO1:** Identify different types of semiconductor and solid mechanic materials that are used to fabricate MEMS devices.
**CO2:** Apply basic science, circuit theory, Electro-magnetic field theory, control theory in Micro fabrication techniques
**CO3:** Distinguish between different sensors and actuators
**CO4:** Distinguish between various processes involved in Micro machining
**CO5:** Apply the knowledge of MEMs to other advanced applications such as polymer and optical MEMs

**UNIT-I : BASICS:** Intrinsic Characteristics of MEMS, Energy Domains and Transducers, Sensors and Actuators, Introduction to Micro fabrication, Silicon based MEMS processes, New Materials, Review of Electrical and Mechanical concepts in MEMS, Semiconductor devices, Stress and strain analysis, Flexural beam bending, Torsional deflection

**UNIT-II : SENSORS AND ACTUATORS-I:** Electrostatic sensors, Parallel plate capacitors, Applications, Inter-digitated Finger capacitor, Comb drive devices, Micro Grippers, Micro Motors, Thermal Sensing and Actuation , Thermal expansion, Thermal couples, Thermal resistors, Thermal Bimorph, Applications, Magnetic Actuators, Micro-magnetic components, Actuation using Shape Memory Alloys

**UNIT-III : SENSORS AND ACTUATORS-II:** Piezoresistive sensors, Piezoresistive sensor materials, Stress analysis of mechanical elements, Applications to Inertia, Pressure, Tactile and Flow sensors, Piezoelectric sensors and actuators, piezoelectric effects, piezoelectric materials, Applications to Inertia , Acoustic, Tactile and Flow sensors.

**UNIT –IV : MICROMACHINING:** Silicon Anisotropic Etching, Anisotrophic Wet Etching, Dry Etching of Silicon, Plasma Etching, Deep Reaction Ion Etching (DRIE), Isotropic Wet Etching, Gas Phase Etchants, Case studies, Basic surface micro machining processes, Structural and Sacrificial Materials, Acceleration of sacrificial Etch, Striction and Antistriction methods

**UNIT –V:POLYMER AND OPTICAL MEMS :**Polymers in MEMS, Polimide, SU-8, Liquid Crystal Polymer (LCP), PDMS, PMMA, Parylene, Fluorocarbon, Application to Acceleration, Pressure, Flow and Tactile sensors, Optical MEMS, Lenses and Mirrors, Actuators for Active Optical MEMS.

**TEXT BOOKS :**

1. Foundations of MEMS, Chang Liu, Pearson Education Inc., 2006.
2. MEMS & Micro systems Design and Manufacture, Tai Ran Hsu, Tata McGraw Hill, New Delhi, 2002.

**REFERENCE BOOKS:**

1. An Introduction to Micro Electro Mechanical System Design, Nadim Maluf, Artech House, 2000.
2. Microsystem Design, Stephen D Senturia, Springer Publication, 2000.
3. The MEMS Handbook, Mohamed Gad-el-Hak, editor, CRC press Baco Raton, 2000
4. Micro Sensors MEMS and Smart Devices,Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, John Wiley & Son LTD,2002
5. Micro Electro Mechanical System Design, James J.Allen, CRC Press Publisher, 2010
6. Introduction MEMS, Fabrication and Application, Thomas M.Adams and Richard A.Layton, Springer 2012.

## 18EC4244 - BIOMEDICAL INSTREUMENTATION

**(Open Elective- III)**

**B. Tech. ME - IV Year II Sem.**
**Prerequisite(s): None**

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

**Note: No detailed mathematical treatment is required and only elementary treatment is sufficient.**

**Course Objectives:** Develop ability to,

1. Learn the basics of human physiology
2. Understand the basics of bio-medical transducers and recorders.
3. Understand the applications of measuring, recording and monitoring instruments.
4. Understand the concepts of various medical instruments and supporting systems.

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

**CO 1:** Explain the functioning of different human physiological systems.

**CO 2:** Explain the operations of transducers and recorders used for bio-medical applications.

**CO 3:** Explain the principles of medical imaging systems.

**CO 4:** Explain the principles of monitoring instruments used for bio-medical application

**CO 5:** Explain the need for health supporting systems

**UNIT I - HUMAN PHYSIOLOGY :** Introduction to generalized medical instrumentation system, components of instrumentation system, physiological system of human body, cardiovascular system. Respiratory system, Nervous system, generation of bioelectric potentials, Action potential, resting potential, Neuronal communication.

**UNIT II - BIO- POTENTIAL ELECTRODES, TRANSDUCERS AND RECORDERS:** The electrode – electrolyte interface, Polarization, Ag/Agcl Electrodes, Body surface electrodes, Internal Electrodes. Transducers in general, Pressure Transducers, Temperature transducers, pulse sensors, Basic recording systems.

**UNIT III - MEDICAL IMAGING SYSTEMS:** Basics of medical imaging systems, block diagrams and applications of - X-ray machine, Computer Tomography, Magnetic Resonance Imaging systems, Ultrasonic Imaging systems.

**UNIT IV - MONITORING SYSTEMS:** Basic principles of -Stethoscope, BP measuring Instrument, Electrocardiography (ECG), Electroencephalography( EEG) and Electromyography(EMG) recorders,

**UNIT V - SUPPORTING SYSTEMS:** Basic principles of Pacemaker system, Transcutaneous Electrical Nerve stimulation (TENS), surgical diathermy, Heart lung machine, Hemo Dialysis, Lithotripsy.

**TEXT BOOKS:**

1. Bio-Medical Instruments and Measurements, Cromwell, Prentice Hall of India, 1990.
2. Bio-Medical Instrumentation, Dr. Arumugam, Anuradha Agencies, 1994.

**REFERENCE BOOKS:**

1. Bio-Medical Electronics & Instrumentation, Prof. Venkataram S. K, Galgotia Publications, 2000.
2. John. Can. Brown, "Introduction to Bio Medical Equipment Technology", Pearson Education of ASIA, 2001.
3. Khandpur. R.S, "Hand book of Bio-Medical Instrumentation", Tata McGraw –Hill, 1987

# 18CS4245 - DATABASE SYSTEMS
**(Open Elective III)**

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

**B. Tech. ME- IV Year II Semester**
**Prerequisites:** None

**Course Objectives:** Develop ability to

1. Understand the basic concepts and the applications of database systems.
2. Master the basics of SQL and construct queries using SQL.
3. Apply relational database design principles.
4. Understands the basic issues of transaction processing and concurrency control.
5. Know the needs of database storage structures and access techniques.

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

**CO1:** Demonstrate the basic elements of a relational database management system.

**CO2:** Design entity relationship model and convert entity relationship diagrams into RDBMS and formulate SQL queries on the data.

**CO3:** Apply normalization for the development of application software.

**CO4:** Implement Transaction and Query processing techniques for data storage and retrieval.

**CO5:** Implement data storage structures and access through special databases.

**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, 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.

**UNIT II : 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.

**Relational Algebra:** Express Preliminaries, Relational Algebra.

Basic Structure of SQL Queries, Set Operations, Null Values, Additional Basic Operations, Aggregate Functions, Nested Sub Queries, Views, Joins.

**UNIT III: SCHEMA REFINEMENT AND NORMAL FORMS:** Introduction to Schema Refinement, Functional Dependencies.

Normal Forms – INF, 2NF, 3NF, BCNF, Multi valued dependencies – 4NF, 5NF.

**UNIT IV: TRANSACTION MANAGEMENT:** Transactions, Transaction Concept, A Simple Transaction Model, Transaction Atomicity and Durability, Transaction Isolation and consistency, Serializability.

**Concurrency Control:** Lock–Based Protocols, Multiple Granularity, deadlock handling Timestamp-Based Protocols, Validation-Based Protocols, Recovery Systems.

**UNIT V : INDEXING AND HASHING:** Basic Concepts, Ordered Indices, B+ Tree Index Files, B Tree Index Files, Multiple-Key Access, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices.

**Special Databases:** Data analysis, data mining, data warehousing, spatial and geographical, multimedia database, mobility and personal database, distributed information system. World Wide Web, OLAP

**TEXT BOOKS :**

1. Database System Concepts, Abraham Silberschatz, Henry. F. Korth, S. Sudarshan, McGraw Hill Education(India) Private Limited , 6th edition.

**REFERENCE BOOKS:**

1. Database Systems, 6th 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.

## 18MB4246- ENTREPRENEURSHIP
**(Open Elective- III)**

**B. Tech. ME- IV Year II Semester**

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

**Prerequisite(s): None**

**Course Objectives:** Develop ability to

1. Understand the mindset of the entrepreneurs.
2. Analyze the financial aspects of establishing an enterprise.
3. Learn entrepreneurial activities and determine strategies for launching.
4. Identify the challenges of entrepreneurship and develop an idea on the entrepreneurial framework.
5. Apply strategic perspectives in entrepreneurship.

**Course Outcomes (COs):** At the end of the course, the student would be able to

**CO1:** Explore and identify the entrepreneurial traits.

**CO2:** Identify various funding agencies and role of IPR.

**CO3:** Imagine and identify opportunities to launch new ventures.

**CO4:** Address entrepreneurial challenges.

**CO5:** Develop strategies for bringing stability and growth in business.

**UNIT-I : INTRODUCTION TO ENTREPRENEURSHIP:** meaning, importance, entrepreneurship characteristics, women entrepreneurs, classifications of entrepreneurs, myths of entrepreneurship, qualities of entrepreneurship, competencies, attitude function and nature of forms of entrepreneurship.

**UNIT-II: PROMOTION AND FINANCIAL ASPECTS OF ENTREPRENEURSHIP:** Idea generation- opportunities- SWOT analysis, patents and trademark, intellectual property rights, source of capital, debt capital, seed capital, venture capital- informal agencies in financing entrepreneurs. Government grants and subsidies, types of investors and private offerings

**UNIT-III: LAUNCHING ENTREPRENEURIAL VENTURES:** opportunities identification- entrepreneurial imagination and creativities – the nature of the creativity process innovation and entrepreneurial- methods to initiate venture creating, new ventures-acquiring and established entrepreneurial venture, franchising hybrid-disadvantage of franchising.

**UNIT-IV: LEGAL CHALLENGES OF ENTREPRENEURSHIP:** Intellectual property protection patents, copy rights-trademarks and trade secret. Avoiding pitfalls-formulation of the entrepreneurial plan-the challenges of new venture startups-poor financial understanding-critical factors for new venture development, the evaluation process, feasibility criteria approach

**UNIT-V: STRATEGIC PERSPECTIVES IN ENTREPRENEURSHIP:** Strategic planning-strategic actions-strategic positioning-business stabilization-building the adoptive firms-understanding the growth stage unique managerial concern of growing ventures.

**Text Books**

1. Entrepreneurship- A South - Asian Perspective, D F Kuratko and T V Rao, Cengage Learning, 1/e, 2012.
2. Small Scale industries and entrepreneurship, Vasanth Desai, Himalaya Publishing 2012.

**Reference Books**

1. Effectual Entrepreneurship, Stuart Read, Routledge, 2013.
2. Fundamentals of Entrepreneurship, Nandan H, PHI, 2013.