GEETHANJALI COLLEGE OF ENGINEERING AND TECHNOLOGY (Autonomous)
(**Approved by AICTE, Permanently Affiliated to JNTUH, Accredited by NAAC with 'A+')**
Cheeryal (V), Keesara (M), Medchal Dist., Telangana - 501 301

AR22

ACADEMIC REGULATIONS

AND

DETAILED SYLLABUS

MECHANICAL ENGINEERING

For CBCS BASED B.TECH – FOUR YEAR PROGRAM
(Applicable for the batches admitted from AY 2023-24)

GEETHANJALI COLLEGE OF ENGINEERING AND TECHNOLOGY (Autonomous)
Cheeryal (V), Keesara (M), Medchal Dist., Telangana State, Pin Code: 501 301

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***Activity oriented non laboratory courses.**

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ACADEMIC REGULATIONS 2022

For CBCS Based B.Tech PROGRAMMES

(Effective for the students admitted into FIRST year from the Academic Year **2023-2024)**

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 2023-2024, in the following Branches of Engineering

S. No.	***Branch***
1.	Civil Engineering
2.	Computer Science and Engineering
3.	Computer Science and Engineering (Artificial Intelligence and Machine Learning)
4.	Computer Science and Engineering (Cyber Security)
5.	Computer Science and Engineering (Data Science)
6.	Electrical and Electronics Engineering
7.	Electronics and Communication Engineering
8.	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 on the basis of any other order of merit approved by the Government of Telangana, subject to reservations as prescribed 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, failing which the student shall forfeit his seat in B. Tech program. The 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)** as indicated 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) or Drawing (D) courses.
- No Credits for mandatory courses.

3.2.3 **Course Classification:**

The College follows almost all the guidelines issued by AICTE/ UGC. All subjects/ courses offered for the B.Tech. Degree programmes are broadly classified as follows.

S. No	Broad Course Classification	Course Group/Category	Course Description
1	Foundation Courses (FnC)	BSC-Basic Science Courses	Includes Mathematics, Physics and Chemistry courses
2		ESC-Engineering Science Courses	Includes Fundamental Engineering Courses
3		HSMC-Humanities and Social sciences including Management Courses	Includes courses related to Humanities, Social Sciences and Management
4	Core Courses (CoC)	PCC-Professional Core Courses	Includes core courses related to parent discipline/department/ branch of Engineering
5	Elective Courses (EℓC)	PEC-Professional Elective Courses	Includes elective courses related to parent discipline / related department / branch of Engineering
6		OEC-Open Elective Courses	Elective Courses which include interdisciplinary courses or courses in an area outside the parent discipline/department /branch of engineering
7	Core Courses	PROJ –Project	Project Seminar/ Project
8			Design Thinking/ Internship/ Industry Oriented Mini-Project/ Mini-Project
9			Technical Seminar based on core contents related to parent discipline/ department/ branch of Engineering.
10	Mandatory Courses (MC)		Mandatory courses (Non Credit)

4. Course Registration

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

4.2 The Academic Departments of the college invite 'Registration Forms' from students 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'.

4.3 A student may be permitted to register for all the courses in a semester as specified in the course structure with maximum additional course(s) (elective course(s)) limited to 6 credits, duly approved by faculty advisor, based on progress and SGPA/ CGPA, and completion of the 'pre- requisites' as indicated for various courses, in the department course structure and syllabus content.

4.4 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).

4.5 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, as listed in the programme structure, Faculty Advisor shall rectify such errors and advise the student accordingly.

4.6 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.

4.7 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.

4.8 **Open electives**: The student has 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.

4.9 **Professional electives**: The student has to choose the required professional electives from the list given.

5. Courses to be offered

5.1 A Course may be offered to the students, ONLY IF a Minimum of 15 students opt for it.

5.2 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'. (i.e. the first focus shall be on early registration from the student for registration in that semester, and the second focus, if needed, will be on CGPA of the student)

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

5.4 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 (including attendance in mandatory course like Environmental Science, Indian Constitution for that semester.

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

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

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

6.5 **Students, whose shortage of attendance is not condoned in any semester, are not eligible to take their 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 the 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.

6.6 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 requirement mentioned in section 6.

7.1 A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course, if student secures not less than 35% (14 marks out of 40 marks including minimum 35% of average Mid-Term examinations for 25 marks) in the internal examinations, not less than 35% (21 marks out of 60 marks) in the semester end examination, and a minimum of 40% (40 marks out of 100 marks) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together; in terms of letter grades, this implies securing 'C' grade or above in that subject/ course.

7.2 Academic requirements in respect of Internship, Mini-Project, Technical Seminar, Project Seminar, Project, Activity Oriented (Non-Laboratory) courses such as Design Thinking, Logical reasoning and English Language courses (English for effective communication, English for career development, English for professional success) are as follows:

Name of the Course	Academic Requirements
Internship	A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Internship if the student: i. Submits a report on his Internship. ii. Makes a presentation of the Internship carried out before the Departmental Evaluation Committee as per schedule iii. Secures not less than 40% of the total marks allocated for the course in the evaluation by Departmental Evaluation Committee.
Mini-Project	A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Mini-Project if the student: i. Submits a report on his Mini-Project. ii. Makes a presentation of the Mini-Project carried out before the Departmental Evaluation Committee as per schedule. iii. Secures not less than 40% of the total marks allocated for the course in the evaluation by Departmental Evaluation Committee.
Project Seminar	A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Project Seminar if the student: i. Submits a report on his Project Seminar. ii. Makes a presentation of the Project Seminar carried out before the Departmental Evaluation Committee as per schedule. iii. Secures not less than 40% of the total marks allocated for the course in the evaluation by Departmental Evaluation Committee.
Technical Seminar	A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Technical Seminar if the student: i. Submits a report on his Technical Seminar. ii. Makes a presentation of the Technical Seminar carried out before the Departmental Evaluation Committee as per schedule. iii. Secures not less than 40% of the total marks allocated for the course in the evaluation by Departmental Evaluation Committee.
*Project	A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Project if the student: i. Submits a report on his Project. ii. Makes a presentation of the Project carried out before the Internal Project Review Committee as per schedule. iii. Secures not less than 40% of the total marks allocated for the course, in the project evaluation.
Activity Oriented (Non –Laboratory) courses (CIE) a. Design Thinking b. Logical reasoning c. English for effective communication d. English for career development e. English for professional success.	A student shall be deemed to have satisfied the academic requirements and earned the credits allotted if the student: i. Submits all assignments in time. ii. Secures not less than 40% of the total marks allocated for the course in continuous Internal Evaluation.

*Note: A student who has not satisfied the above requirements in any of the courses mentioned in the above table, is deemed to have failed; he may reappear once for each of the evaluations in the failed courses 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.

7.3 **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. ii. Must have secured at least 50% 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.
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. ii. Must have secured at least 60% 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
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. ii. Must have secured at least 60% 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
7	Fourth year First semester to Fourth year Second semester	Regular course of study of Fourth year First semester.

7.4 A student (i) shall register for all courses/subjects covering 160 credits as specified and listed in the program structure, (ii) fulfills all the attendance and academic requirements for 160 credits, (iii) earn all 160 credits by securing SGPA $\geq$5.0 (in each semester), and CGPA $\geq$ 5 (at the end of 8 semesters), (iv) **passes all the mandatory courses,** to successfully complete the undergraduate programme. The performance of the student in these 160 credits shall be

considered for the calculation of the final CGPA **(at the end of undergraduate programme),** and shall be indicated in the grade card / marks memo of IV-year II semester

7.5 If a student registers for '**extra Courses'** (in the parent department or other departments/branches of Engg.) other than those listed Courses totaling to 160 credits as specified in the course structure of his department, the performances in those '**extra Courses**' (although evaluated and graded using the same procedure as that of the required 160 credits) will not be considered while calculating the SGPA and CGPA. For such '**extra Courses'** registered, percentage of marks and letter grade alone will be indicated in the grade card / marks memo as a performance measure, subject to completion of the attendance and academic requirements as stated in regulations Items 6 and 7.1 – 7.4 above.

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

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

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

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, Internship, Mini-Project, Project Seminar, Project, Technical seminar, Activity Oriented (Non-Laboratory) courses etc., and their evaluation is as follows:

Theory, practical, drawing and Project course(s) shall be evaluated based on **40** marks CIE (Continuous Internal Evaluation) and **60** marks SEE (Semester End Examination)

Internship/ Mini-project/ Project Seminar / Technical seminar/ Activity Oriented (Non Laboratory) courses shall be evaluated internally by the Department Evaluation Committee.

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

In CIE, for theory subjects, during a semester, there shall be two mid-term examinations. Each Mid-Term examination consists of two parts i) **Part – A** for 10 marks, ii) **Part – B** for 20 marks with a total duration of 2 hours as follows:

1. Mid Term Examination for 30 marks:
   a. Part - A: Objective/quiz paper for 10 marks.
   b. Part - B: Descriptive paper for 20 marks.

- The objective/quiz paper is set with multiple choice, fill-in the blanks and match the following type of questions for a total of 10 marks.
  The descriptive paper shall contain 6 full questions out of which, the student has to answer 4 questions, each carrying 5 marks. The **average of the two Mid Term Examinations** shall be taken as the final marks for Mid Term Examination (for 30 marks).

  The remaining 10 marks of Continuous Internal Evaluation are distributed as:

  2. Assignment for 5 marks. (**Average of 2 Assignments** each for 5 marks)
  3. Subject Viva-Voce/PPT/Poster Presentation/ Case Study on a topic in the concerned subject for 5 marks.

While the first mid-term examination shall be conducted on 50% of the syllabus, the second mid-term examination shall be conducted on the remaining 50% of the syllabus.
Five (5) marks are allocated for assignments (as specified by the subject teacher concerned). The first assignment should be submitted before the conduct of the first mid-term examination, and the second assignment should be submitted before the conduct of the second mid-term examination. The average of the two assignments shall be taken as the final marks for assignment (for 5 marks).

Subject Viva-Voce/PPT/Poster Presentation/ Case Study on a topic in the subject concerned for 5 marks before II Mid-Term Examination.

- The student, in each subject, shall have to earn 35% of marks (i.e. 14 marks out of 40 marks) in CIE, 35% of marks (i.e. 21 marks out of 60) in SEE and overall 40% of marks (i.e. 40 marks out of 100 marks) both CIE and SEE marks put together.

The student is eligible to write Semester End Examination of the concerned subject, if the student scores ≥ 35% (14 marks) of 40 Continuous Internal Examination (CIE) marks.

In case, the student appears for Semester End Examination (SEE) of the concerned subject but not scored minimum 35% of CIE marks (14 marks out of 40 internal marks), his performance in that subject in SEE shall stand cancelled inspite of appearing the SEE.

There is NO makeup test in theory/laboratory internal examination for AR22 regulations

The semester end examinations (SEE), for theory subjects, will be conducted for 60 marks consisting of two parts viz. i) **Part- A** for 10 marks, ii) **Part - B** for 50 marks.

- Part-A is a compulsory question which consists of ten sub-questions from all units carrying equal marks.
- Part-B consists of five questions (numbered from 2 to 6) carrying 10 marks each. Each of these questions is from each unit and may contain sub-questions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions.
- The duration of Semester End Examination is 3 hours.

8.2 For laboratory course(s), there shall be a Continuous Internal Evaluation (CIE) during the semester for 40 marks, and Semester End Examination (SEE) for 60 marks.

A detailed break up of 40 marks for CIE is given below:

1. A write-up on day-to-day experiment in the laboratory (in terms of aim, components/procedure, expected outcome) which shall be evaluated for 10 marks
2. 10 marks for viva-voce **(**or) tutorial (or) case study (or) application (or) poster presentation of the course concerned.
3. Internal practical examination conducted by the laboratory teacher concerned shall be evaluated for 10 marks.
4. The remaining 10 marks are for Laboratory Project, which consists of the Design (Or) Software / Hardware Model Presentation (or) App Development (or) Prototype Presentation submission which shall be evaluated after completion of laboratory course and before semester end practical examination.

The Semester End Examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed from the other reputed colleges which will be decided/approved by the examination branch/Chief Controller of Examinations of the Institution.

In the Semester End Examination held for 3 hours, total 60 marks are divided and allocated as shown below:

1. 10 marks for write-up
2. 15 for experiment/program
3. 15 for evaluation of results
4. 10 marks for presentation on another experiment/program in the same laboratory course and
5. 10 marks for viva-voce on concerned laboratory course

The Student, in each subject, shall have to earn 35% of marks (i.e. 14 marks out of 40 marks) in CIE, 35% of marks (i.e. 21 marks out of 60) in SEE and Overall 40%of marks (i.e. 40 marks out of 100 marks) both CIE and SEE marks put together.

The student is eligible to write Semester End Examination of the concerned subject, if the student scores ≥ 35% (14 marks) of 40 Continuous Internal Examination (CIE) marks.

In case, the student appears for Semester End Examination (SEE) of the concerned subject but not scored minimum 35% of CIE marks (14 marks out of 40 internal marks),his performance in that subject in SEE shall stand cancelled inspite of appearing the SEE.

8.3 **Internship, Mini-Project, Technical Seminar, Project seminar, Project and Activity Oriented courses.**

8.3.1 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 about four weeks. The Work carried out during Internship shall be submitted in the form of a report, 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 or his nominee, the supervisor allocated for the internship, one senior faculty of the department. There shall be only CIE for 100 marks for internship and shall be evaluated during third year first semester.

8.3.2 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 the form of a report, 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 Head of the Department or his nominee, supervisor of the mini project, a senior faculty member of the department. **There shall be no internal marks (CIE) for Mini Project.**

8.3.3 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 or his nominee, seminar supervisor and a senior faculty member. The technical seminar report shall be evaluated for 100 marks as CIE.

8.3.4 There shall be a Project seminar presentation in Fourth year First semester, for which, the student shall collect the information on the Project topic, prepare a report, submit it and present the same before a departmental committee. It shall be evaluated internally (CIE) for 100 marks by the departmental committee, consisting of Head of the Department or his nominee, seminar supervisor and a senior faculty member.

8.3.5 The student shall carryout the Project 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 or his nominee, the supervisor allocated for the Project, and two Professors /Assoc-Professors of the department. Each review shall be evaluated for forty (40) marks and average of all three reviews shall constitute CIE of forty (40) 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 or his nominee, the supervisor and an external examiner, appointed by the chief controller of examinations, selected from a panel of examiners suggested by the chairperson, BoS, which evaluates it for sixty (60) marks.

8.3.6 Activity Oriented (Non-laboratory) courses shall be evaluated internally (CIE) for 100 marks; there shall be no SEE.

8.3.7 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 securing satisfactory grade.

8.3.8 No marks / letter grades shall be allotted for mandatory/non-credit course(s). Only Satisfactory (S) / Unsatisfactory (US) shall be indicated in Grade Card.

8.4. A student shall be given only one time chance to re-register for a maximum of two subjects in a semester:

- If the internal marks secured by a student in the Continuous Internal Evaluation marks for 40 (Sum of average of two mid-term examinations consisting of Objective & descriptive parts, Average of two Assignments & Subject Vivavoce/ PPT/ Poster presentation/ Case Study on a topic in the concerned subject) are less than 35% and failed in those subjects.

A student must re-register for the failed subject(s) for 40 marks within four weeks of commencement of the classwork in next academic year.

In the event of the student taking this chance, his Continuous Internal Evaluation marks for 40 and Semester End Examination marks for 60 obtained in the previous attempt stand cancelled.

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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, Activity Oriented courses 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 in those course(s) shall remain the same as obtained earlier.

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 in those course(s) shall remain the same as obtained earlier.

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

9.6 A student earns 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_j 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 an 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.

10.3 **There shall be no exemption of credits under any circumstances.**

11. Declaration of Results

11.1 Computation of SGPA and CGPA are done using the procedure listed in sections 9.5 through 9.8.

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 the 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 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) ≥ 7.00 but < 8.00, shall be placed in 'FIRST CLASS'.

12.2.4 Students with final CGPA (at the end of the B.TECH Programme) ≥ 6.00 but < 7.00, 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 < 6.00, 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 of 12.2.1 alone shall be eligible for the award of 'college rank' and / or 'gold / silver / bronze medal'.

12.5 **Award of 2-Year B.Tech. Diploma Certificate**

12.5.1 A student is awarded 2-Year UG Diploma Certificate in the concerned engineering branch on completion of all the academic requirements and earned all the 80 credits(with in 4 years from the date of admission) up to B. Tech. – II Year – II Semester, if the student want to exit the 4-Year B. Tech. program. The student once opted and awarded for 2-Year UG Diploma Certificate, the student will not be permitted to join in B. Tech. III Year – I Semester and continue for completion of remaining years of study for 4-Year B. Tech. Degree.

12.5.2 A student may be permitted to take one year break after completion of II Year – II Semester or B. Tech. – III Year – II Semester (with permission through the principal of the college well in advance) and can re-enter the course in next Academic Year in the same college and complete the course on fulfilling all the academic credentials within a stipulated duration i.e. double the duration of the course (Ex. within 8 Years for 4-Year program).

13. Withholding of Results

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 shall be withheld, and he shall not be allowed to go into the next higher semester. The award or issue of the degree shall also be withheld in such cases.

14. Transitory Regulations

A. For students detained due to shortage of attendance:

1. A Student who has been detained in I year of AR18/AR20 Regulations due to lack of attendance, shall be permitted to join I year I Semester of AR22 Regulations and he 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 I Year.
2. A student who has been detained in any semester of II, III and IV years of AR18/AR20 regulations for want of attendance, shall be permitted to join the corresponding semester of AR22 Regulations 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 I Year. The AR22 Academic Regulations under which a student has been readmitted shall be applicable to that student from that semester. See rule (C) for further Transitory Regulations.

B. For students detained due to shortage of credits:

3. A student of AR18/AR20 Regulations who has been detained due to lack of credits, shall be promoted to the next semester of AR22 Regulations only after acquiring the required number of credits as per the corresponding regulations of his/her first admission. The total credits required are 160 including AR18, AR20 and AR22 regulations. 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. The AR22 Academic Regulations are applicable to a student from the year of readmission. See rule (C) for further Transitory Regulations.

C. For readmitted students in AR22 Regulations:

4. A student who has failed in any Course under any regulation has to pass those Courses in the same regulations.
5. The maximum credits that a student acquires for the award of degree, shall be the sum of the total number of credits secured in all the regulations of his/her study including AR22 Regulations. There is NO exemption of credits in any case.
6. If a student is readmitted to AR22 Regulations and has any Course with 80% of syllabus common with his/her previous regulations, that particular Course in AR22 Regulations will be substituted by another Course to be suggested by the College.

Note: If a student readmitted to AR22 Regulations and has not studied any Courses/topics in his/her earlier regulations of study which is prerequisite for further Courses in AR22 Regulations, the College shall conduct remedial classes to cover those Courses/topics for the benefit of the students.

15. Student Transfers

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

15.2 The students seeking transfer to this college from other Universities/institutions should obtain NoC from the college and apply to Department of Technical Education, Government of Telangana, and Telangana state. The student, on transfer, shall pass additional courses, from the courses, from the courses prescribed in the curriculum of AR22, upto the class/ semester preceding the class/ semester into which the student is admitted, if he had not studied those courses or their equivalents, or failed in those courses at the previous institution.

15.3 Further, though the students have passed some of the Courses at the earlier institutions, if the same Courses are prescribed in different semesters of GCET, the students have to study those Courses in GCET in spite of the fact that those Courses are repeated.

15.4 The transferred students from other Universities/Institutions to GCET who are on rolls are to be provided one chance to write the written test (for internal marks) in the equivalent Course(s) as per the clearance letter issued by the University.

16. Scope

1. Where the words "he", "him", "his", occur in the write-up of regulations, they include "she", "her", "hers".
2. The Academic Regulations should be read as a whole, for the purpose of any interpretation.
3. In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Head of the Institution is final.
4. 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.
5. B. Tech (Regular) program is B. Tech 4-year degree program to which students are admitted to FIRST year.
6. 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.
7. The terms "mid-term" and "internal" are used interchangeably.

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17. 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. 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.
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 tears of the script or any part	Expulsion from the examination hall and cancellation of performance in that course and

	thereof inside or outside the examination hall with the mala fide intention of destroying any evidence of use of unfair means.	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.
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 Courses of that semester / year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College shall be handed over to police and, a police case shall be registered against them.
10	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that Course and all other Courses the student has already appeared for including practical examinations and project work and shall not be permitted for the remaining examinations of the Courses of that semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that Course and all other Courses the student has appeared for including practical examinations and project work of that semester/year examinations.
12	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to Chief Controller of Examination.	

GEETHANJALI COLLEGE OF ENGINEERING AND TECHNOLOGY (Autonomous)
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18. ACADEMIC REGULATIONS FOR B.TECH **(LATERAL ENTRY SCHEME)** FROM THE AY 2024-2025

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

1. 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 ≥ 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).

18.2 **Promotion rules**

S. No.	Promotion	Conditions to be fulfilled
1.	Second year first semester to Second year second semester	Regular course of study of Second year first semester.
2.	Second year second semester to Third year first semester	(i) Regular course of study of Second year second semester. (ii) Must have secured at least 60% 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.
3.	Third year first semester to Third year second semester	Regular course of study of Third year first semester.
4.	Third year second semester to Fourth year first semester	(i) Regular course of study of Third year second semester. (ii) Must have secured at least 60% 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.
5.	Fourth year first semester to Fourth year second semester	Regular course of study of Fourth year first semester.

5. All the other regulations as applicable to B. Tech. FOUR (4) - year degree course (Regular) will hold good for B. Tech. (Lateral Entry Scheme).
6. LES students are not eligible for 2-year B. Tech Diploma Certificate.

18.3 **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. 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.
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 tears of the script or any part thereof inside or outside the examination	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has

	hall with the mala fide intention of destroying any evidence of use of unfair means.	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 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 Courses of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College shall be handed over to police and, a police case shall be registered against them.
10	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that Course and all other Courses the student has already appeared for including practical examinations and project work and shall not be permitted for the remaining examinations of the Courses of that semester/year.
11	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that Course and all other Courses the student has appeared for including practical examinations and project work of that semester/year examinations.
12	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to Chief Controller of Examination.	

GEETHANJALI COLLEGE OF ENGINEERING AND TECHNOLOGY (Autonomous)
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VISION

The Mechanical Engineering Department strives to be recognized globally for outstanding education and research leading to well-qualified engineers, who are innovative, entrepreneurial and successful in solving problems of society.

MISSION

1. Imparting quality education to students to enhance their skills and make them globally competitive.
2. Prepare its graduates to pursue life-long learning, serve the profession and meet intellectual, ethical and career challenges.
3. Maintain a vital, state-of-the-art research to provide its students and faculty with opportunities to create, interpret, apply and disseminate knowledge.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The Program Educational Objectives of Mechanical Engineering Program are developed to provide guidance to graduating Mechanical Engineers, so that they can contribute effectively to the advancement of needs of Mechanical Engineering Profession. The graduates from Mechanical Engineering program are expected to demonstrate within three to five years of graduation that they would

PEO1 Be on a successful career path as competent professionals in their chosen profession or pursue advanced study, actively pursue lifelong learning for professional development.

PEO2 Serve their professional roles to meet the needs of engineering and society exhibiting professional ethics, interpersonal skills while working in multicultural teams.

PEO3 Be creative and innovative in their professional settings, including contributions to multidisciplinary areas.

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PROGRAM OUTCOMES (POs)

Program Outcomes (POs) describe what students are expected to know and be able to do by the time of graduation to accomplish Program Educational Objectives (PEO's). The Program Outcomes for Mechanical Engineering students are:

PO1 **Engineering Knowledge:** An ability to apply knowledge of mathematics, science and engineering fundamentals to model, analyse and obtain solution for real-life engineering problems

PO2 **Problems Analysis:** Ability to Identify, formulate and analyze engineering problems including thermal, manufacturing and industrial systemsarriving at meaningful conclusions involving mathematical inferences.

PO3 **Design/Development of Solutions:** Ability to Design, implement, and evaluate systems and processes considering public health, safety, cultural, societal and environmental issues.

PO4 **Conduct investigations of complex problems:** An ability to Design and conduct experiments using domain knowledge and analyze data to arrive at valid conclusions.

PO5 **Modern tool usage:** Ability to apply current techniques, skills, knowledge and computer based methods & tools to develop systems with an understanding of the limitations.

PO6 **The Engineer and society:** Ability to understand the effect of engineering solutions on legal, cultural, social, public health and safety aspects.

PO7 **Environment and team work:** Apply knowledge of contemporary issues to investigate and solve problems with a concern for sustainability and eco-friendly environment.

PO8 **Ethics:** Ability to apply ethical principles to engineering practices and professional responsibilities.

PO9 **Individual and team work:** Ability to function effectively in teams, in diverse and multidisciplinary areas to accomplish common goals.

PO10 **Communication:** Ability to comprehend, design documentation, write effective reports, make effective presentations to the engineering community and society at large.

PO11 **Project management and finance:** An understanding of engineering and management principles and apply these to work, as a member and leader in a team, to manage projects in multidisciplinary environment.

PO12 **Life-long learning:** Ability to engage in independent and life-long learning in the broad context of technological changes and advancements.

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 function in software industry in the areas of Design and development of mechanical systems using software tools such as AUTO CAD, Solid works, ANSYS, Pro E, CATIA etc.

PSO3 Able to work in power plants and manufacturing industry in the sphere of operation and maintenance.

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SCHEME OF INSTRUCTION AND EXAMINATION
B.Tech. in MECHANICAL ENGINEERING

Academic Regulation: AR22 **Academic Year: 2023 - 24**

PROGRAM STRUCTURE

FIRST YEAR, SEMESTER - I

S No	Course Code	Course Title	Category	Number of Periods per Week			Scheme of Examination with Maximum Marks			No. of Credits
				L	T	P/D	CIE	SEE	Total	C
1	20PH11002	Engineering Physics	BSC	3	1	-	40	60	100	4
2	20MA11001	Basic Engineering Mathematics	BSC	3	1	-	40	60	100	4
3	20CS11001	Programming for Problem Solving- I	ESC	2	-	-	40	60	100	2
4	20ME11001	Engineering Mechanics	ESC	3	1	-	40	60	100	4
5	20ME11002	Engineering Graphics	ESC	2	-	2	40	60	100	3
6	20PH11L02	Engineering Physics Lab	BSC	-	-	2	40	60	100	1
7	20CS11L01	Programming for Problem Solving -I Lab	ESC	-	-	2	40	60	100	1
8	20ME11L01	Engineering Workshop	ESC	-	-	2	40	60	100	1
9		Induction Program	MC	-	-	-	-	-	-	0
		Total		**13**	**3**	**8**	**320**	**480**	**800**	**20**
	Total periods per week			**24**						

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FIRST YEAR, SEMESTER - II

S No	Course Code	Course Title	Category	Number of Periods per Week			Scheme of Examination with Maximum Marks			No. of Credits
				L	T	P/D	CIE	SEE	Total	C
1	20EN12001	English	HSMC	3	-	-	40	60	100	3
2	20MA12001	Multi Variable Calculus	BSC	3	1	-	40	60	100	4
3	20CS12001	Programming for Problem Solving- II	ESC	2	-	-	40	60	100	2
4	20CH12001	Engineering Chemistry	BSC	3	-	-	40	60	100	3
5	20ME12001	Mechanics and Mechanical Drives	ESC	3	-	-	40	60	100	3
6	20EN12L01	English Language Communication Skills Lab	HSMC	-	-	2	40	60	100	1
7	20CS12L01	Programming for Problem Solving- II Lab	ESC	-	-	2	40	60	100	1
8	20CH12L01	Engineering Chemistry Lab	BSC	-	-	2	40	60	100	1
9	20ME12P01	Design Thinking*	PROJ	-	-	4	100	-	100	2
		Total		**14**	**1**	**10**	**420**	**480**	**900**	**20**
	Total periods per week			**25**						

CODE	Definitions	CODE	Definitions
L	Lecture	PCC	Professional Core Courses
T	Tutorial	PEE	Professional Elective Courses
P	Practical	OEC	Open Elective Courses
D	Drawing	MC	Mandatory Courses
HSMC	Humanities and Social Sciences Including Management Courses	PROJ	Project, Internship, Min project and Technical Seminar
ESC	Engineering Science Courses	BSC	Basic Science Courses

***Activity Based Non-Laboratory Course (NO LABORATORY REQUIRED)**

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SECOND YEAR, SEMESTER - I

S No	Course Code	Course Title	Category	Number of Periods per Week			Scheme of Examination with Maximum Marks			No. of Credits
				L	T	P/D	CIE	SEE	Total	C
1	20ME21001	Materials Technology	ESC	3	-	-	40	60	100	3
2	20ME21002	Mechanics of Solids	PCC	3	-	-	40	60	100	3
3	20EE21001	Basic Electrical Engineering	ESC	3	-	-	40	60	100	3
4	20ME21003	Fluid Mechanics and Hydraulic Machinery	PCC	3	-	-	40	60	100	3
5	20ME21004	Thermodynamics	PCC	3	-	-	40	60	100	3
6	20ME21L01	Materials Technology Lab	ESC	-	-	2	40	60	100	1
7	20EE21L01	Basic Electrical Engineering Lab	ESC	-	-	2	40	60	100	1
8	20ME21L02	Fluid Mechanics and Hydraulic Machines Laboratory	PCC	-	-	2	40	60	100	1
9	20ME21L03	Mechanics of Solids Lab	PCC	-	-	2	40	60	100	1
10	20EN21P01	English for Effective Communication*	HSMC	-	-	2	100	-	100	1
11	20CH21M01	Environmental Science	MC	3	-	-	-	-	-	-
		Total		**18**	**-**	**10**	**460**	**540**	**1000**	**20**
	Total periods per week			**28**						

***Activity Based Non-Laboratory Course (NO LABORATORY REQUIRED)**

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SECOND YEAR, SEMESTER - II

S No	Course Code	Course Title	Category	Number of Periods per Week			Scheme of Examination with Maximum Marks			No. of Credits
				L	T	P/D	CIE	SEE	Total	C
1	20ME22001	Thermal Engineering	PCC	3	-	-	40	60	100	3
2	20MA22001	Computational Mathematics	BSC	3	-	-	40	60	100	3
3	20ME22002	Kinematics of Machinery	PCC	3	-	-	40	60	100	3
4	20ME22003	Manufacturing Technology	PCC	3	-	-	40	60	100	3
5	**Open Elective-I**		OEC	3	-	-	40	60	100	3
	20CE22061	Building Technology (CE)								
	20EE22062	Industrial Safety and Hazards (EEE)								
	20EC22064	Electronic Measuring Instruments (ECE)								
	20CS22065	Web Programming(CSE)								
	20MB22066	Intellectual Property Rights (MBA)								
6	20ME22L01	Thermal Engineering Lab	PCC	-	-	2	40	60	100	1
7	20MA22L01	Computational Mathematics Lab	BSC	-	-	2	40	60	100	1
8	20ME22L02	Machine Drawing with AutoCAD Lab	PCC	-	-	2	40	60	100	1
9	20ME22L03	Manufacturing Technology Lab	PCC	-	-	2	40	60	100	1
10	20EN22P01	English for Career Development*	HSMC	-	-	2	100	-	100	1
		Total		**15**	**-**	**10**	**460**	**540**	**1000**	**20**
		Total periods per week		**25**						

***Activity Based Non-Laboratory Course (NO LABORATORY REQUIRED)**

Note: Students have to undergo internship program during the summer vacation which shall be evaluated internally during third year first semester. There is no Semester End Examination for internship.

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THIRD YEAR, SEMESTER - I

S No	Course Code	Course Title	Category	Number of Periods per Week			Scheme of Examination with Maximum Marks			No. of Credits
				L	T	P/D	CIE	SEE	Total	C
1	20ME31001	Mechanical Measurements and Instrumentation	PCC	3	-	-	40	60	100	3
2	20ME31002	Dynamics of Machinery	PCC	3	-	-	40	60	100	3
3	20MA31001	Statistics for Machine Learning	BSC	3	-	-	40	60	100	3
4	20ME31003	Design of Machine Elements-I	PCC	3	-	-	40	60	100	3
5	20MA31L01	Statistics for Machine Learning Lab	BSC	-	-	2	40	60	100	1
6	20ME31L01	Kinematics and Dynamics Lab	PCC	-	-	2	40	60	100	1
7	20EN31L01	Professional Communication Skills Lab	HSMC	-	-	2	40	60	100	1
8	20MA31P01	Logical Reasoning-I*	BSC	-	-	4	100	-	100	2
9	20ME31P01	Internship	PROJ	-	-	-	100	-	100	2
10	20CS31M02	Introduction to Artificial Intelligence	MC	3	-	-	-	-	-	-
		Total		**15**	**-**	**10**	**480**	**420**	**900**	**19**
		Total periods per week		**25**			-	-	-	-

***Activity Based Non-Laboratory Course (NO LABORATORY REQUIRED)**

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THIRD YEAR, SEMESTER - II

S No	Course Code	Course Title	Category	Number of Periods per Week			Scheme of Examination with Maximum Marks			No. of Credits
				L	T	P/D	CIE	SEE	Total	C
1	20ME32001	Finite Element Methods	PCC	3	-	-	40	60	100	3
2	20ME32002	Design of Machine Elements-II	PCC	3	-	-	40	60	100	3
3	20ME32003	CAD/CAM	PCC	3	-	-	40	60	100	3
4	20ME32004	Heat Transfer	PCC	3	-	-	40	60	100	3
	Professional Elective-I									
5	20ME32005	Mechatronics	PEC	3	-	-	40	60	100	3
	20ME32006	Refrigeration and Air Conditioning								
	20ME32007	Advanced Mechanics of Solids								
	20ME32008	Automation in Manufacturing								
6	20ME32L01	Mechanical Measurements and Instrumentation Lab	PCC	-	-	2	40	60	100	1
7	20ME32L02	CAD/CAM Lab	PCC	-	-	2	40	60	100	1
8	20ME32L03	Heat Transfer Lab	PCC	-	-	2	40	60	100	1
9	20MA32P01	Logical Reasoning - II*	BSC	-	-	4	100	-	100	2
10	20EN32P01	English for Professional Success*	HSMC	-	-	2	100	-	100	1
11	20CS32M03	Introduction to Cyber Security	MC	3	-	-	-	-	-	-
12	20MB32M04	Professional Ethics	MC	3	-	-	-	-	-	-
		Total		**21**	**-**	**12**	**520**	**480**	**1000**	**21**
		Total periods per week		**33**						

***Activity Based Non-Laboratory Course (NO LABORATORY REQUIRED)**

Note: Students have to do Mini Project during the summer vacation which shall be evaluated during fourth year first semester through Semester End Examination.

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FOURTH YEAR, SEMESTER - I

S No	Course Code	Course Title	Category	Number of Periods per Week			Scheme of Examination with Maximum Marks			No. of Credits
				L	T	P/D	CIE	SEE	Total	C
1	20ME41001	Additive Manufacturing	PCC	3	-	-	40	60	100	3
2	20MB41004	Engineering Economics and Accounting	HSMC	3	-	-	40	60	100	3
3	**Professional Elective-II**		PCC	3	-	-	40	60	100	3
	20ME41002	Unconventional Machining Processes								
	20ME41003	Gas Dynamics								
	20ME41004	Industrial Robotics								
	20ME 41005	Tool Design								
4	**Professional Elective – III**		PEC	3	-	-	40	60	100	3
	20ME41006	Operations Research								
	20ME41007	Mechanics of Composite Materials								
	20ME41008	Tribology								
	20ME41009	Power Plant Engineering								
5	**Open Elective – II**		OEC	3	-	-	40	60	100	3
	20CE41071	Green Buildings (CE)								
	20EE41072	Energy Conservation and Management (EEE)								
	20EC41074	Principles of Communication Systems (ECE)								
	20CS41075	Knowledge Management (CSE)								
	20MB41076	Supply Chain Management (MBA)								
6	20ME41L01	Digital Manufacturing Lab	PCC	-	-	2	40	60	100	1
7	20ME41L02	Computer Aided Production Drawing Practice Lab	PCC	-	-	2	40	60	100	1
8	20ME41P01	Project seminar	PROJ	-	-	2	100	-	100	1
9	20ME41P02	Mini Project	PROJ	-	-	-	-	100	100	2
		Total		**15**	**-**	**6**	**380**	**520**	**900**	**20**
		Total periods per week		**21**						

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FOURTH YEAR, SEMESTER - II

S No	Course Code	Course Title	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 IV**		PEC	3	-	-	40	60	100	3
	20ME42001	Industrial Management								
	20ME42002	Advanced Metal Forming								
	20ME42003	Mechanical Vibrations and Acoustics								
	20ME42004	Computational Fluid Dynamics								
2	**Professional Elective V**		PEC	3	-	-	40	60	100	3
	20 ME42005	Production Planning and Control								
	20ME42006	Renewable Energy Sources								
	20ME42007	Automobile Engineering								
	20ME42008	Fluid Power Systems								
3	**Open Elective III**		OEC	3	-	-	40	60	100	3
	20CE42081	Disaster Management (CE)								
	20EE42082	Micro-Electro-Mechanical Systems (EEE)								
	20EC42084	Biomedical Instrumentation (ECE)								
	20CS42085	Database Systems (CSE)								
	20MB42086	Entrepreneurship (MBA)								
4	20ME42P01	Technical Seminar	PROJ	-	-	2	100	-	100	1
5	20ME42P02	Project	PROJ	-	-	20	40	60	100	10
		Total		**9**	**-**	**22**	**260**	**240**	**500**	**20**
		Total periods per week		**31**						

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Comparison of AICTE Guidelines for Curriculum Structure of B.Tech Degree Program in Mechanical Engineering Vis-à-vis GCET Program:

S.No	Category		Credits by GCET	Credits by AICTE
1	Humanities and Social Sciences including Management courses	HSMC	11	12
2	Basic Science Courses	BSC	29	25
3	Engineering Science Courses including workshop, drawing, basics of electrical/mechanical/computers etc.	ESC	25	24
4	Professional Core Courses	PCC	53	48
5	Professional Elective Courses relevant to chosen specialization/branch	PEC	15	18
6	Open subjects - Electives from other technical and/or elsewhere	OEC	9	18
7	Project work, seminar and internship in industry or elsewhere	PROJ	18	15
8	Mandatory Courses (Environmental Sciences, Induction Program, Indian Constitution, Human Values and Professional Ethics	MC	-	-
	Total Credits		**160**	**160**

Note: 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
1	Building Technology (CE)	20CE22061
2	Industrial Safety and Hazards (EEE)	20EE22062
3	Electronic Measuring Instruments (ECE)	20EC22064
4	Web Programming (CSE)	20CS22065
5	Intellectual Property Rights (MBA)	20MB22066
6	Nano Materials and Technology	20ME22063/20ME31063/20ME32063

Open Elective - II

S.No	Course Title	Course Code
1	Green Buildings (CE)	20CE41071
2	Energy Conservation and Management (EEE)	20EE41072
3	Principles of Communication Systems (ECE)	20EC41074
4	Knowledge Management (CSE)	20CS41075
5	Supply Chain Management (MBA)	20MB41076
6	Digital Fabrication	20ME31073/20ME32073/20ME41073

Open Elective -III

S.No	Course Title	Course Code
1	Disaster Management (CE)	20CE42081
2	Micro-Electro- Mechanical Systems (EEE)	20EE42082
3	Biomedical Instrumentation (ECE)	20EC42084
4	Database Systems (CSE)	20CS42085
5	Entrepreneurship (MBA)	20MB42086
6	Principles of Automobile Engineering	20ME42083

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B.Tech (ME)
I Year I Semester
Detailed Syllabus

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20PH11002-Engineering Physics

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

B.Tech. CE/ME - I Year, I Semester.

Prerequisite(s): None

Course objectives: Develop ability to

1. Understand the concepts of simple harmonic, damped and forced oscillations and their characteristics in different conditions with analogous to electrical oscillations.
2. Understand the propagation of transverse and longitudinal waves in one dimensional media, standing waves and their frequencies, concept of impedance matching, acoustic wave and minimizing errors in acoustic wave velocity.
3. Understand division of amplitude and wave front using Newton's rings, Michelson's interferometer, anti-reflection coatings and Young's double slit experiment, and the concept of diffraction using single slit, double slit and diffraction grating.
4. Understand the interaction of radiation with matter, working of different types of lasers and their applications. Understand the total internal reflection of light, numerical aperture, types of optical fibers based on refractive index, materials, and the causes for light attenuation, and the applications of optical fibers.
5. Understand the principle of reverberation and absorption coefficient of materials, noise control in machines and automobiles using quieting. Understand the principle, construction and working of magnetostriction, piezoelectric method for the production of Ultrasonic waves, properties, detection of ultrasonics and its applications.

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

1. Derive the characteristic parameters of harmonic oscillations, transverse, longitudinal and standing waves in different media.
2. Explain the generation, detection of ultrasonic waves and distinguish between electrical and mechanical oscillators.
3. Demonstrate the optical phenomena of interference and diffraction.
4. Apply the principles of energy-matter interactions to various types of lasers, optical fibers and analyse their characteristics for different applications.
5. Explain the quality of acoustically good hall and sound absorbing materials.

UNIT-I: Harmonic Oscillations (12 Hrs)

Introduction to harmonic oscillations, simple harmonic oscillations, damped harmonic oscillations: over, critical and under damping, energy, power dissipation and quality factor of damped harmonic oscillations, steady state motion of forced oscillation, mechanical and electrical oscillators, electrical analogous for a simple oscillator, mechanical and electrical impedance.

UNIT II: Waves in one dimension (12 Hrs)

Transverse wave on a string, the 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-III: Wave Optics (10 Hrs)

Huygens's principle, superposition of waves and interference of light by wave front division and amplitude division, 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-IV: Lasers and Fiber Optics (12 Hrs)

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.

UNIT V: Acoustics of buildings and Ultrasonics (10Hrs)

Acoustics of buildings: Reverberation time, Sabine's formula, measurement of absorption coefficient of material, factors affecting the architectural acoustics and their remedies, acoustic quieting. Noise control in machines and auto mobiles- mufflers.

Ultrasonics: Introduction to ultrasonics, production of ultrasonic waves: magnetostriction method and piezoelectric method (principle, construction and working), properties of ultrasonics, detection of ultrasonics, applications of ultrasonics.

Text Books:

1. Engineering Mechanics- ManojK.Harbola, Cengage Learning, 2013.
2. Vibrations and waves in physics - I.G. Main, 3rdEdn, Cambridge University Press, 2018.

Reference Books:

1. Elements of properties of matter - D.S. Mathur, S. Chand publications, 2010.
2. Optics – Ajoy Ghatak -McGraw Hill Education,2012.
3. The physics of vibrations and waves - H.J. Pain, Wiley, 2006.
4. Principles of Lasers - O.Svelto, 1998.
5. Introduction to Mechanics –MahendraK.Verma, Universities Press, 2016.

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20MA11001 –Basic Engineering Mathematics

(Common to All Branches)

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 transformation.
3. Solve first and higher order differential equations of various types.
4. Analyze properties of Laplace Transform, Inverse Laplace Transform and to understand how the product of the Transforms of two functions relates to their convolution
5. Identify the methods of solving the differential equations of first and higher order applications namely, Newton's law of cooling, Natural growth and decay, Electrical circuits, Simple harmonic motion and Bending of Beams.

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

1. Apply elementary transformations to solve a system of linear equations and reduce the quadratic form to the canonical form using linear and / or orthogonal transformation.
2. Form first order differential equations for Heat flow, Growth and Decay, Electrical Circuits and apply appropriate methods for solving them.
3. Form higher order differential equations for Bending of beams, Simple harmonic motion, Electrical circuits and apply appropriate methods and / or Laplace Transforms for solving them.

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 form.

UNIT-III: Ordinary Differential Equations

First Order Ordinary Differential Equations: *Exact Differential Equations, *Linear Differential Equations and Bernoulli's Equations.

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 Ordinary Differential Equations with constant coefficients: Legendre's equation, Cauchy-Euler equation.

UNIT-IV: Laplace Transforms

Definition of Laplace transform, 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, Evaluation of integrals using Laplace Transforms, 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.

UNIT-V: Applications of Ordinary Differential Equations

Applications of First order Ordinary Differential Equations: *Newton's law of cooling, *Law of Natural growth and decay, Electrical circuits.

Applications of Higher order Ordinary Differential Equations: Electrical circuits, Simple harmonic motion, Bending of Beams.

*****Enlightenment with flowchart and algorithmic approach.

Text books:

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

Reference books:

1. A Text book of Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Publications, 10th Edition, 2015.
2. Advanced Engineering Mathematics, H.K. Das, S. Chand and Company Ltd, 21st Edition, 2013.
3. Advanced Engineering Mathematics, Jaggi and Mathur, Khanna Publishers, 6th Edition, 2019.
4. Advanced Engineering Mathematics, R.K. Jain and S.R.K. Iyengar, Alpha Science International Limited, 5th Edition, 2013.

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20CS11001-Programming for Problem Solving-I

B.Tech. ME - I Year, I Semester

L	T	P/D	C
2	-	-	2

Prerequisite(s): None.

Course Objectives: Develop ability to

1. Developing flowcharts for given problem.
2. Understand the concepts of variables, constants, basic data types and input and output statements in C programming language.
3. Understand the use of sequential, selection and repetitive statements in algorithms implemented using C programming language.
4. Understand structured design by implementing programs with functions to solve complex problems.
5. Understand the concepts related to arrays and pointers along with dynamic memory allocation using C programming language.

Course Outcomes (COs): After completion of the course, student would be able to

1. Develop Flowchart and Convert it into C Program for a given problem.
2. Apply conditional branching, iteration and recursion to solve a given problem.
3. Analyze the given problem and write a C Program by applying the concept of function call mechanism for a given problem
4. Solve problems through C programs using the concepts of Arrays, Pointers and Dynamic Memory Allocation

UNIT – I:

Basics of Computers- Introduction to components of a computer system: disks, primary and secondary memory, processor, operating system, compilers.
Logic Building: Flow chart, Algorithm, Pseudo code.
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, C program examples. Expressions, Precedence and Associativity, Expression Evaluation, Type conversions.

UNIT – II:

Statements- Selection Statements (decision making) – if and switch statements with C program examples.
Repetition statements (loops) - while, for, do-while statements with 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, Scope and Lifetime of variables, Storage classes-auto, register, static, extern, 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, Bubble Sort, Linear Search, two – dimensional arrays-matrix addition and matrix multiplication, Declaration of Multidimensional arrays, Pre-processor Directives, 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 Books:

1. Computer Science: A Structured Programming Approach Using C, B.A.Forouzan and R.F. Gilberg, Third Edition, Cengage Learning.

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.

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20ME11001–Engineering Mechanics

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

B.Tech. ME – I Year, I Semester

Prerequisite(s): NIL

Course Objectives: Develop ability to

1. Understand basic terms, represent and analyse forces to simplify any force system using free body diagram.
2. Explain the resolution of a system of forces, compute their resultant and solve problems using equations of equilibrium.
3. Apply equilibrium equations to solve problems comprising frictional forces.
4. Understand and explain the kinetics and kinematics of a body undergoing rectilinear and curvilinear motion.
5. Explain the concepts of work-energy method and its applications to translation motion.

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

1. calculate the resultant force and moments of a force system in engineering mechanics.
2. construct free body diagrams to calculate the reaction forces and frictional forces under equilibrium conditions.
3. determine the forces when a body is under dynamic equilibrium.
4. calculate the parameters of vibration and position, velocity, acceleration of a particle by work energy method.

UNIT-I:

Two Dimensional Force Systems: Basic concepts, Laws of motion, Force and system of forces, Principle of Transmissibility of forces, Resultant of a force system, Simplest Resultant of Two dimensional concurrent and Non-concurrent Force systems, Couple and Moment, Characteristics of moment and couple, Varignon's theorem and its Application.

UNIT-II:

Equilibrium of force system: Introduction, Rigid Body equilibrium, Equilibrium of System of Forces, Equilibrant, Free body diagrams, Equilibrium conditions for coplanar concurrent forces, Lami's theorem, Applications.

UNIT-III:

Friction: Theory of friction, Types of friction, Limiting friction, Laws of Friction, Angle of friction, Angle of repose, cone of friction, Application of theory of friction: Friction on inclined plane, ladder friction, wedge friction.

UNIT-IV:

Kinematics and Kinetics of a particle: Review of particle dynamics – Rectilinear motion; Plane curvilinear motion, Kinetics of particles: Translation analysis of a particle – D'Alembert's principle and its applications in plane motion and connected bodies.

UNIT-V:

Work Energy Method: Basic concepts, Work done by a force, Work energy equation for translation, work energy principle applied to motion of connected bodies, Work done by spring force.

Mechanical Vibrations: Introduction, Definitions and concepts, Simple Harmonic Motion, Free vibration, Simple Pendulum, Compound Pendulum, Torsion Pendulum.

Text Books:

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

Reference Books:

1. Engineering Mechanics, Timoshenko & Young (2007), McGraw Hill, India.
2. Engineering Mechanics, A.K. Tayal (2010), Umesh Publications, New Delhi.
3. Engineering Mechanics, Irving. H. Shames (1999), Prentice-Hall, India.

Suggested web links for additional self-learning

1. https://nptel.ac.in/courses/112/106/112106286/
2. https://nptel.ac.in/courses/122/104/122104015/

Suggested activity based works

i) Investigate and prove the theory that the resultant of a number of concurrent forces acting simultaneously at a single point can be determined by simple addition of the forces graphically
ii) Investigate and verify the theory that the support reactions of loaded beams can be found by summing the moments about each of the supports separately.
iii) Investigate and verify the theory of dry friction.

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20ME11002 - Engineering Graphics

(Common to All Branches)

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

B. Tech. ME – I Year, I Semester

Prerequisite(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 of various solids.
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:

1. illustrate dimensioning, specifications, conventions and CAD tools used in Engineering Drawing.
2. construct scales, geometric curves (conic sections & cycloids) and apply them in engineering drawing.
3. apply the principles of orthographic projections to draw projections of points, straight lines, planes, solids and sections of solids.
4. develop the isometric views from orthographic views and vice versa for the better visualization and communication.

UNIT - I:

Introduction to Engineering Drawing: Principles of Engineering Graphics and their Significance, Conic Sections including the Rectangular Hyperbola – General method only. Cycloid, Epicycloid, Hypocycloid

UNIT - II:

Engineering Scales: Plain, Diagonal
Orthographic Projections: Principles of orthographic Projections Conventions-Projections of Points.

UNIT - III:

Projections of Lines- Projections of Plane regular geometric figures

UNIT - IV:

Projections of Regular Solids inclined to one plane, Sections or Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone, Sphere.

UNIT -V:

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.

Conversion of Isometric views to Orthographic Views and vice versa.

Introduction to CAD: (For Internal Evaluation 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 CM Agrawal- McGraw-Hill, 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.
4. Engineering Graphics with AutoCAD -Dr. D.M. Kulkarni and A. Sarkar., Prentice Hall India, New Delhi, 2009

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20PH11L02 - Engineering Physics Lab

B. Tech. ME – I Year, I Semester.

Pre-requisite(s): Engineering Physics

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

Course objectives: Develop ability to

1. Determine the frequency of a given tuning fork and a.c. 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

1. Measure the frequencies of unknown vibrating bodies using the concept of resonance.
2. Infer the moduli of elasticity of given material, explain the concept of conservation of energy and resonance.
3. Demonstrate the optical phenomena like dispersion, interference and diffraction.
4. Determine the band width and quality factor of a given LCR circuit.
5. Demonstrate the characteristics of laser and propagation of light through an optical fiber.

List of Experiments: (Note: Any 8 experiments are to be performed)

1. **Melde's experiment:**

   Determination of frequency of a vibrating bar or tuning fork using Melde's arrangement.

2. **Torsional Pendulum:**

   Determination of rigidity modulus of the material of the given wire using torsional pendulum.

3. **Sonometer:**

   Determination of frequency of a.c. source using Sonometer and electromagnet.

4. **Newton's rings:**

   Determination of radius of curvature of the plano convex lens by forming Newton's rings.

5. **Diffraction grating:**

   Determination of number of lines per inch of the grating.

6. **Dispersive power:**

   Determination of dispersive power of prism by using spectrometer.

7. **Coupled Oscillator:**

   Determination of coupling constant by single coupled oscillator.

8. LCR Circuit:

Determination of resonant frequency and quality factor of LCR circuit.

9. LASER:

Study the characteristics of LASER source.

10. Optical fiber:

Determination of Numerical aperture & bending losses of a given Optical fiber.

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20CS11L01-Programming for Problem Solving-I LAB

B. Tech. ME – I Year, I Semester.

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

Prerequisite(s): None.

Course Objectives: Develop ability to

1. Developing flowcharts for given problem.
2. Understand the concepts of variables, constants, basic data types and input and output statements in C programming language.
3. Understand the use of sequential, selection and repetitive statements in algorithms implemented using C programming language.
4. Understand structured design by implementing programs with functions to solve complex problems.
5. Understand the concepts related to arrays and pointers along with dynamic memory allocation using C programming language.

Course Outcomes (COs): After completion of the course, student would be able to

1. Develop Flowchart and Convert it into C Program for a given problem.
2. Apply conditional branching, iteration and recursion to solve a given problem.
3. Analyze the given problem and write a C Program by applying the concept of function call mechanism for a given problem
4. Solve problems through C programs using the concepts of Arrays, Pointers and Dynamic Memory Allocation

LIST OF EXPERIMENTS

Week-1

Introduction to RAPTOR Tool

Draw Flow chart using RAPTOR to,

a. Read two numbers from user and calculate addition and subtraction of those numbers
b. Read two numbers from user at the time of execution and calculate multiplication and division of those numbers
c. Find the square of a given number (take the number from the user)
d. Calculate the value of Y from the equation $y = x^2 + 2x + 3$ (read the value of X from user)
e. Calculate the area of a Circle
f. Find the sum of square of two numbers

Week-2

a. Write a C program to perform arithmetic operations
b. Write a C program to implement increment and decrement operators
c. Write a C program to implement conditional operator
d. Write a C program to implement bit wise operator

Week-3

Draw Flow chart using RAPTOR tool and Implement using C program to,

a. Check whether the given number is Positive or Negative.
b. Check whether the given number is even or odd.
c. Calculate the Largest of two numbers.
d. Check the given year is leap year or not.

Week-4

Draw Flow chart using RAPTOR tool and Implement using C program to,

a. Calculate and display the grade of a student
    i. < 30 % - Fail
    ii. Between 31 and 50 – C grade
    iii. Between 51 to 60 – B grade
    iv. Between 61 to 75 – A grade
    v. Greater than 75 – distinction
b. Find the quadratic roots of an equation (real or imaginary)
c. Check the given number is multiple of 2,4and 8.

Week-5

Draw Flow chart using RAPTOR for,

a. Displaying n numbers using looping
b. Calculating the sum of n natural numbers
c. Calculating sum of even numbers and odd numbers from 1 to n (n value supplied by the user)

Week-6

a. Write a C program to implement arithmetic calculator using switch-case.
b. Write a C program to find sum of n natural numbers.
c. Write a C program to find sum of individual digits of the given number
d. Write a C program to find factorial of a given number

Week-7

a. Write a C program to check the given number is prime or not.
b. Write a C program to check the given number is Palindrome or not.
c. Write a C program to display the prime numbers below n.

Week-8

a. Write a C program to find GCD and LCM of two given numbers using functions
b. Write a C program to check the given number is Armstrong number or not using functions.

Week-9

a. Write a C program to find the sum of prime numbers from 1 to n using functions.
b. Write a C program to generate Fibonacci series for n number of terms.

Week-10

a. Write a C program to find the factorial of a given number using recursive function
b. Write a C program to generate the Fibonacci series using recursive function.
c. Write a C program to find GCD and LCM of two numbers using recursive function.

Week-11

a. Write a c program to find largest and smallest numbers in a list of array elements using functions
b. Write a C program to sort the given list of elements in ascending order using Bubble Sort.
c. 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". Using fixed length and variable length array

Week-14

a. Write a C program to find Largest Number Using Dynamic Memory Allocation
b. Write a C program to return multiples values from a function using pointers

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20ME11L01 - Engineering Workshop

(Common to All Branches)

B. Tech. ME - I Year, I Semester

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

Prerequisite(s): **None**

Course Objectives: Develop Ability to

1. To provide hands on experience about use of different engineering materials, tools, equipment and processes those are common in the engineering field.
2. To impart a good basic working knowledge required for the production of various engineering products.

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

1. devise plan of experimentation encompassing process variables identification, preparatory sketches, and methodology
2. apply various hand tools and perform basic manufacturing operations in different trades to produce engineering components adhering to workshop safety regulations.
3. demonstrate usage of power tools in different trades
4. demonstrate the experimental learning through presentation/ prototype submission.

I. TRADES FOR EXERCISES:

A. Carpentry exercises:

a. Make a T-lap joint from given pieces of wood as per as for the job drawing.
b. Make a mortise and tenon joint from given pieces of wood as per as for the job drawing.
c. Make a Bridle joint from given pieces of wood as per as for the job drawing.
d. Make a Corner lap joint from given pieces of wood as per as for the job drawing.
e. Make a cross lap joint from given pieces of wood as per as for the job drawing.

B. Fitting exercises:

a. Make an L-Fitting joint from given pieces of mild steel as per as for the job drawing.
b. Make a "V" – joint from given pieces of mild steel as per as for the job drawing.
c. Make a "Half round" joint given pieces of mild steel as per as for the job drawing.
d. Make a "Dovetail" joint given pieces of mild steel as per as for the job drawing.
e. Perform a "Square" joint given pieces of mild steel as per as for the job drawing.

C. Tin-Smithy exercises:

a. Make an Open scoop with soldering from given G.I. sheet as for the job drawing
b. Make a Rectangular tray with soldering from given G.I. sheet as for the job drawing
c. Make a Cylinder with soldering from given G.I. sheet as for the job drawing
d. Make a Hopper with soldering from given G.I. sheet as for the job drawing
e. Make a funnel with soldering from given G.I. sheet as for the job drawing

D. Black Smithy exercises:

a. Make an "S-Hook" from given piece of mild steel rod by hand forging.
b. Make a "U-Hook" from given piece of mild steel rod by hand forging.

c. Make a "C-Hook" from given piece of mild steel rod by hand forging.
d. Make a "Flat chisel" from given piece of mild steel rod by hand forging.

E. House-wiring exercises:

a. Wiring of simple light circuit for controlling light/fan point (PVC conduit wiring)
b. Wiring of light/fan circuit using two way switches (staircase wiring)
c. Measurement of voltage, current and power in a single phase circuit using voltmeter, ammeter and wattmeter. Calculate power factor of the circuit.
d. Wiring for a water pump with single phase starter.

F. Foundry exercises:

a. Prepare a mould for the given single piece pattern in green sand.
b. Prepare a mould for the given split piece pattern in green sand.

G. Welding Practice exercises:

a. Prepare simple butt joint by electric arc welding from given pieces of mild steel.
b. Prepare lap joint by electric arc welding from given pieces of mild steel.
c. Prepare corner joint by electric arc welding from given pieces of mild steel.

II. TRADES FOR DEMONSTRATION AND EXPOSURE:

a. **Machine Shop:** Demonstration and applications of drilling machine, grinding machine and lathe.
b. **Plumbing:** Various plumbing tools and its functions
c. **Disassembling and reassembling:** Tailstock of a lathe, cylinder piston of an engine and Bicycle or any machine.

NOTE: *At least **TWO** exercises to be done from each trade.*

Text books:

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

Reference books:

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

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B.Tech (ME)
I Year II Semester
Detailed Syllabus

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20EN12001 - English

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

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

Prerequisite(s): None.

Course objectives: Develop ability to

1. Improve their English Language proficiency with an emphasis on Vocabulary, Grammar, Reading and Writing skills.
2. Communicate formally in a given context.

Course Outcomes: At the end of the course students would be able to:

1. Infer and use the vocabulary/ grammatical components befitting the context.
2. Comprehend any given text and respond precisely.
3. Construct meaningful and explicit sentences in written form befitting the context.

UNIT- I:

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

Vocabulary Building: Etymology; 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: Improving Reading Comprehension Skills-Techniques for effective reading.

Writing: Importance of proper Punctuation, Types of sentences-Simple, Complex and Compound sentences.

UNIT- II:

'Ancient Architecture in India', from the prescribed text book '*English for Engineers*' published by Cambridge University Press.

Vocabulary Building: Synonyms and Antonyms, homonyms, homophones, homographs.

Grammar: Identifying Common Errors in writing with reference to Noun-Pronoun Agreement and Subject +Verb-Agreement.

Reading: Improving Reading Comprehension skills; Skimming and Scanning: Techniques for good Comprehension.

Writing: Paragraph writing: Types, Structures and Features of Paragraph, Creating Coherence, Organizing Principles of Paragraphs in a document, expansion of proverbs.

UNIT- III:

'Patriotism beyond Politics and Religion' from Ignited Minds-Unleashing the Power Within India by Dr. A.P.J. Abdul Kalam published by Penguin Books.

Vocabulary Building: Words from Foreign Languages and their use in English-word roots.

Grammar: Identifying common errors in writing with reference to misplaced and dangling modifiers and Tenses.

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

Writing: Format of a Formal Letter, Writing Formal Letters: Letter of Complaint, Letter of Requisition, Cover Letter with Resume: Abstract Writing

UNIT- IV:

'What Should You Be Eating' from the prescribed text book '*English for Engineers'* published by Cambridge University Press.

Vocabulary Building: Idioms and phrases, phrasal verbs.

Grammar: Redundancies and Clichés in Oral and Written Communication.

Reading: Comprehension-Intensive Reading and Extensive Reading, searching for implied meaning-answering the questions on theme and tone.

Writing: Writing Practices-Writing Introduction and Conclusion, Blog Writing and Responding to Blogs, Essay Writing - Précis Writing.

UNIT- V:

'How a Chinese Billionaire Built her Fortune' from the prescribed text book '*English for Engineers' Published* by Cambridge University Press.

Vocabulary Building: Practice exercises.

Grammar: Active and Passive Voice.

Reading: Reading Comprehension-Exercises for Practice-unseen passages.

Writing: Technical Reports; Introduction, Characteristics of report, Categories of reports, Formats, Structure of reports (Manuscript Format) and Types of a Report.

Text Books:

1. Sudarshana, N.P. and Savitha, C. (2018). *English for Engineers*, Cambridge University Press.
2. Penguin Books e-book: Ignited Minds-Unleashing the Power within India by Dr. A.P.J. Abdul Kalam-Published by Penguin Books.

Reference Books:

1. Swan, M. (2016) Practical English Usage. Oxford University Press.
2. Mikulecky Beatrice S & Linda Jeffries, Pearson Publications, 2007

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20MA12001 –Multi Variable Calculus

(Common to All Branches)

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

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

Prerequisite(s): 20MA11001-Basic Engineering Mathematics

Course Objectives Develop ability to

1. Compute partial derivatives, composite functions of several variables and apply the methods of differential calculus to optimize multivariable functions and evaluate improper integrals using Beta and Gamma functions.
2. Evaluate definite integrals to calculate surface and volume of revolutions of curves, multiple integrals and apply the same to solve engineering problems.
3. Explain properties of vector operators to determine solenoidal and irrotational vectors, directional derivatives of vectors.
4. Determine the length of a curve, area between the surfaces and volumes of solids using vector integration.
5. Formation of Partial differential equations and various methods to solve them.

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

1. Apply the concept of partial differentiation to solve constrained optimization problems without graphical representation.
2. Apply the definite / multiple integrals to compute arc length and areas / volumes of any region / solids.
3. Transform line, surface and volume integrals by using vector integral theorems to measure the boundary of a region, area of a surface and / or volume of solids.
4. Form first and higher order partial differential equations and apply appropriate methods to solve one-dimensional heat and wave equations.

UNIT-I: Partial Differentiation, applications and Beta, Gamma Functions

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 multiplier.
Improper Integrals: Beta and Gamma functions and their applications.

UNIT-II: Multiple Integrals and Applications of Integration

Applications of definite integrals to evaluate surface areas and volumes of revolutions of curves (Only in Cartesian coordinates).
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 integrals, (Cartesian to Spherical and Cylindrical polar coordinates) for triple integrals.
Applications: Areas (by double integrals) and volumes (by double integrals and triple integrals).

UNIT-III: Vector Differentiation

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

UNIT-IV: Vector Integration

Line, Surface and Volume Integrals. Fundamental theorems of Vector Integration: Green's Theorem, Gauss divergence Theorem and Stokes Theorem (without proofs).

UNIT-V: Partial Differential Equations

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order Linear (Lagrangian) equation, Method of separation of variables for second order equations. Applications of Partial Differential Equations: One dimensional Wave equation, One dimensional Heat equation.
*Enlightenment with flowchart and algorithmic approach.

Text books:

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

Reference books:

1. A Text book of Engineering Mathematics, N.P. Bali and Manish Goyal, Laxmi Publications, 10th Edition, 2015.
2. Advanced Engineering Mathematics, H.K. Das, S. Chand and Company Ltd, 21st Edition, 2013.
3. Advanced Engineering Mathematics, Dr. A. B. Mathur and Prof. V.P. Jaggi, Khanna Publishers, 6th Edition, 2019.
4. Advanced Engineering Mathematics, R.K. Jain and S.R.K. Iyengar, Alpha Science International Limited, 4th Edition, 2013.

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20CS12001-Programming for Problem Solving-II

B. Tech. ME – I Year, II Semester.

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

Prerequisite(s): 20CS1101-Programming for Problem Solving-I

Course Objectives: Develop ability to

1. Understand the concepts of strings ,structure, union, and enumerated types
2. Understand linear lists and their implementation using arrays and linked list.
3. Understand the classical approaches to sorting arrays: selection sort, quick 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 and command line arguments.

Course Outcomes (COs): After completion of the course, student would be able to

1. Solve problems using concepts of string functions, structures, unions.
2. Perform basic operations by building Linear Linked List.
3. Build C Programs for searching and sorting algorithms
4. Build Stacks and Queues through C programs for different applications.
5. Perform operations on files using C programs.

UNIT – I:

Strings – Concepts, C Strings, String Input / Output functions, string manipulation functions, arrays of strings, string / data conversion, C program examples.
Enumerated Types– The Type Definition (type def), 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.

UNIT – II:

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

UNIT – III:

Sorting - Selection sort, Quick 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.

Command line arguments.

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

Text Book(S):

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

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.

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20CH12001- Engineering Chemistry

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

B. Tech. ME – I Year, II Semester.

Prerequisite(s): None.

Course objectives: Develop ability to

1. Acquire the knowledge of atomic, molecular and electronic modifications for understanding properties of transition complexes.
2. Comprehend the basic concepts of hardness of water, corrosion and their impact on industries.
3. Learn the essential concepts of electro chemistry and working of Lead acid battery and Lithium battery.
4. Learn the synthetic aspects of drugs and polymers through organic reaction mechanisms.
5. Understand the basic concepts of UV-Visible, IR, Microwave and NMR spectroscopy for identifying molecular/atomic changes.

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

1. Apply the concepts of atomic and molecular changes for analyzing the nature of diatomic molecules and transition metal complexes.
2. Analyze the causes of hardness of water, corrosion and apply the knowledge acquired to solve the problems of industrial significance.
3. Utilize the concepts of electrochemistry to explain the functioning of Lead acid and Lithium batteries.
4. Apply the fundamentals of reaction mechanisms for the synthesis of organic compounds and polymers of industrial importance.
5. Identify the molecular/atomic changes using UV-Visible, IR, Microwave and NMR spectroscopic techniques.

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

Electrochemical 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 polymeric materials

Reaction Mechanisms

Substitution reactions: Nucleophilic substitution reactions: Mechanism of S_N1, S_N2 reactions. Electrophilic and Nucleophilic addition reactions: Addition of HBr to propene. Markovnikov's and anti-Markovnikov's additions. Grignard additions on carbonyl compounds. Elimination reactions: Dehydrohalogenation of alkyl halides, Saytzeff's 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.

Polymeric materials

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

Introduction to spectroscopic techniques- Electronic spectroscopy- Beer lambert's law, Principle of UV-Visible spectroscopy, Selection rules, Types of electronic transitions and applications of UV-Visible spectroscopy; Vibrational and rotational spectroscopy- IR spectroscopy-Principle- Mode of vibrations, Selection rules, Applications of IR spectroscopy, Nuclear magnetic resonance Spectroscopy- Principle, Chemical shift, Factors influencing chemical shift, Medical application of NMR spectroscopy - Magnetic Resonance Imaging.

Text Books:

1. Engineering Chemistry by B. Ramadevi, Prasanta Rath and Ch. Venkata Ramana Reddy, Cengage Publications, 2018.
2. A Text Book of Engineering Chemistry by M. Thirumala Chary, E. Laxminarayana and K. Shashikala, Pearson Publishers, 2020.

Reference Books

1. Engineering Chemistry by P.C Jain & Monica Jain, Dhanpatrai Publishing Company, 17th edition, 2015.
2. Elements of Physical Chemistry by P.W. Atkins 4th Edition.

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20ME12001 - Mechanics and Mechanical Drives

B. Tech. ME - I Year II Semester

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

Prerequisite(s): Engineering Mechanics

Course Objectives: Develop ability to

1. Locate the centroid and centre of gravity of various standard and composite bodies.
2. Compute the area moment of inertia and mass moment of inertia of standard and composite sections.
3. Acquire knowledge to draw shear force and bending moment diagrams for various beams under different loading conditions.
4. Understand principles of operation of flexible and chain drive systems.
5. Understand the theory involved in the analysis of brakes and dynamometers.

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

1. construct free body diagrams to calculate the centroid and centre of gravity of various standard and composite sections.
2. evaluate the area and mass moment of inertia of regular and irregular objects
3. calculate shear force and bending moments to construct Shear Force Diagram and Bending Moment Diagram.
4. design belt drives, chain drives, brakes and dynamo meters

UNIT-I:

Centroid and Center of Gravity: Centroid, Difference between Center of Gravity and Centroid, Axis of Symmetry, centroid of simple figures from first principle, centroid of composite sections; Introduction, Centre of Gravity and its implications. Pappus-Guldinus first and second theorems.

UNIT-II:

Moment of Inertia:

Area moment of inertia: Parallel and perpendicular axis theorems, polar moment of inertia, radius of gyration of areas. Moment of inertia of standard lamina using first principle, Examples related to moment of inertia of composite sections.

Mass Moment of Inertia: Mass Moments of Inertia, Transfer Formula, Mass moment of inertia from first principle, Mass moment of inertia of composite bodies (restricted to uniform thin rod, disc, sphere and cylinder)

UNIT-III:

Shear Force and Bending Moment: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, UDL, UVL and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT-IV:

Belt and Chain drives: Introduction, Types, Velocity ratio, Length of an open belt drive, Transmission of power by Belt drives, Transmission efficiencies, Belts – Flat and V types – Materials, Chain drives, Terminology, Chain Speed and Angular Velocity of Sprocket, Length of Chain.

UNIT-V:

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.

Text Books:

1. Engineering Mechanics, Ferdinand. L. Singer, (1998), Harper – Collins publishers, New Delhi.
2. Engineering Mechanics, S.S. Bhavikatti and J.G. Rajasekharappa, (2012), New Age International, India.
3. Strength of Materials A Practical Approach, D.S. PrakashRao, Universities Press, Hyderabad, 1999.
4. Theory of Machines, S. S. Rattan, TMH Publishers, Third Edition, 2009

Reference Books:

1. Engineering Mechanics, Timoshenko & Young (2007), McGraw Hill, India.
2. Engineering Mechanics, A.K. Tayal (2010), Umesh Publications, New Delhi.
3. Strength of Materials, S.S. Bhavakatti, Vikas Publication, 2003.
4. Theory of Machines, P.L.Ballaney, Khanna Publishers, 2001
5. Theory of Machines, Thomas Bevan, CBS Publishers, Third Editon, 2002

Suggested web links for additional self-learning

1. https://nptel.ac.in/courses/112/106/112106286/
2. https://nptel.ac.in/courses/112/102/112102284/

Suggested activity based works:

i) The 'Centroids Game' to improve the proficiency in centroid and centre of gravity calculations.

ii) Design an experiment to verify that the moment of inertia varies as the square of radius ($I \propto r^2$).

iii)Draw/compute shear force and Bending moment diagrams using computer program.

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20EN12L01 - English Language Communication Skills Lab (ELCS)

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

L	T	P/D	C
-	-	2	1

Prerequisite(s): **None**

Course Objectives:

Students would develop the ability to

1. Use computer-assisted multimedia instruction for independent language learning.
2. Enunciate English speech sounds, word accent, intonation and rhythm appropriately.
3. Present their ideas and views in any formal context.

Course Outcomes: At the end of the course students would be able to:

1. Listen actively, speak intelligibly and write clearly.
2. Use Phonetics to neutralize accent.
3. Articulate ideas explicitly, both verbally and non-verbally.
4. Demonstrate basic skills to succeed in interviews.

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

Practice: Introduction to Phonetics-Speech Sounds-Vowels and Consonants-Minimal pairs.

ICS Lab

Understand: Communication at Work Place-Spoken vs. Written language.

Practice: Speaking: Ice-Breaking Activity and JAM Session. Know your partner activity.

Module-II

CALL Lab

Understand: Listening: Structure of Syllable, 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: Speaking: Telephone Etiquette, Situational Dialogues-Greetings-Taking Leave-Making request and seeking permission-Introducing oneself and others.

Module-III

CALL Lab

Understand: Listening: Intonation; Errors in pronunciation-The interference 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: Speaking: Descriptions- Places, Objects, Events and Process-Formal Presentations.

Module-IV

CALL Lab

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

Practice: Listening: Listening Comprehension-Tests. (2 practice exercises)

ICS Lab

Understand: Public Speaking-Debate-Exposure to Structured Talks.

Practice: Speaking: Making a Short Speech-Extempore. (2 practice exercises), Talks. (2 practice exercises) 'My Newspaper activity'.

Module-V

CALL Lab

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

Practice: Listening Comprehension Tests. (2 practice exercises)

ICS Lab

Understand: Speaking: General Interview Skills.

Practice: General Interview Strategies and Skills.

Books Recommended:

1. Krishna Mohan & N. P Singh: *Speaking English Effectively* 2nd ed., MacMillan Publishers, 2011
2. ELCS Lab Manual prepared by Faculty, Department of English, GCET.

Reference Books:

1. English Language Communication Skills Lab Manual cum Workbook by Cengage Learning India, 2013.
2. Podcasts on Listening, Cambridge University Press.

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20CS12L01-Programming for Problem Solving-II LAB

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

B. Tech. ME – I Year, II Semester.

Prerequisite(s): 20CS11L1-Programming for Problem Solving-I

Course Objectives: Develop ability to

1. Understand the concepts of strings ,structure, union, and enumerated types
2. Understand linear lists and their implementation using arrays and linked list.
3. Understand the classical approaches to sorting arrays: selection sort, quick 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 and command line arguments.

Course Outcomes (COs): After completion of the course, student would be able to

1. Solve problems using concepts of string functions, structures, unions.
2. Perform basic operations by building Linear Linked List.
3. Build C Programs for searching and sorting algorithms
4. Build Stacks and Queues through C programs for different applications.
5. Perform operations on files using C programs.

List of Experiments

Week 1:

a. Write a C program to find whether a given string is palindrome or not.

b. Write a C program to insert characters at a given location in a given string.

c. Write a C program to delete characters from a given string and position

d. Write a C program to print the number of vowels and consonants using Strings

Week 2:

a. Write a C program to convert Roman number to Decimal Number.

b. Write a C program to find the 2's Compliment of a given string

c. Write a C program to Reverse a String by Passing it to function

d. Write a C Program to Input a String with at least one Number, Print the Square of all the Numbers in a String

Week 3:

Write a C program to implement complex structures for the following operations.

i. Addition of two Complex numbers

ii. Multiplication of two Complex Numbers

Week 4:

a. Write a C program to implement arrays of structures?

b. Write a C program to implement bit fields in C?

Week 5:

a. Write a C Program to store the information (name, roll no, and branch) of a student using unions.

b. Write a C program to implement inter function communication by passing pointers to a structure.

Week 6:

Write a C program to implement singly linked list for the following operations.

a)Insertion b)Deletion c)Search

Week 7:

a. Write a C program to sort the elements using Selection sort

b. Write a C program to sort the elements using Quick sort.

Week 8:

a. Write a C program to sort the elements using Insertion sort

b. Write a C program to search a string in a list of strings using linear search. If the string is found display the position, otherwise print "string not present".

Week 9:

Write a C program to search an element in a list of elements using Binary search. If the element is found, display the position, otherwise print "element not present".

Week 10:

Write a C program convert infix to postfix notation and postfix evaluation using stack.

Week 11:

Write a C program implement Queue using arrays for the following operations.

i)Enqueue ii)Dequeue iii) Peek iv)Display

Week 12:

Write a C program open a new file and implement the following I/O functions.

i) fprintf(), fscanf()

ii) getw(), putw()

iii) getc(), putc()

Week 13:

a. Write a C program to copy data from one file to another.

b. Write a C program to merge two files, using command line arguments.

Week 14:

Write a C program to implement multi file programming for basic arithmetic operations

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20CH12L01-Engineering Chemistry Lab

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

B.Tech. ME – I Year, II Semester.

Prerequisite(s): None.

Course objectives: Develop ability to

1. Estimate the hardness content in water and 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, acid value and viscosity.
4. Explain the synthesis of simple drug molecules such as Aspirin.
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

1. Determine the temporary and permanent hardness in water to verify its suitability for drinking purpose.
2. Find the concentration of given solution using instrumental techniques such as Potentiometry and Conductometry.
3. Determine physical properties, namely, surface tension, acid value and viscosity of a given fluid.
4. Use fundamental preparatory techniques for the synthesis of drugs such as aspirin.
5. Estimate the rate constant of a reaction from concentration – time relationship.

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 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.

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 5th edition.
4. Text book on Experiments and calculations in Engineering Chemistry – S.S. Dara.

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20ME12P01 - Design Thinking*

L	T	P/D	C
-	-	4	2

B. Tech. ME - I Year, II Semester

Prerequisite (s): NIL

Knowledge of analyzing societal problems and a zeal to improve the current situation, in addition to usage of laptops/computers, internet, social media interaction and communication etiquette.

Course Objectives: Develop ability to

1. Increase ability to communicate with people, enhance their creative and innovative thinking skills.
2. Examine Design Thinking concepts and principles.
3. Apply Design Thinking methodologies to problems in the field of study and other areas as well.
4. Practice thinking creatively for innovative development.
5. Prepare the student for future engineering positions with scope of understanding dynamics of working between inter departments.

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

1. enumerate the critical theories of design, systems' thinking, and design methodologies
2. illustrate the diverse methods/ frame work employed in design thinking to apply the same in practice
3. conceive projects in interdisciplinary domain and address social concerns with innovative approaches
4. illustrate the concept of design thinking for product and service development

UNIT–I:

Basics of Design Thinking: Definition of Design Thinking, Objective of Design Thinking, Concepts and Brainstorming, Stages of Design Thinking process (explain with examples)**.**

Design Thinking Strategy and capability: Build design thinking strategy and capability (structure, culture, skills, process) in an organization to define the organization's design journey.

UNIT–II:

Being Ingenious and Fixing problem: Understanding creative thinking process, Understanding problem solving, testing creative problem solving

Explore: Discover challenges, interpret through empathy study, understand various tools of empathy study and perform risk assessment.

UNIT–III:

Ideate: Generate ideas, shortlist a workable solution, perform risk assessment**.**

Prototyping and Testing: Basic concepts of prototype; Rapid prototype development process, Testing, perform financial analysis of the solution and risk assessment.

UNIT–IV:

Celebrating the difference: Understanding individual differences and Uniqueness

Group discussion and activities to encourage the understanding, acceptance and appreciation of individual differences

Evolve: Track success and scale the solution.

UNIT–V:

Design for Service: Product vs Service, service development and experience lifecycle.

Feedback: Final presentation – "Solving practical Engineering problem through Innovative and Creative solution".

Recommended references:

All the relevant resources available from the authorized sources of internet will be utilized in the course delivery and for defining group activities.

Note: (*) represents ACTIVITY ORIENTED NON-LABORATORY course

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B.Tech (ME)
II Year I Semester
Detailed Syllabus

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20ME21001 – Materials Technology

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

B. Tech. ME - II Year, I Semester

Prerequisite(s): Engineering Physics and Chemistry

Course Objectives: Develop ability to

1. Understand concept of Plastic Deformation of metals, 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: At the end of the course, the student will be able to:

1. interpret physical and mechanical properties of materials based on the crystal structures, bonds and heat treatment methods.
2. identify the phases present in different alloy systems using phase diagrams.
3. apply the principles of ferrous/ non-ferrous physical metallurgy to select materials for any specific application.
4. demonstrate non-metallic materials and powder metallurgy techniques.

UNIT–I:

Structure and properties of Engineering Materials: Introduction to Engineering materials and Mechanical properties, Bonds in solids, Crystallography, packing factor and density calculations, imperfections in Crystals, Crystallization of metals, Grain and grain boundaries, grain size and its effect on the properties of metals/alloys.

Mechanisms of Plastic Deformation: Slip and Twinning.

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 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, Surface hardening methods.

UNIT-IV: Engineering Materials – I:

Ferrous Metals and Alloys 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 and Alloys: Properties and Applications of Copper and its alloys, Nickel and its alloys, Aluminium and its alloys, Titanium and its 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.

Suggested web links for additional self learning:

1. https://nptel.ac.in/courses/113/106/113106032
2. https://nptel.ac.in/courses/113/102/113102080
3. https://nptel.ac.in/courses/113/107/113107078

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20ME21002 - Mechanics of Solids

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

B.Tech. ME - II Year, I Semester

Prerequisite(s): **20ME11001- Engineering Mechanics**

20ME12001- Mechanics and Mechanical Drives

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 on stresses induced in complex loading systems
3. Understand combined stresses and strains at a point across any plane in a two dimensional system.
4. Understand the concept of bending stress and shear stress for various beam sections.
5. Understand the behaviour of beams under complex loading.
6. Understand torsion equation to compute torsional stresses in solid and hollow shafts and concepts of stresses in thin and thick cylinders.

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

1. explain mechanical properties and elastic behaviour of engineering materials
2. determine stresses and strains in elastic members subjected to static loads with/ without a change in working temperature
3. evaluate principal stresses and principal strains, and apply theories of elastic failure to design machine components

UNIT–I:

Stresses and Strains: Material properties-stress-strain diagrams for engineering materials; Definitions-Stress, strain; Hooke's law, modulus of elasticity; Types of stresses and strains - Tensile, compressive, shear; Stresses and strains in compound bars under axial loading; Temperature stresses; Strain energy;

Elastic Moduli: Poisson's ratio; Shear strain and volumetric strain; Relationship between elastic constants.

UNIT–II:

Principle Stresses and Strains: Normal and Tangential stresses induced on an inclined plane under uniaxial loading and biaxial loading combined with state of simple shear; Analytical and Mohr's graphical solution to determine Principal stresses and strains.

Theories of Elastic Failure: Rankine's theory, Tresca's theory, Von Mises theory, St Venant's theory, Haigh's theory

UNIT–III:

Flexural Stresses: Theory of simple bending – Assumptions; Derivation of bending equation: M/I = f/y = E/R; Design of Beam sections under bending stresses- Concept of Neutral Axis, Section modulus and induced bending stress in rectangular, circular, I, and T sections;

Shear Stresses in Beams: Distribution of shear stresses in rectangular, circular, I and T solid sections.

UNIT–IV:

Deflection of Beams: Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods –

Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, U.D.L, U.V.L.

UNIT–V:

Torsion: Circular shaft, Derivation of torsion equation for circular sections; Power transmission through circular shafts; Concept of design based on strength and rigidity; Effect of combined bending, torsion and axial loads;

Thin Cylinders-Stresses in thin cylinders with internal and external pressures; volumetric strains – changes in diameter, length and volume of thin cylinders; Stresses in thin spherical shells.

Text Books:

1. Strength of Materials, G.H. Ryder,3rd Edition in SI units, Macmillan India Limited, Delhi, 2002
2. Strength of Materials, S. Ramamrutham, Dhanpat Rai & Sons, 1993.

Reference Books:

1. Strength of Materials A Practical Approach, D.S. Prakash Rao, Universities Press, Hyderabad, 1999.
2. Engineering Mechanics of Solids, E gor P.Popov, Pearson,
3. Strength of Materials, Schaum Series.
4. Mechanics of materials, Beer and Jhonson, McGraw Hill

Suggested web links for additional self-learning

1. https://nptel.ac.in/courses/112/102/112102284/
2. https://nptel.ac.in/courses/105/102/105102090/
3. http://www.nptelvideos.in/2012/11/mechanics-of-solids.html

Suggested activity based works:

1. Investigate elongation behaviour of composite bars,
2. Investigate stresses induced due to change in temperature
3. Draw/compute shear force and Bending moment diagrams using computer program
4. Write computer program to find section modulus of built up beam sections.

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20EE21001- Basic Electrical Engineering

B.Tech. ME - II Year, I Semester

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

Prerequisite(s): NIL

Pre requisites: None

Course Objectives: Develop ability to

1. Understand the concepts of DC circuits and its analysis.
2. Understand the concepts of AC single phase circuits and its analysis.
3. Understand the concepts of single phase and three phase Transformers.
4. Understand the concepts of AC and DC machines.
5. Understand the working of various domestic electrical installation components.

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

1. Analyze DC and AC electrical circuits using basic laws and network theorems
2. Illustrate the fundamental laws used in the working of different AC and DC machines
3. Determine the performance characteristics of various DC and AC machines
4. Differentiate various electrical installation components based on the application and perform the energy consumption calculations

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, The venin 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 RL-C circuit.

UNIT-III:

Faradays Laws of Electromagnetic Induction. Statically and dynamically induced emf. Transformers: Ideal and practical transformers, equivalent circuit, losses in transformers and efficiency. Auto-transformer and Three-phase transformer connections, voltage and current relation.

UNIT-IV:

Direct-Current Machines: Construction, operation and Types. Torque-Speed Characteristics of DC shunt and series motors and its applications. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Single-phase induction motor: Construction and working and its applications.

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 and their applications. Elementary calculations for energy consumption.

Text-Books:

1. Basic Electrical Engineering - D.P. Kothari and I.J. Nagrath, 3rd edition 2010, Tata McGraw Hill.
2. Electrical Engineering Fundamentals, Vincent Del Toro, Second Edition, Prentice Hall India, Pvt. Ltd.

Reference-Books:

1. D.C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
2. L.S. Bobrow, Fundamentals of Electrical Engineering", Oxford University Press, 2011
3. "Basic Electrical Engineering", T.K. Nagsarkar, M.S Sukhija, JNTU Edition, 2005
4. "A text book of Electrical Technology", Volume II, B.L.Thereja, A.K.Thereja

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20ME21003 - Fluid Mechanics and Hydraulic Machinery

B.Tech. ME - II Year, I Semester

Prerequisite(s): NIL

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

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

1. explain fluid properties, types of fluid flows and solve 1-D and 3-D fluid flow problems
2. apply the laws of conservation of mass, conservation of momentum and conservation of energy to analyse fluid flow
3. explain boundary layer concepts
4. analyse fluid flow in closed conduits, turbines and pumps

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 gauges.

Fluid Kinematics: Stream line, path line and streak lines and stream tube, classification of flows-steady and 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, Flow nozzle and Diffuser.

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: Boundary layer definitions and characteristics, Boundary layer thickness, Displacement thickness, Momentum thickness, Energy thickness (no derivations), laminar boundary layer, Turbulent boundary layers (no derivation), separation of boundary layer and its control.

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.

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 principle, work done –barometric head- losses and efficiencies specific speed- pumps in series and parallel-performance characteristic curves, Cavitation, Priming, NPSH.
Reciprocating Pumps: Working principle, Discharge, slip, indicator diagrams,
Submersible pumps: Introduction and working principle

Text Books:

1. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH, Standard book house. Delhi 1991.volume 1.
2. Fluid Mechanics and Hydraulic Machines by Rajput, s. chand & company ltd. Delhi. 2008.

Reference Books:

1. Fluid Mechanics, Frank M. White, McGraw Hill
2. Fluid Mechanics & fluid power engineering by D.S. Kumar, S.K. Katiraia & Sons publications.
3. Fluid Mechanics and Machinery, Cengel & Cibala, New Age International.
4. Fluid Mechanics and Hydraulic Machines by Bansal, Lakshmi publications

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20ME21004 – Thermodynamics

B. Tech. ME – II Year, I Semester.

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

Prerequisite: NIL

Course Objectives: Develop ability to

1. Learn about thermodynamic system and its equilibrium
2. Understand various forms of energy - heat transfer and work
3. Study the basic laws of thermodynamics including, zeroth law, first law and second law.
4. To understand the concept of entropy.
5. Study of available and unavailable energy and evaluation of thermodynamic relations

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

1. establish relationships among thermodynamic properties, heat and work using laws of thermodynamics.
2. evaluate the existence of thermodynamic systems by applying quantitative and qualitative analysis.
3. evaluate the performance of heat engines and reversed heat engines under ideal conditions.
4. solve problems in heat engineering by applying the principles of conservation, ideal gas laws and thermodynamic property relations.

UNIT – I:

Introduction and Basic Concepts:-
Types of Systems; Macroscopic and Microscopic viewpoints; Equilibrium – Thermal, Chemical, Mechanical and Property – Intensive and Extensive, State, Path, Process and Cycle: Point Function and Path Function; Quasi Static Process and processes like Isobaric; Isochoric, Isothermal; Polytropic Process;

Temperature:
Thermal Equilibrium; Zeroth Law; Measurement of Temperature- Reference points, Ideal gas Temperature scale, Celsius Temperature scale and International Practical Temperature scale, Constant volume gas thermometer, constant pressure gas thermometer, mercury in glass thermometer.

Work and Heat:
Exact and inexact differentials, Thermodynamic definition of Work: examples, displacement work, work as a path function, different forms of work transfer, Heat: definition of heat, heat as a path function, Specific heats, and examples of work and heat interactions. Internal energy and enthalpy as functions of Temperature, Characteristic gas constant and Universal Gas Constant

UNIT – II:

First Law of Thermodynamics:
First law for cyclic and non cyclic processes; concept of total energy and energy as the property of a system; various modes of energy- internal energy and enthalpy, Steady Flow Energy Equation (SFEE): Examples of steady flow processes; PMM-1; Limitations of the First Law; Vander Waals Equation of State; compressibility factor and generalized compressibility chart.

UNIT- III:

Second Law of Thermodynamics:

Definition of direct and reversed heat engine (Refrigerator and heat pump), definition of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Equivalence of Kelvin-Planck and Clausius statements; Reversibility and Irreversibility; Causes for Irreversibility; Carnot cycle; Absolute Thermodynamic Temperature scale;

Entropy:

Entropy- entropy as a property, Clausius inequality, Entropy change in reversible and Irreversible process, Principle of increase of entropy, Illustration of process on T-s diagram, Entropy generation in a closed system and open system: Two reversible adiabatic paths cannot intersect each other; First and Second Laws combined relations.

UNIT - IV:

Availability and Exergy:

Available and unavailable energy- concept of availability, availability of heat source at constant and variable Temperatures, Dead state, Exergy balance equation and Exergy analysis for non-flow and steady flow systems: Helmholtz and Gibbs function; second law efficiency.

UNIT – V: Thermodynamic Relations

Maxwell relations- Tds Relations: Energy Equation –Joule-Thomson effect, Clausius -Clapeyron Equation: Elementary Treatment of the Third Law of Thermodynamics.

Text Books:

1. Engineering Thermodynamics- PK Nag / TMH/ 6th Edition
2. Thermodynamics - An Engineering Approach/ Yunus A. Cengel& Michael A. Boles/TMH

Reference Books:

1. Fundamentals of Thermodynamics, Gordon J. Van Wylan & Richard E. Sonntagg, 7th Edition, Wiley Eastern Ltd, 2009
2. Engineering Thermodynamics, Rajput, 4th Edition, Laxmi Publications, 2010
3. Engineering Thermodynamics, Achuthan, 2nd Edition, Phi Learning publications, 2009
4. Engineering Thermodynamics .B. Jones and G. A. Hawkins, John Wiley and Sons

E-Books / Web References

1. Engineering Thermodynamics, Achuthan, 2nd Edition, Phi Learning, 2009.
2. Fundamentals of Engineering Thermodynamics, Rathakrishnan, 2nd Edition, Phi Learning, 2005
3. http://nptel.ac.in/courses/112104113/
4. http://nptel.ac.in/courses/112108148/
5. http://nptel.ac.in/courses/112105123/

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20ME21L01 – Materials Technology Lab

B. Tech. ME - II Year, I Semester

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

Prerequisite(s): **Nil**

Course Objectives: Develop ability to

1. Understand metallography and microstructure of various Ferrous and non-ferrous metals
2. Acquire knowledge for determining metallurgical hardness of metals before and after heat treatment.

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

1. devise plan of experimentation encompassing process variables identification, preparatory sketches, and methodology
2. demonstrate the metallographic procedures to be followed in the preparation of samples of micrography
3. apply suitable heat treatment method to enhance the mechanical properties of materials
4. draw conclusions from the micrographs and heat treatment effects
5. demonstrate the experimental learning through presentation/ project submission.

List of Experiments:

1. Preparation and study of the Microstructure of pure metals like Cu.
2. Preparation and study of the Microstructure of pure metals like Al.
3. Preparation and study of the Microstructure of Mild steels, low carbon steels, high carbon steels.
4. Study of the Microstructures of Cast Irons.
5. Study of Microstructures of nickel base super alloy.
6. Study of the Microstructures of brass.
7. Study of the Microstructures of bronze.
8. Study of the Microstructures of Titanium alloys.
9. Hardenability of steels by Jominy End Quench Test.
10. To find out hardness of various heat treated and untreated plain carbon steels.
11. Study of change in microstructure of steel after annealing and normalizing.
12. Study of change in microstructure of steel after hardening and tempering.
13. Study the effect of heat treatment on hardness of HAZ of the welded joint

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20EE21L01- Basic Electrical Engineering Lab

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

B.Tech. ME – II Year, I Semester

Prerequisite(s): 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. apply physical laws to solve for unknowns like currents, voltages, impedances, etc.
4. Inspect the speed torque characteristics of DC motor
5. Inspect the speed torque characteristics Three Phase Induction Motor

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

1. Apply various fundamental laws and theorems to electrical circuits with AC and DC excitations
2. Calculate electrical parameters in single phase and three phase circuits
3. Determine the performance characteristics of various AC and DC machines

List of experiments:

1. Verification of KVL and KCL
2. Verification of Superposition Theorem
3. Transient Response of Series RL and RC circuits using DC excitation
4. Calculations and Verification of Impedance and Current of RL, RC and RLC series circuits
5. Resonance in series RLC circuit
6. Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer
7. Load Test on Single Phase Transformer (Efficiency Calculations)
8. Measurement of Active and Reactive Power in a balanced Three-phase circuit
9. Torque-Speed Characteristics of a DC Shunt Motor
10. Torque-Speed Characteristics of a Three-phase Induction Motor

Additional Experiments:

11. Verification of Thevenin's Theorem.
12. Three Phase Transformer: Verification of Relationship between Voltages and Currents (Star-Delta, Delta-Delta, Delta-star, Star-Star)

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20ME21L02 - Fluid Mechanics and Hydraulic Machines Laboratory

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

B.Tech. ME – II Year, I Semester

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:

1. devise plan of experimentation encompassing process variables identification, preparatory sketches, and methodology
2. conduct the experiment to i) analyse fluid flow through pipes, ii) find major losses, minor losses and frictional losses in fluid flow iii) determine the coefficient of discharge of obstruction flow meters iv) determine the Impact of a jet on Flat and curved vanes and v) evaluate the performance of pumps/ turbines
3. apply formulae and theorems, perform model calculations and present the results
4. compare the evaluated properties with standard values and reason the deviations, if any.
5. demonstrate the experimental learning through presentation/ project submission.

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. Calibration of turbine flow meter
8. Performance test on Pelton wheel.
9. Performance test on Francis turbine.
10. Performance test on Kaplan turbine.
11. Performance test on single stage centrifugal pump.
12. Performance test on multi stage centrifugal pump.
13. Performance test on reciprocating pump.

Any 12 out of 13 experiments can be done.

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20ME21L03 – Mechanics of Solids Lab

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

B. Tech. ME - II Year, I Semester

Prerequisite(s): **Nil**

Course Objectives: Develop ability to

1. Acquire knowledge of testing the mechanical 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.

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

1. devise plan of experimentation encompassing process variables identification, preparatory sketches, and methodology
2. conduct experiment to evaluate mechanical properties of structural materials such as tensile strength, compressive strength, bending strength, shear strength, Impact strength, Hardness and deflection of beams.
3. apply formulae and theorems, and perform model calculations to evaluate the intended mechanical properties of a given material.
4. compare the evaluated properties with standard values and reason the deviations, if any.
5. demonstrate the experimental learning through presentation/ project submission.

List of Experiments:

1. To determine tensile strength of mild steel specimen using Universal Testing Machine.
2. To determine modulus of rigidity given specimen using Torsion Testing Machine.
3. To determine Young's modulus and stiffness of Simple supported beam.
4. To determine Young's modulus and stiffness of Cantilever beam.
5. To determine Hardness of given specimen using Brinell Hardness Testing Machine.
6. To determine Hardness of given specimen using Rockwell Hardness Testing Machine.
7. To determine impact strength of given specimen by Charpy Testing Machine.
8. To determine impact strength of given specimen by Izod Testing Machine.
9. To determine stiffness and modulus of rigidity of given spring using Spring Testing Machine.
10. To determine compressive strength of given specimen using Compression Testing Machine.
11. Determine the shear strength of a material.
12. To determine bending strength of mild steel specimen using Universal Testing Machine

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20EN21P01 - English for Effective Communication

Classroom Activity based Course. Hence, Lab. is not required.

B. Tech II year, I Semester.

L	T/P	C
-	2	1

Prerequisite(s): None

Course objectives: Develop ability to

1. Delineate the contextual meaning of various words and their functions in sentence.
2. Equip themselves with English language skills using appropriate vocabulary.
3. Improve English language proficiency with an emphasis on Reading skills.
4. Develop ability to think critically and articulate their views.

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

1. Use appropriate words befitting the context.
2. Draw valid inferences by comprehending the given text.
3. Interpret the given picture/text and draw implications.

Module-I

History of words

Etymology: Word Origin, Advanced word roots, words borrowed from different languages to English, Portmanteau words, also called blended words (new coinage of words), assimilation of words.

Module-II

Word Analogy

Vocabulary**:** Same words with different meaning and different words with same meaning,
Analogies: different relationships: worker and tools, worker and article, time sequence, cause and effect, class and species, synonyms, antonyms, person and things sought or avoided part to the whole and symbols that stand for, degree of intensity, parts of speech.

Module-III

Comprehension Techniques

Reading: Reading for facts, opinions and inferences, reading for critical understanding, addressing point of view of the author/writer, jumbled paragraphs.

Module-IV

Sentence Equivalence

Writing: sentence completion, Picture perspective: critical thinking, individual perception and obtaining implications.

Books Recommended:

1. Quirk Randolph: *A Comprehensive Grammar of the English Language*, Pearson publications.
2. Lewis Norman: *Word Power Made Easy*, Goyal Publisher, 2011.
3. Zinsser William: *On Writing Well*, Harper Resource Book, 2001
4. Peterson: *Reading Skill*, New York: Peterson.2007. Print.
5. Brian Galvin, Chris Kane: Text completion & Sentence Equivalence: Veritas Prep.2016.

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20CH21M01 - Environmental Science

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

B.Tech. ME – II Year, I Semester

Prerequisite(s): None.

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: After the completion of the course, the student would be able to -

1. Explain ecosystem and its functions namely, f - ood chain, ecological pyramids etc.
2. 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.
3. Comprehend ecosystem diversity, its values and importance of hot spots to preserve the same.
4. Explain different types of pollution, its control and impact on global environment.
5. 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, Bio-geochemical cycles, Bioaccumulation, Bio magnification.

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: Waste water 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 & amp; 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 explo sion, 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. Environmental Studies by Anubha Kaushik, 4th Edition, New age international publishers.
2. Textbook of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission.

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 R. Rajagopalan, Oxford University Press. Text book of
5. Environmental Science and Technology - Dr. M. Anji Reddy 2007, BS Publications.
6. Introduction to Environmental Science by Y. Anjaneyulu, BS. Publications.

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B.Tech (ME)
II Year II Semester
Detailed Syllabus

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20ME22001 – Thermal Engineering

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

B.Tech. ME – II Year, II Semester

Prerequisite(s):**20ME21004- Thermodynamics**

Course Objectives: Develop ability to

1. Understand the concepts of thermodynamic cycles, Fuel-Air Cycles, Actual Cycles.
2. Understand the concepts of I C Engines and testing parameters of I C Engines.
3. Understand the combustion process in I C engines and fuel properties.
4. Acquire knowledge on steam nozzles, steam boilers, condensers.
5. Understand the concepts of steam turbines, steam power plant and gas power plant.

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

1. explain the working principles of various mechanical components used in gas and steam power plants.
2. analyze the performance of various thermodynamic cycles and mechanical components of gas and steam power plants using thermodynamic concepts.
3. explain the concepts of combustion chamber selection, combustion phenomena and the working principles of I.C. Engines.

UNIT–I:

Air Standard Cycles: Otto cycle, Diesel cycle and its comparison; Introduction - dual combustion cycle, stirling cycle, Ericson cycle, Atkinson cycle and Lenoir cycle.
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 - Actual cycles and their significance - Time loss factor - Heat loss factor - Exhaust Blow Down - Loss Due to Gas Exchange Process - Volumetric Efficiency; comparison of Air standard and Actual cycles.

UNIT–II:

I C Engines: Classification - Four and two stroke engine-SI and CI Engines - Valve and Port Timing diagrams.
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; Fuel properties and combustion.

UNIT–III:

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, Fuel requirements and fuel rating - anti-knock additives, combustion chamber requirements - types.
Combustion in C.I. Engines: Four stages of combustion - Delay period and its importance - Effect of engine variables - Diesel Knock - Need for air movement, suction, compression and

combustion induced turbulence - open and divided combustion chambers and fuel injection, fuel requirements and fuel rating.

UNIT–IV:

Boilers: Classification - Working principles - with sketches including H.P.Boilers; Boiler Mountings and Accessories - Working principles.

Steam Nozzles: Function of nozzle - applications - 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.

Steam Condensers: Requirements of steam condensing plant; classification of condensers - working principles

UNIT–V:

Steam Turbines: Classification; Impulse turbine - Mechanical details - Velocity diagram; 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 - degree of reaction-velocity diagram - Parson's reaction turbine.

Steam power cycle: Rankine cycle.

Gas Power cycle: Brayton cycle.

Text Books:

1. I.C. Engines- V. Ganesan/ TMH/ 4Th Edition.
2. Rajput -Thermal Engineering - Lakshmi Publications – 2016 - 9th Edition.
3. Thermodynamics - Yunus A, Cengel, Michael A Boles Tata McGraw Hill 7th Edition.

Reference Books:

1. Thermal engineering- P.K.Nag/3rd Edition.
2. I.C. Engines- John B. Heywood/TMH/ 2015.

Suggested web links for additional self learning

1. https://in.mathworks.com/help/physmod/simscape/examples/brayton-cycle-gas-turbine.html
2. https://nptel.ac.in/courses/112/103/112103275/
3. https://nptel.ac.in/courses/112/103/112103262/

Suggested activity based works: Write computer program to analyze Otto cycle, Diesel cycle, Brayton cycle, Rankine cycle etc.

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20MA22001 - Computational Mathematics

B. Tech. ME – II Year, II Semester

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

Prerequisite(s): 20MA11001-Basic Engineering Mathematics

Course Objectives: Develop ability to

1. Learn the concept of interpolation, numerical differentiation and integration for a given set of data points/functions.
2. Understand and compute algebraic/transcendental, first-order ordinary differential equations with initial conditions, and curve fitting using appropriate numerical methods.
3. Distinguish between the direct and iterative methods to solve system of linear equations and approximate the largest eigen value of a given matrix.

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

1. Estimate unknown function/definite integral value through interpolation by applying appropriate numerical techniques.
2. Solve algebraic/transcendental, first-order ordinary differential equations with initial conditions using appropriate numerical methods, and compute best fit to the curve for the given data.
3. Solve a system of linear equations using direct/iterative method, compute approximate dominant eigenvalue by applying power method.

UNIT- I: Interpolation

Introduction, Errors in polynomial Interpolation, Finite Differences: Forward Differences, Backward Differences, Central Differences, Symbolic relations and separation of symbols, Difference Equation: Formation and Complimentary function.
Interpolation with equal and unequal intervals: Newton's forward and backward difference formulae, Lagrange's interpolation formula.

UNIT-II: Numerical Differentiation and Integration

Numerical differentiation: Derivatives using Newton's forward and backward interpolation formula.
Numerical integration: General quadrature formula for equidistant ordinates, Trapezoidal rule, Simpson's $1/3^{rd}$ and $3/8^{th}$ rule.

UNIT-III: Numerical Solutions of First Order Differential Equations

Numerical Solution of Ordinary Differential Equations: Taylor's series method, Picard's method of successive approximation, Single Step Methods for Linear Differential Equations: Euler's method, Euler's modified method, Runge-Kutta fourth order method.

UNIT- IV: Curve Fitting and Root Finding Methods

Fit a straight line, Second degree polynomial, Exponential curve and Power curve by method of least squares.

Solution of Algebraic and Transcendental Equations: Bisection Method, Regula-Falsi Method, Iteration Method, Newton-Raphson Method.

UNIT-V: Numerical Methods for System of Equations, Eigenvalue Problems

Solving system of linear non-homogeneous equations: L-U Decomposition method (Crout's Method), Jacobi's and Gauss-Seidel Iteration methods
Numerical computation of Eigenvalues and Eigenvectors using Power method

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, 5th Edition, 2012.
2. Advanced Engineering Mathematics, Michael Greenberg, Pearson Education, 2nd Edition, 2013.
3. Numerical Methods in Engineering & Science with Programs in C, C++ &MATLAB, B. S. Grewal, Khanna Publishers, 10th Edition, 2012.

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20ME22002-Kinematics of Machinery

B.Tech. ME – II Year, II Semester

Prerequisite(s):**20ME11001: Engineering Mechanics**
20ME12001: Mechanics and Mechanical Drives

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

Course Objectives: Develop ability to

1. Understand the kinematics and rigid-body dynamics of kinematically driven machine components.
2. Drawing velocity and acceleration diagrams for various mechanisms.
3. Understand the working of various straight-line mechanisms, steering gear mechanisms, and a Hooke's joint.
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. Analyze the motion transmission between elements using lower and higher pairs.

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

1. evaluate movability of kinematic linkages
2. Synthesize a mechanism to generate desired path (Planar mechanisms, cams, pantograph, steering gears)
3. analyse the motion of gear trains, and design gear wheels according to laws of gearing
4. analyse planar mechanisms, Hooke's joints and Cams for displacement, Velocity and acceleration

UNIT- I:

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

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

UNIT – II:

Straight-line motion mechanisms: Exact and approximate copied and generated types, Peaucellier, Hart, Scott Russel, Grasshopper, Watt, Tchebicheff's and Robert Mechanisms, Pantographs.

Steering gears: Conditions for correct steering - Davis Steering gear, Ackerman's steering gear

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

UNIT – III:

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

Plane motion of body: Instantaneous center of rotation-centrodes and axodes-Three centers in line theorem-Graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method.
Klien's construction- Corioli's acceleration - determination of Corioli's component of acceleration
Analysis of Mechanism: Analysis of slider crank chain for displacement – velocity and acceleration of slider-Acceleration diagrams for a given mechanism.

UNIT – IV:

Cams: 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 of 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, condition for constant velocity ratio for transmission of motion-velocity of sliding. Forms of teeth, cycloidal and involute profiles-Phenomena of interferences – Methods of interference, condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact of Pinion and Gear and Pinion and Rack Arrangements-Introduction to Helical-Bevel and worm gearing
Gear Trains: Gear trains–simple and compound, reverted and epicyclic gear trains. Differential of an Automobile

Text Books:

1. Theory of Machines, S. S. Rattan, Tata McGraw Hill Publishers, 2014.
2. Theory of Machines, Thomas Bevan, CBS Publishers, 2009.

Reference Books:

1. Theory of Machines, P.L. Ballaney, Khanna Publishers, 1965.
2. Theory of Machines, Sadhu Singh, Pearson Education, 2006.
3. Theory of machines, R. S. Khurmi, J. K. Gupta, S. Chand Pub, New Delhi, 2010.

Suggested web links for additional self learning

1. http://ocw.metu.edu.tr/pluginfile.php/3960/mod_resource/content/1/ch7/7-1.htm
2. http://ocw.metu.edu.tr/pluginfile.php/3961/mod_resource/content/2/ch3/3-7.htm

Suggested activity based works

1. To find factor of safety by calculating all the forces occurring on the vehicle or any other part.
2. To calculate the degree of freedom, so that we can calculate that in which direction the motion is possible and which direction motion is restricted.
3. Robotics mechanism is based in the kinematics of machine specially study of link and pair.

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20ME22003 - Manufacturing Technology

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

B.Tech. ME - II Year, II Semester

Prerequisite(s): **Workshop Technology,**

Course Objectives: Develop ability to

1. Impart knowledge on selection of suitable manufacturing process for the typical component

Course Outcomes: At the end of this session, the student will be able to:

1. illustrate conventional manufacturing methods with their principles of operation.
2. explain the principles of casting, metal forming and metal joining processes for the selection of suitable manufacturing process.
3. analyze cold working/ hot working processes, press tool operations, fusion/pressure welding and machining processes for product-based adaptability.
4. explain theory of metal cutting and machine tools for their applications in manufacturing industry.

UNIT-I:

Introduction to manufacturing technology – importance – classifications and selection of manufacturing processes.

Metal Casting: Introduction to casting – Advantages – Limitations – Applications, Steps involved in casting; Patterns –types – materials – Allowances; Molding materials and additives, cores, core prints, chaplets, elements of gating system, gating system design.

Advanced Casting Processes: Process, advantages, limitations and applications of shell molding, precession investment casting, die casting, centrifugal casting, continuous casting, Stir Casting and Slush Casting, Defects in casting, causes and remedies.

UNIT-II:

Metal Forming: Plastic Deformation and yield criteria; fundamentals of hot and cold working processes.

Rolling: Principle, rolling stand arrangement, rolling passes, rolling defects.

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

Extrusion: Principle, Hot and Cold extrusion, forward and backward extrusion, impact extrusion, hydrostatic extrusion.

Drawing: Wire, and Tube drawing,

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

UNIT-III:

Metal Joining: Introduction, classification, Gas welding, - principle, equipment. Arc Welding- Procedure, capabilities, limitations and applications of MMAW, GTAW, GMAW, SAW, PAW. Resistance welding- types.

Advanced Joining Processes: Electron beam welding, Laser beam welding, Ultrasonic welding, and friction stir welding.
Brazing, soldering, welding defects, causes and remedies

UNIT-IV:

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-V:

Machine Tools: Principle of working, specifications, classifications, operations performed on Lathe machine, Milling machine, Drilling machine, Grinding machines.
Lapping, Honing and Broaching operations

Text Books:

1. Manufacturing Technology, P. N. Rao, Vol -1 & 2, 3rd edition, Tata McGraw- Hill education (P) Ltd, and New Delhi
2. Manufacturing Engineering and Technology by Serope Kalpakjian, Steven R. Schmid 6th edition, Pearson Publication.

Reference Books:

1. Production Technology, R. K. Jain (2010), 16th edition, Khanna publishers, New Delhi, India.
2. Manufacturing science, Ghosh and Mallik (2004), Affiliated East-west press (p) Ltd, New Delhi, India
3. Fundamentals of Modern Manufacturing by Groover Edition 4th Wiley Publications
4. Bhattacharya A and Sen. G. C, Principles of Machine Tools, New Central Book Agency.
5. A Course in Workshop Technology Vol II by B S Raghuvanshi, Dhanapat Rai and Co. Publishers

Suggested web links for additional self learning:

1. https://nptel.ac.in/courses/112/107/112107215/
2. https://nptel.ac.in/courses/112/107/112107250/

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20CE22061 - Building Technology

(Open Elective-I)

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

B Tech. ME - II Year, II Semester

Pre-requisite: 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

1. Explain characteristics of building materials.
2. Describe the types of buildings, building by-laws and prefabrication systems in buildings.
3. Describe ventilation, lighting, acoustics and plumbing services for a building.
4. Explain the repairs, fire protection measures and vertical transportation for a building.

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 Hall of India Learning Pvt. Ltd., 2015.
2. Building Construction, B.C.Punmia, Ashok Kumar Jain and 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.

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20EE22062 - Industrial Safety and Hazards

(Open Elective-I)

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

B Tech. ME - II Year, II Semester

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 or 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

1. Apply risk management principles to anticipate, identify, evaluate and control physical, chemical, biological and electrical hazards.
2. Apply the methods of prevention of fire and explosions.
3. Analyze the effect of release of toxic substances.
4. Interpret and apply legislative requirements, industry standards, and best practices in a variety of workplaces.

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, vapours, 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 Book:

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

Reference Books:

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

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20EC22064 - Electronic Measuring Instruments

(Open Elective-I)

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

B Tech. ME - II Year, II Semester

Pre-requisite: None
Prerequisite: Nil
Note: No detailed mathematical treatment is required for this course.

Course Objectives: Develop ability to

1. It provides an understanding of various measuring systems functioning and metrics for performance analysis.
2. Provides understanding of principle of operation, working of different electronic instruments viz. signal generators, signal analyzers, recorders and measuring equipment.
3. Provides understanding of use of various measuring techniques for measurement of different physical parameters using different classes of transducers.

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

1. **Analyze** static and dynamic characteristics of measuring systems.
2. **Illustrate** the functionality of various signal generators.
3. **Explain** the operations of various DC and AC measuring instruments.
4. **Illustrate** the working principles of various recording instruments.

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.

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20CS22065 - Web 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 web programming
2. Use HTML language to design web pages
3. Use CSS to for designing interfaces
4. Understand Java Script programs
5. Use XML and PHP as back end and server side technologies

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

1. Design static webpages with HTML and CSS.
2. Implement client side scripts using Java Script.
3. Prepare and parse XML schemas.
4. Implement and deploy server side programs using PHP

UNIT-I:

Introduction – HTML, XML, and the World Wide Web. Protocols, IP and TCP, HTTP, CGI HTML – Basic HTML, The Document Body, Text, Hyperlinks, Lists, Using color and images, Images, More HTML – Tables, Frames, Forms.

UNIT-II:

CSS – Introduction, Using Styles, Defining your own styles, Properties and Values in styles, Formatting blocks of Information.

UNIT-III:

JavaScript – Basics, Variables, String manipulation, Mathematical functions, Statements, Operators, Arrays, Functions, Objects in Java Script – Data and Objects in JavaScript, Regular Expressions, Built – in Objects, Events

UNIT-IV:

XML – Basic XML, Document Type Definition, XML Schema

UNIT-V:

PHP – Introduction, Data Types, Program Control, Arrays, User-defined Functions, Built-in Functions, Using Files, Building web applications using PHP

Text Book:

1. Web Programming: Building Internet Applications, 3rd Edition, Chris Bates

Reference Books:

1. Programming the World Wide Web, 4th edition, Robert W Sebesta
2. Web Technologies, Uttam K Roy, Oxford University Press

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20MB22066 - Intellectual Property Rights
(Open Elective-I)

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

B Tech. ME - II Year, II Semester

Prerequisite(s): 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

1. Define the fundamental concepts of IPR and distinguish between patents, copyrights, trademarks, and trade secrets.
2. Distinguish between fundamental laws of copyright, patents, and trademark.
3. Explain the registration process of IPR.
4. Evaluate unfair competition practices in business.
5. Justify the need for IPR and IP Audits to protect business secrets.
6. Evaluate the national and international developments in IPR.

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.

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20ME22L01 - Thermal Engineering LAB

B Tech. ME - II Year, II Semester

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

Pre-requisite: None

Course objectives:

1. To understand the working principles of IC Engines, Compressors, Steam boilers.

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

1. devise plan of experimentation encompassing process variables identification, preparatory sketches, and methodology
2. conduct the experiment to i) evaluate the performance of IC engines and Air Compressor, ii) prepare the heat balance sheet of an IC engine and iii) calculate frictional horse power of an IC engine
3. perform model calculations, present the results and compare the results with available standard values
4. explain components of IC engines and boilers.
5. demonstrate the experimental learning through presentation/ project submission.

Any 10 experiments compulsory

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

Additional experiments:

1. Mechanical efficiency of reciprocating air compressor.
2. Performance test on Multi - Cylinder 4-stroke SI Engine.

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20MA22L01 - Computational Mathematics Lab

B. Tech. ME - II Year, II-Sem

Prerequisite(s): 20CS11L01 Programming for Problem Solving-I Lab

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

Course Objectives: Develop ability to

1. Understand the basic concepts of numerical methods and write a C program that implements a simple numerical algorithm.
2. Learn the necessary skills and analytical ability to write computer-based solutions using mathematical concepts.
3. Implement the numerical methods in computer programming using 'C' language.
4. Learn the accurate and efficient use of specific computational mathematics techniques.

Course Outcomes: At the end of the course, student would be able to develop and execute a 'C' program to:

1. Estimate unknown function values from a given set of equal/unequal data points by using Forward, Backward and Lagrange's interpolation method.
2. Find the area using numerical integration techniques, namely, Trapezoidal and Simpson's rule.
3. Compute first-order ordinary differential equations with initial conditions and a system of linear equations by using Modified Euler's, Runge–Kutta, L-U Decomposition, Jacobi, and Gauss- Siedel methods.
4. Find the real root of given algebraic/transcendental equations by using Newton Raphson, Bisection method, and dominant eigenvalue by using the Power method.

List of Programmes:

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 Newton's backward interpolation method).
3. Program to determine y for a given x, if two arrays of x and y of same size are given (using Lagrange's interpolation).
4. Program to evaluate definite integral using trapezoidal rule, Simpson's $1/3^{rd}$ rule and $3/8^{th}$ rule.
5. Program to solve a given first order ordinary differential equation with initial condition using Runge-Kutta fourth order method.
6. Program to solve a given first order ordinary differential equation with initial condition using Modified Euler's method.
7. Program to find the root of algebraic / transcendental equation by using Bisection method and Newton-Raphson method.
8. Program to find the solution of given system of linear non-homogeneous equations using L-U decomposition method.

9. Program to find the solution of given system of linear non-homogeneous equations using Gauss-Seidel iteration method.
10. Program to compute largest eigenvalue and eigenvectors of a given matrix using Power method.

Additional Programmes:

1. Program to find the solution of given system of linear non-homogeneous equations using Gauss Jordan elimination method.
2. Program to find the best fit of straight-line ($y = a + bx$) for the given data by the Method of Least squares.
3. Program to find a root of an algebraic/transcendental equation by using Regula-Falsi Method.

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20ME22L02 - Machine Drawing with AutoCAD Lab

B.Tech. ME - II Year, II Semester

Prerequisite(s):

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

Course Objectives:

1. To introduce students to the basics and standards of engineering drawing related to machines and components.
2. To teach students technical skills regarding assembly, production and part drawings.
3. To help students gain knowledge about standard CAD packages on modeling and drafting.
4. To familiarize students with various limits, fits and tolerances
5. To enable user to create 3D model based on the dimension or conceptual modeling.

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

1. illustrate dimensioning, specifications, conventions and principles of orthographic projections using CAD software.
2. apply CAD tools to draw geometric shapes, engineering curves and orthographic projections.
3. develop assembly drawings in reduced lead times with accuracy using CAD tools.

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

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.

Principles of drawing, free hand sketching, manual drawing, CAD drawing etc Code of practice for Engineering Drawing, BIS specifications sectional views, Welding symbols, riveted joints, keys, fasteners –bolts, nuts, screws, keys etc Limits, Fits–Tolerances of individual dimensions–Specification of Fits–basic principles of geometric and dimensional tolerances.

Name of the Experiment

1. Introduction to CAD
2. Draw riveted joint as per given standards and convert it in 3D.
3. Draw welded joint as per given standards and convert it in 3D.
4. Draw bolted joint as per given standards and convert it in 3D.
5. Draw components of the knuckle joint as per given figure and assemble them.
6. Draw components of the cotter joint as per given figure and assemble them.

7. Generate orthographic views and apply Geometrical Dimension and Tolerances for final assembly of knuckle joint
8. Generate orthographic views and apply Geometrical Dimension and Tolerances for final assembly of Cotter joint.
9. Drawing of Keys, Cotters And Pins in Temporary Joints
10. Apply Geometrical Dimension and Tolerances for welded joints and riveted joints.

Text Books:

1. N. D. Bhatt and V.M. Panchal, Machine Drawing, Charotar Publishing House,2014
2. K C John, Machine Drawing, PHI,2009
3. P I Vargheese and K C John, Machine Drawing, VIP Publishers,2011
4. K. L. Narayana, P.Kannaiah & K. Venkata Reddy, Machine Drawing, New Age Publishers,2009
5. Ajeet Singh, Machine Drawing Includes AutoCAD, Tata McGraw-hill,2012
6. P S Gill, Machine Drawing, Kataria & Sons, 2009

Suggested web links for additional self learning

1. http://www.cadmaxx.com/free-online-course-nx-cad/
2. https://www.lynda.com/NX-tutorials/574011-0.html/

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20ME22L03 - Manufacturing Technology LAB

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

B.Tech. ME - II Year, II-Sem

Prerequisite(s): **20ME11L01 - Engineering Workshop**

Course Objectives: Develop ability to

1. To familiarize the students with the basic tools and equipment used in manufacturing
2. To impart practical knowledge on various aspects of manufacturing processes

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

1. devise plan of experimentation encompassing process variables identification, preparatory sketches, and methodology
2. conduct the experiment to i) Demonstrate applications of machining, welding, casting, and plastic moulding to obtain an end product, ii) identify the sequence of machining operations
3. compare the end product with part drawings and conclude upon the deviations, if any
4. substantiate the suitability of chosen manufacturing process.
5. demonstrate the experimental learning through presentation/ project submission.

Note: Students should perform at least 4 experiments from each section of manufacturing process

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 and Casting**.**

II. Metal Joining

1. Manual Metal Arc Welding (MMAW) - Preparation of Lap and Butt Joint.
2. Gas Metal Arc Welding - practice.
3. Gas Tungsten Arc Welding (GTAW) - practice.
4. Resistance Welding - Spot welding.
5. Gas Welding. - Practice
6. Plasma Welding and Cutting**.**

III. Metal Forming

1. Study of simple, compound and progressive dies
2. Blanking and piercing using fly press.
3. Bending and Deep drawing using Hydraulic press.
4. Deep drawing using Hydraulic press.
5. Making of bottle cap using Injection moulding.
6. Making of bottle using blow moulding.

IV. Machining Process

1. Step turning and taper turning on lathe machine.
2. Thread cutting and knurling on -lathe machine.
3. Drilling and Taping.
4. Shaping and Slotting
5. Milling
6. Cylindrical and Surface Grinding**.**

Text Books:

1. S. Kalpakjian and S.R. Schmid, Manufacturing Engineering and Technology, Pearson Education, 6th Edition, 2009
2. A. Ghosh, and A.K. Malik, Manufacturing Science, Affiliated East West Press Pvt. Ltd., 2nd Edition, 2010.

Reference Books:

1. P.C. Sharma, A text book of Production Technology, S. Chand and Company, 4th Edition, 2006
2. R.K. Jain, Production Technology: Manufacturing Processes, Technology and Automation", Khanna Publishers, 17th Edition, 2011
3. P.N. Rao, Manufacturing Technology Volume-1, Tata McGraw-Hill Education, 4th Edition, 2013

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20EN22P01 - English for Career Development*

B.Tech. ME - II Year, II-Sem

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

Prerequisite(s): **NIL**

Course objectives: Develop ability to

1. Understand the importance of vocabulary to be used in different situations.
2. Read, comprehend and summarize the given text.
3. Articulate in different socio-cultural contexts both oral and written.

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

1. Use appropriate collocations, connotations and prepositional phrases in any given text.
2. Predict the flow of information in a given text and draw inferences.
3. Articulate views, ideas and events in various contexts both oral and written.

Module-I

Must have words/Word power

Vocabulary: Collocations: noun and noun, noun and verb, noun and adverb, noun and adjective, prepositional phrases-connotative words.

Module-II

Cognitive Reading

Reading: Reading comprehension: rapid reading (vertical reading), meta-cognition, cloze tests, paragraph jumbles.

Module-III

Advanced Articulation

Speaking: Narrating: techniques, events, experiences, stories. Interactive speaking: Contextual Vocabulary and Oral presentations.

Module-IV

Essentials of composition

Writing: Picture interpretation: analyzing and expressing in either oral or written form. Sentences out of context, summarizing, Essay (Analytical, argumentative and exploratory) writing practice.

Text Books:

1. Wilfred J. Funk, Six Weeks to Words of Power, Binny Publishing House.
2. Sue Gilbert, The Essentials of Grammar and Composition, Oxford University Press.

Reference Books:

1. Inc. Bar Charts, English Composition & Style, Inc. Bar Charts, 2009-11-30
2.K.Buehler Huber Gray, *Practical Exercises in English*, Project Gutenberg, www.gutenberg.net

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B.Tech (ME)
III Year I Semester
Detailed Syllabus

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20ME31001- Mechanical Measurements and Instrumentation

B. Tech, ME-III Year I Semester

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

Pre-requisites: Nil

Course Objectives: This course covers

1. The basic characteristic of a typical measuring instrument
2. To develop the concepts of various measurement systems & standards with regards to realistic applications.

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

1. explain standards of measurement, methods of measurement, measurement parameters and errors in measurement.
2. Illustrate tolerance, fits, types of gauges and their design.
3. explain the methods and devices for measurement of angle, gear thread parameters, Screw thread parameters, surface roughness, straightness and squareness of a given object
4. describe the functioning of transducers and measuring devices for the measurement of force, torque, pressure, displacement, strain and temperature.

UNIT-I:

Introduction to Metrology: Definition, objectives of metrology, Material Standards, Wavelength Standards, Classification of standards, Line and End standards, Calibration of End bars. Numerical examples

Liner measurement and angular measurements: Slip gauges-Indian standards on slip gauges, Adjustable slip gauges, Wringing of slip gauges, Problems on building of slip gauges, Measurement of angle-sine bar, Sine centre, Angle gauges, Optical instruments for angular measurements. Autocollimator-Applications for measuring straightness and squareness

UNIT-II:

System of Limits, Fits, Tolerance and Gauging: Definitions, Tolerance, Tolerance analysis (addition & subtraction of tolerances) Inter changeability & Selective assembly; Class &grade of tolerance, Fits, Types of fits, Numerical on limits, fit and tolerance; Hole base system & shaft base system. Taylor's principle, Types of limit gauges, Numerical on limit gauge design

UNIT-III:

Measurement of screw thread profile: Terminology of screw threads, Measurement of major diameter, Minor diameter, Pitch, Angle and Effective diameter of screw threads by 2- wire and 3-wire methods, Best size wire. Screw thread gauges, Toolmaker's microscope.

Gear tooth Measurements: Tooth thickness measurement using constant chord method, Addendum, Comparator method and Base tangent method, Measurement of pitch, Concentricity, Run out and Involute profile. Gear roll tester for composite error.

UNIT-IV:

Generalized measurement system: Definition, Significance of measurement, Generalized measurement system, Static characteristics- Accuracy, Precision, Calibration, Threshold,

Sensitivity, Hysteresis, Repeatability, Linearity, Loading effect, Dynamic characteristics- System response, Time delay. Errors in measurement, Classification of errors

Transducers: Transfer efficiency, Primary and Secondary transducers, Electrical transducers, Mechanical

UNIT-V:

Mechanical measurements: Measurement of force, Torque, Pressure, Types of Dynamometers, Absorption dynamometer, Prony brake and Rope brake dynamometer, and Power Measuring Instruments. Use of elastic members, Bridgeman gauge, McLeod gauge, Pirani gauge

Measurement of strain and temperature: Theory of strain gauges, Types, Electrical resistance strain gauge, Preparation and mounting of Strain gauges, Gauge factor, Methods of strain measurement, temperature compensation, Resistance thermometers, Thermocouple, Law of thermocouple, Pyrometer, Optical pyrometer.

Textbooks:

1. Instrumentation, Measurement and Analysis B C Nakra, K K Chaudhry Mc Graw–Hill 4th Edition
2. Engineering Metrology R.K. Jain Khanna Publishers 2009

Reference Books:

1. Instrumentation and Control systems, S. Bhaskar, Anuradha Agencies
2. Mechanical and industrial Measurements, R.K Jain, Khanna Publishers
3. Metrology & Measurement, Anand K Bewoor, Vinay A Kulkarni, McGraw-Hill, 2009

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20ME31002 - Dynamics of Machinery

B Tech, ME- III Year I Semester

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

Prerequisites: 20ME11001-Engineering Mechanics
20ME12001-Mechanics and Mechanical Drives

Course Objectives: This course covers

1. Motion, forces and torques involved in different machine members.
2. Dynamic behaviour and principle of operation of flywheels and governors
3. Awareness on speed fluctuations, rotor imbalance and machine vibration in mechanical systems.

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

1. analyse machine components for static forces, dynamic forces, centrifugal forces, gyroscopic couples, inertia and vibrations
2. design governors and flywheels to regulate speed fluctuations
3. analyse machines, steam engines and IC engines, to mitigate unwanted/ unbalanced forces/couples and vibrations

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); Dynamic force Analysis - D'Alembert's principle, forces in 4-bar mechanism, Slider Crank Mechanism.

UNIT - III:

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, isochronism and hunting

UNIT - IV:

Balancing: Balancing of rotating masses- Static and Dynamic balancing;
Balancing of Reciprocating masses - Primary and secondary balancing of reciprocating masses (Analytical and graphical methods), Examination of "V", multi cylinder inline and radial engines for primary and secondary balancing

UNIT - V:

Free vibrations: Concepts of vibrations, 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.

Damped Vibrations: 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. Setov, 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 Grover, Nem Chand and Bros.
4. Theory of Vibrations with Applications, William T Thomson, Pearson, 5th edition

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20MA31001- Statistics for Machine Learning

(Common to CSE-DS, CSE-CS, CSE-AIML, EEE & ME)

B. Tech. ME-III Year, I Semester
Prerequisites(s): None

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

Course Objectives:

Develop ability to

1. Understand different types of random variables and their distributions.
2. Estimate the minimum proportion of observations that fall within a specified value; Solve counting problems using generating functions.
3. Estimate the population parameter from a sample and identify the different types of Testing of hypothesis.
4. Classify the linear and logistic regression.
5. Observe the closest point of the lines from both the classes. Learn the concept of PCA.

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

1. Apply the basics of probability to calculate posterior probabilities, distributions, boundary limits and generate random numbers.
2. Estimate the population parameter and test its significance level by using various test statistics.
3. Predict the response variable and test the significance of the parameters for Multiple Linear Regression (MLR) or Logistic Regression (LR) or both.
4. Reduce the given high dimensional data sets by applying Principal Component Analysis (PCA) or classification techniques using K-means clustering, Support Vector Machine (SVM).

UNIT-I:

Basics of Probability Theory, Baye's Theorem; Random Variables (Discrete and Continuous); Probability Distribution of RV, Expectation, Variance (Binomial, Poisson, Uniform, Normal and Exponential)

Unit-II:

Chebyshev's and Markov inequalities, Law of Large Numbers and Central Limit Theorem.
Data simulations in parametric setup: Random Number Generation A. Discrete RVs (Binomial, Poisson and Uniform) (b) Continuous RVs (Normal and Exponential). Acceptance/ Rejection algorithm

UNIT-III: Parameter Estimation

Estimation of Model Parameters (Maximum Likelihood Estimation and Method of Moments), Confidence Interval (CI) Estimation, Bayesian Estimation and CI
Testing of Hypothesis: Z-test, t-test, Chi square-test and F-test (concept of p-value).

UNIT-IV: Linear / Non-linear models

Multiple Linear Regression: Multiple Regression Models, Hypothesis Test for Significance of regressors, Logistic Regression: Models with a Binary Response Variable, Estimating the Parameters in a Logistic Regression Model, Interpretation of the Parameters in a Logistic Regression Model; Classification and Density Estimation.

UNIT V:

Classification (SVM), Clustering (K-means) and Dimension Reduction (PCA)
Kernel Methods: Mercer's Kernels, Kernel Classification, Kernel PCA.

Text Books:

1. Probability and Statistics for Engineers and Scientists by Sheldon Ross, Academic Press, 5th Edition, 2014.
2. Introduction to Statistical Machine Learning, Masashi Sugiyama, Book Aid International, 2016.

Reference books:

1. Probability for Statistics and Machine Learning: Fundamentals and Advanced Topics by Anirban Das Gupta, Springer 2011.
2. Statistical Inference by George Casella and Roger L. Berger, Thomson Learning, 2002.
3. An Introduction to Statistical Learning with Applications in R by James, G., Witten, D., Hastie, T., Tibshirani, R. Springer 2013.
4. Introduction to Linear Regression Analysis, Fifth Edition by Douglas C. Montgomery, Elizabeth A. Peck, G. Geoffrey Vining, Wiley series in Probability and Statistics 2012.

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20ME31003-Design of Machine Elements-I

Note: Design data handbook is not permitted in examination

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

B. Tech, ME-III Year I Semester
Prerequisites:20ME11001-Engineering Mechanics

20ME12001-Mechanics and Mechanical Drives

20ME21001-Materials Technology

20ME21002-Mechanics of solids

Course Objectives: This Course covers

1. Application of fundamental knowledge of materials and mechanics.
2. Design a mechanical system, or its components to meet desired needs.

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

1. demonstrate materials selection, design considerations and design standards for the suitable design of a machine component.
2. apply theories of elastic failure(ToEF), theories of fatigue failure(ToFF) to design machine components for safe functional operation.
3. design and analyze machine components according to industry standards for a desired application.
4. evaluate the developed design to ensure the safety, reliability and manufacturing flexibility.

UNIT-I:

Introduction: General considerations in the design of Engineering Materials and their properties, Selection, Manufacturing consideration in design; Tolerances and fits, BIS codes of steels; The concept of stiffness in tension, Bending, Torsion and combined loading

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, Modified Goodman's line, Soderberg's line

UNIT-II:

Riveted joints: Methods of failure of riveted joints-strength equations-efficiency of riveted 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

UNIT-III:

Design of keys, Shafts and shaft couplings: Design of shafts, Shaft sizes, BIS codes;
Design of couplings: Rigid couplings - Muff, Split muff and Flange couplings; Flexible Couplings – Bushed pin couplings; Design of keys

Axially Loaded Joints: Cotter joints, Spigot and socket, Sleeve and cotter, Jib and cotter joints, Knuckle joints

UNIT –IV:

Design of Cylinders and Pressure Vessels: Thin cylinders, Thick cylinders - Lame's equation, Clavarino's and Birnie's equations; Cylinders with external Pressure; Gaskets, Unfired pressure vessels, Thickness of cylindrical and spherical shells

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

Text Books:

1. Design of Machine Elements, V.B.Bhandari, Tata McGraw hill, 2nd Ed 2007
2. Machine Design, Pandya and shah, Charotar publishing house Pvt Ltd, 19th Ed, 2014

Reference Books:

1. Maleev and Hartman's Machine Design, O P Grover, CBS Publications
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

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20MA31L01 Statistics for Machine Learning Lab

B. Tech. ME-III Year, I Semester

L	T	P/D	C
-	-	2	1

Prerequisite(s): None

Course Objectives:

Develop ability to

1. Understand the basic concepts of R-programming. Learn descriptive statistics and data types in R -programming. Describes the shape, centre, and spread of sampling distributions of sample statistics.
2. Recognize the logic and framework of the inference of hypothesis testing.
3. Use regression analysis to predict the value of a dependent variable based on an independent variable.
4. Learn the concept SVM and Kernel methods.

Course Outcomes:

At the end of the course, student would be able to use R software to:

1. Construct frequency distribution for the given data.
2. Obtain specified set of samples from large data through random variables using Acceptance-Rejection (AR) algorithm.
3. Estimate and test the significance of the specified population parameter(s) for the given data.
4. Reduce the dimensionality of large data sets using Principal Component Analysis (PCA), Logistic Regression (LR), K-means clustering and Support Vector Machine (SVM) for selecting variables.

List of Experiments:

1. Introduction to R Programming
2. Introduction to descriptive statistics using R (Frequency Distribution and Cumulative Distribution Function)
3. Acceptance/Rejection Sampling in R
4. Maximum likelihood and method of moments estimation. Testing of Hypothesis based on Z-test. Concept of p-value in R
5. Testing of hypothesis based on t-test, chi-square test and F-test. Confidence interval estimation in R
6. Multiple linear regression: Outlier analysis, residual analysis, test for normality, multi-collinearity in R
7. Logistic Regression in R
8. Classification with SVM in R
9. Dimensionality reduction with PCA in R and K-means Clustering in R
10. Kernal PCA and Kernal SVM in R

List of Additional programs

1. Generating Functions (Binomial, Poisson, Uniform, Normal and Exponential) using R programming
2. Multiple linear regression: Testing overall hypothesis and testing significance of individual variables, model selections and prediction in R programming.

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20ME31L01 - Kinematics and Dynamics Lab

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

B Tech, ME- III Year I Semester

Prerequisite(s): 20ME22002-Kinematics of Machinery
20ME31002-Dynamics of Machinery

Course Objectives: This course covers

1. Basic principles of motion and inertia
2. Formation and functioning of various mechanisms
3. Concepts of static and dynamic balancing
4. Evaluation of vibrating systems for stability concepts

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

1. devise plan of experimentation encompassing process variables identification, preparatory sketches, and methodology
2. identify links, kinematic pairs, mechanisms and their movability
3. conduct the experiment to i) calculate motion/power transmission capability of belt drives, gear trains, and cams ii) find inertia, momentum, force, and torque in gyroscope iii) evaluate unbalanced force and vibrations using dynamic equilibrium
4. substantiate movability and dynamic equilibrium of machine parts
5. demonstrate the experimental learning through presentation/ project submission.

List of Experiments

1. Study of various types of kinematic links, pairs, chains and mechanisms
2. Study of various kinds of belt drives
3. Study of various types of Cams and Followers
4. Study of different types of Gears
5. Study of 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. Determination of coefficient of friction between a belt and pulley

Note: Student will perform any ten experiments out of the above

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20EN31L01 Professional Communication Skills Lab

(PCS Lab)

B Tech, ME- III Year I Semester

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

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 effectively orally and in written form

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

1. Use acquired vocabulary from etymology in different contexts
2. Demonstrate self-management, interpersonal skills and group discussion skills
3. Interpret and infer from the given text employing different reading techniques
4. Prepare diverse documents for various purposes

Module-I:

Activities on Fundamentals of Inter-Personal Communication: Responding appropriately and relevantly using the right body language, discourse skills. Resilience and Personal Management-Managing stress, time, anger and other emotions, assertiveness and culture shock.

Module-II:

Activities on Reading Skills: Reading for facts, reading for specific information, reading between the lines, negative facts, inferential reading, critical reading.

Module-III:

Activities on Writing Skills: Writing process, gather information, analyzing the content, formatting, editing, Resume writing and CV preparation, writing SOP, letter writing and email writing and Video Resume or Visume'.

Module-IV:

Activities on Presentation Skills: Oral Presentations (individual & group), seminars, ppts and written presentations through posters, projects, portfolio building or management, brochures and reports.

Module-V:

Activities on Group Discussion and Interview Skills: Dynamics of Group Discussion-Videos of Mock GDs-intervention, summarizing, body language, relevance and organization of ideas and rubrics for evaluation. Three stages of Interviews-pre, during and post interview planning, opening strategies, answering strategies, interview through Tele-Conference and Video Conference and Mock Interviews, Videos of Mock Interviews, H.R questions, SJT questions.

TEXT BOOKS:

1. PCS Lab Manual prepared by the Faculty of English, Freshman Engineering Department.
2. David A. McMurrey& Joanne Buckley: Handbook for Technical Communication, Cengage Learning Pvt. Ltd., New Delhi, 2012.

REFERENCE BOOKS:

1. Paul V. Anderson: Technical Communication, Cengage Learning Pvt. Ltd., New Delhi, 2007.
2. O'Connor Tamara, Generic Skills Integration Project (GENSIP)Interpersonal Skills Module Exercises & Handouts, University of Dublin, Trinity College, 2003.

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20MA31P01 – Logical Reasoning-I

B. Tech, ME- III Year I Semester

L	T	P/D	C
0	0	4	2

Prerequisite(s): None

Course Objectives: Develop ability to

1. Distinguish between simple and compound interest and demonstrate how to determine each; Evaluate profit/loss for the given various price related problems; Understand the importance of percentage, ratio and proportions while solve the problems in different scenarios.
2. Evaluate the average by various methods; Understand the concepts of speed, distance and time, solve the related problems; Understand the concepts of work done in a given period of time in various contexts.
3. Understand the statements and their connectives; Identify the validity of conclusions drawn from the given statements and identify strong/weak arguments from a given statement; Determine various Analogies to identify the similarities of the objects.
4. Understand the various concepts of Non-Verbal reasoning; Create awareness on blood relations and solve the related problems; Understand the concepts of binary logic and solve the analytical problems.

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

1. Interpret the validity conclusion from arguments and / or statements.
2. Develop strategies to find solutions and persevere in solving them.
3. Perform advance tricky approaches for solving reasoning and aptitude problems.

Quantitative Aptitude:

1. **Simple Interest**: Definitions, Problems on interest and amount, Problems when rate of interest and time period are numerically equal. **Compound Interest:** Definition and formula for amount in compound interest, Difference between simple interest and compound interest for 2 years on the same principle and time period

2. Profit & Loss:

Cost price, selling price, marked/list price, profit/gain, discount, use of false scale for selling an article, discount series and net selling price, successive Selling.

3. Percentages, Ratio & Proportions:

Calculating a percentage, calculating increase or decrease, calculating percent change, calculating successive percentages, definition of ratio and proportions, direct proportion, Inverse or reciprocal proportion, continued proportion, Mean proportion, Third proportion, Fourth proportion, compound ratio

4. Averages:

Definition of Average, Rules of Average, Problems on Average, Problems on Weighted Average, finding average using assumed mean method**.**

5. Time and Distance:

Relation between speed, distance and time, converting km/h into m/s and vice versa, Problems on average speed, Problems on relative speed, Problemson trains.

6. Time and Work:

Problems on Unitary method, Relation between Men, Days, Hours and Work, Problems on Man-Day-Hour's method, Problems on alternate days, Problems on Pipes and Cisterns.

Logical Reasoning:

7. Logical Connectives:

Definition of simple statement, Definition of compound statement, finding the implications for compound statements, finding the negations forcompound statements.

8. Syllogism:

Definition of statement/premises and conclusion, explanation through Venn diagram, problems on two/three statements and one/two conclusions, identification of statements and conclusions from the given set of statements. **Statements and Arguments**: Types of arguments, Strong argument, weak argument, identifying strong/weak arguments from a given statement.

9. Analogy Classifications:

Definition of Analogy, Problems on number analogy, Problems on letter analogy, Problems on verbal analogy.

10. Non-Verbal Reasoning:

Identification of continued figure or odd figure by using analogy, series, rotation in clockwise and rotation in anticlockwise, vertical, horizontal, alternative rotation, addition, subtraction.

11. Blood Relations:

Blood relations on Family Tree concepts (relationships in the family), paternal side relations, maternal side relations, simple and direct relationships, relation puzzles, coded relations.

12. Binary Logic:

Definition of a truth-teller, Definition of a liar, Definition of analternator, solving problems using method of assumptions, solving analytical puzzles using binary logic.

Text Books:

1. A modern approach to Logical reasoning, R S Agarwal, S. Chand Publications, 2013.
2. Quantitative Aptitude for Competitive Examinations, Dinesh Khattar, Pearson Education, 4th Edition, 2019.

Reference Books:

1. Quantitative Aptitude and Reasoning, R. V. Praveen, PHI Learning Private Ltd, 2nd Edition, 2013.
2. Quantitative Aptitude for competitive examinations, AbhijithGuha, McGraw HillEducation, 6th Edition, 2017.
3. Analytical & Logical Reasoning, Peeyush Bhardwaj, Arihant Publications, 4th Edition,2015.
4. Logical Reasoning for the CAT, Arun Sharma, McGraw Hill Education, 2nd Edition2014.

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20EC31P01 – Internship

B. Tech. ME- III Year I Sem.

L	T	P/D	C
-	-	-	2

Prerequisites: None

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 about four weeks. The Work carried out during Internship shall be submitted in the form of a report, 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 or his nominee, 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.

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

CO1. **Research** independently in collecting the required information through various resources during the course of internship.
CO2. **Apply** knowledge of basic sciences, mathematics and engineering for real life applications.
CO3. **Present** the skills acquired during the internship in an effective manner**.**
CO4. **Demonstrate** the writing skills in the preparation of report.
CO5. **Exhibit** critical and analytical thinking skills acquired during the internship.

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20CS31M02-Introduction to Artificial Intelligence

(Mandatory Course)

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

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

Course Objectives: To train the students to understand different types of AI agents, various AI search algorithms, fundamentals of knowledge representation, building of simple knowledge-based systems and to apply knowledge representation, reasoning. Study of Markov Models enable the student ready to step into applied AI.

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

1. Apply search techniques to given problem instances.
2. Use basic and advanced search techniques for a given problem
3. Explain various basic and advanced knowledge representation and reasoning techniques.
4. Explain different types of learning mechanisms
5. Explain domain knowledge acquisition and representation in building an expert system.

UNIT - I:

Introduction: AI problems, Agents and Environments, Structure of Agents, Problem Solving Agents **Basic Search Strategies**: Problem Spaces, Uninformed Search (Breadth-First, Depth-First Search, Depth-first with Iterative Deepening), Heuristic Search (Hill Climbing, Generic Best-First, A*), Constraint Satisfaction (Backtracking, Local Search)

UNIT - II:

Advanced Search: Constructing Search Trees, Stochastic Search, A* Search Implementation, Minimax Search, Alpha-Beta Pruning

Basic Knowledge Representation and Reasoning: Propositional Logic, First-Order Logic, Forward Chaining and Backward Chaining, Introduction to Probabilistic Reasoning, Bayes Theorem

UNIT - III:

Advanced Knowledge Representation and Reasoning: Knowledge Representation Issues, Non-monotonic Reasoning, Other Knowledge Representation Schemes

Reasoning Under Uncertainty: Basic probability, Acting Under Uncertainty, Bayes' Rule, Representing Knowledge in an Uncertain Domain, Bayesian Networks

UNIT - IV:

Learning: What Is Learning? Rote Learning, Learning by Taking Advice, Learning in Problem Solving, Learning from Examples, Winston's Learning Program, Decision Trees.

UNIT - V:

Expert Systems: Representing and Using Domain Knowledge, Shell, Explanation, Knowledge Acquisition.

Text Book:

1. Russell, S. and Norvig, P, Artificial Intelligence: A Modern Approach, Third Edition, Prentice- Hall, 2010.

Reference Books:

1. Artificial Intelligence, Elaine Rich, Kevin Knight, Shivasankar B. Nair, The McGraw Hill publications, Third Edition, 2009.
2. George F. Luger, Artificial Intelligence: Structures and Strategies for Complex Problem Solving, Pearson Education, 6th ed., 2009.

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B.Tech (ME)
III Year II Semester
Detailed Syllabus

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20ME32001 –Finite Element Methods

B. Tech, ME-III Year II Semester

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

Pre-requisites: 20MA11001-Basic Engineering Mathematics
20ME21002-Mechanics of Solids
20ME32004-Heat Transfer

Course Objectives: The course is intended to

1. Gain a fundamental understanding of the finite element method for solving 1-D structural problem.
2. Formulate the finite element equations for truss and beam elements.
3. Study two-dimensional problems such as plain stress and plain strain elasticity problems.
4. Learn finite element analysis of 1-D and 2-D heat conduction and torsion problem
5. Analyze the structures by considering the mechanical vibrations.

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

1. Explain stages in modelling and analysing a physical component using FEM
2. Develop stiffness matrix for 1D, 2D and 3D Problems.
3. Solve for the stresses, strains and displacements in structural FE, and heat transfer in thermal FE by applying boundary conditions.

UNIT – I:

Introduction to Finite Element Methods for solving field problems, Methods of Engineering Analysis, Functional Approximation Methods: Rayleigh- Ritz Method, Weighted Residual Methods, Applications of FEM, Advantages and Disadvantages of FEM, Stress and Equilibrium, Strain – Displacement relations, Stress – strain relations for 2D and 3D Problems. Basic Steps of FEM, Characteristics of Finite Element, Principle of Minimum Potential Energy, Convergence Requirements.

UNIT – II:

One Dimensional Problems: Formulation of Stiffness Matrix for a Bar Element by the Principle of Minimum Potential Energy, Properties of Stiffness Matrix, Characteristics of Shape Functions, Quadratic shape functions. Problems on uniform and stepped bars for different loading conditions
Analysis of Trusses: Derivation of Stiffness Matrix for Trusses, Stress and strain Calculations, Calculation of reaction forces and displacements.

UNIT – III:

Analysis of Beams: Derivation of Stiffness matrix for two noded, two degrees of freedom per node beam element, Load Vector, Deflection, Stresses, Shear force and Bending moment, Problems on uniform and stepped beams for different types of loads applied on beams.

UNIT – IV:

Finite element – formulation of 2D Problems: Derivation of Element stiffness matrix for two dimensional CST Element, Derivation of shape functions for CST Element, Elasticity Equations,

constitutive matrix formulation, Formulation of Gradient matrix. Two dimensional Isoparametric Elements and Numerical integration.

Finite element – formulation of 3D problems: Derivation of Element stiffness matrix for Tetrahedron Element, Properties of Shape functions for 3D Tetrahedral Element, Stress-Strain Analysis for 3D Element, Strain Displacement for Relationship Formulation.

UNIT – V:

Steady state heat transfer analysis: One Dimensional Finite Element analysis of fin and composite slabs. **Two dimensional steady state heat transfer problems:** Derivation of Thermal Stiffness matrix for 2D heat transfer problems-CST, Derivation of thermal force vector for 2D heat transfer problems.

Dynamic Analysis: Formulation of mass matrices for uniform bar and beam Elements using lumped and consistent mass methods, Evaluation of Eigen values and Eigen vectors for a stepped bar and beam Problems.

Text Books:

1. Introduction to Finite Elements in Engineering by Chandrupatla, Ashok and Belegundu, Prentice, Hall, Pearson
2. The Finite Element Methods in Engineering by SS Rao, Pergamon.

Reference Books:

1. Finite Element Methods: Basic Concepts and applicationsby Alavala, PHI
2. Finite Element Method by Zincowitz, Mc Graw Hill
3. Introduction to Fininte element analysis by S.Md.Jalaludeen, Anuradha Publications, print-2012
4. Finite Element Analysis by P.Seshu, PHI
5. Finite Element Analysis by Hutton, TMH
6. Finite Element Analysis by Bathe, PHI
7. Finite Element Method by Krishna Murthy, TMH

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20ME32002-Design of Machine Elements- II

Note: Design data handbook is permitted in the examination

B. Tech, ME-III Year I Semester

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

Prerequisites: 20ME11001-Engineering Mechanics
20ME12001-Mechanics and Mechanical Drives
20ME21001-Materials Technology
20ME21002-Mechanics of solids

Course Objectives: This Course covers

1. Application of fundamental knowledge of materials and mechanics
2. Design a mechanical system, or its components to meet desired needs

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

1. demonstrate materials selection, design considerations and design standards for the suitable design of a machine component.
2. establish empirical relations between applied loads and dimensions of machine components, leading to designers' off- the- shelf procedures.
3. design and analyze machine components according to industry standards for specified applications.
4. evaluate the developed design to ensure the safety, reliability and manufacturing flexibility.

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
Rolling contact bearings: Static and dynamic 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
Design of Piston- Forces acting on piston, Design and proportions of piston; Design of Cylinder, Cylinder liners

UNIT-III:

Clutches: Introduction to clutches, Friction materials, Design of clutches-Cone clutch, Centrifugal clutch, Heat Dissipation- Thermal considerations

UNIT – IV:

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

UNIT – V:

Power Screws: Design of screw - Square, ACME, Buttress screws; Design of nut, Design of screw jack, Compound Screw

Text Books:

1. Design of Machine Elements, V. B. Bhandari, Tata McGraw hill, 2nd Ed 2007
2. Maleev and Hartman's Machine Design, O P Grover, CBS Publications

Design Data Hand Books:

1. Design Data Hand book: V.B.Bhandari, Tata McGraw hill
2. Design Data Hand book: S MD Jalaluddin, Anuradha Publishers
3. Design Data: Data Book of Engineers by PSG College-Kalaikathir Achchagam

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

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20ME32003– CAD/CAM

B. Tech, ME-III Year II Semester

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

Pre-requisites: 20ME22003 - Manufacturing Technology

Course Objectives: This course covers

1. Fundamentals required to geometric modelling.
2. Manufacturing aspects of CAM and CNC coding.
3. CIM concepts and possible industry applications.

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

1. demonstrate geometric modeling using computer graphics.
2. develop curves, surfaces and solid models used in machine design.
3. develop programming for NC, CNC and DNC machines.
4. illustrate Advanced Manufacturing systems such as FMS, CIM CAPP, etc.

UNIT-I:

Introduction to CAD: Fundamentals of CAD/CAM, Automation, design process, Application of computers for design, Benefits of CAD, Computer configuration for CAD applications, Computer peripherals for CAD, Raster Scan Graphics, CAD software - definition of system software and application software, CAD database and structure.

Geometric Modelling: Wire frame modelling, 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 Modelling: Algebraic and geometric form, Parametric space of surface, Blending functions, parameterization of surface patch, Cylindrical surface, Ruled surface, Surface of revolution, Spherical surface, Composite surface, Bezier surface, B-spline surface, Regenerative surface and pathological conditions.

Solid Modelling: Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representation.

UNIT-III:

NC Machine Tools: Fundamentals of Numerical Control - elements of NC machine tools, classification of NC machine tools, Advantages, suitability and limitations of NC machine tools, Application of NC system. Definition and designation of control axes, Constructional details of Numerical Control Machine Tools, MCU structure and functions

Computer Numerical Control (CNC): Features of CNC, Elements of CNC machines, the Machine Control Unit for CNC, Direct Numerical Control (DNC) and Adaptive Control

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

UNIT-V:

Computer Aided Manufacturing Resource Planning: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise source planning, Capacity requirements planning

Flexible Manufacturing System: FMS equipment, FMS layouts, benefits of FMS

Computer Aided Quality Control: Automated inspection - Offline, Online, contact, Non-contact; Coordinate Measuring Machine

Computer Integrated Manufacturing: CIM system, Benefits of CIM

Text Books:

1. CAD/CAM, Groover M P, Pearson education, 1st edition, 2003.
2. CAD /CAM Theory and Practice, Ibrahim Zeid, TMH, 2nd edition, 2009.
3. CAD/CAM Principles and Applications, P. N. Rao, TMH, 3rd edition, 2013.

Reference Books:

1. CAD / CAM / CIM, P. Radhakrishnan and Subramanian, New Age, 4th edition 2016.
2. CAD/CAM Concepts and Applications, Alavala, PHI, 2013.
3. Principles of Computer Aided Design and Manufacturing, Farid Amirouchel, Pearson, 2nd edition, 2004.
4. Computer Numerical Control Concepts and Programming, Warren S Seames, Thomson, 2001.

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20ME32004 - Heat Transfer

L	T	P	C
3	-	-	3

B. Tech. ME - III Year II Semester

Prerequisites: 20ME21004 - Thermodynamics
20ME21003 - Fluid Mechanics and Hydraulic Machinery

Note: Heat And Mass Transfer Data Book by C.P. Kothandaraman is permitted in examination

Course Objectives: This Course covers:

1. Concepts of different modes of heat transfer
2. Effectiveness and Efficiency in Fins or Extended Surfaces
3. Relation between various non-Dimensionless numbers in Free and Forced Convection
4. Concepts of Condensation, Boiling Phenomenon and principles of radiation
5. Design of heat exchanger and their effectiveness

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

1. Explain the concepts of various modes of heat transfer.
2. Develop the overall heat transfer co-efficient for steady state and unsteady state conditions to determine the rate of heat transfer.
3. Apply the empirical relations to determine the heat transfer rate in phase changing processes, heat exchangers, internal and external flows.

UNIT – I:

Introduction: Modes and mechanisms of heat transfer – Basic laws of heat transfer –General discussion about applications of heat transfer.
Conduction Heat Transfer: Fourier rate equation – General heat conduction equation in Cartesian, Cylindrical and Spherical coordinates – simplification and forms of the field equation – steady, unsteady and periodic heat transfer – Initial and boundary conditions
One Dimensional Steady State Conduction Heat Transfer: Homogeneous slabs, hollow cylinders and spheres- Composite systems– overall heat transfer coefficient – Electrical analogy – Critical radius of insulation

UNIT – II:

One Dimensional Steady State Conduction Heat Transfer: Variable Thermal conductivity – systems with heat sources or Heat generation-Extended surface (fins) Heat Transfer – Long Fin, Fin with insulated tip and Short Fin, Application to error measurement of Temperature
One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance – Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi infinite body.

UNIT – III:

Convective Heat Transfer: Classification of systems based on causation of flow, condition of flow, configuration of flow and medium of flow – Dimensional analysis as a tool for experimental investigation – Buckingham π Theorem and method, application for developing semi – empirical

non- dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations.

Forced convection: External Flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer -Flat plates and Cylinders.

Internal Flows: Concepts about Hydrodynamic and Thermal Entry Lengths – Division of internal flow based on this –Use of empirical relations for Horizontal Pipe Flow and annulus flow.

UNIT – IV:

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

Heat Exchangers: Classification of heat exchangers – overall heat transfer Coefficient and fouling factor – Concepts of LMTD and NTU methods - Problems using LMTD and NTU methods.

UNIT V:

Heat Transfer with Phase Change: Boiling – Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling; Condensation- Film wise and drop wise condensation –Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations.

Radiation Heat Transfer : Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchoff, Lambert, Stefan and Boltzmann– heat exchange between two black bodies – concepts of shape factor – Emissivity – heat exchange between grey bodies – radiation shields – electrical analogy for radiation networks.

Text Books:

1. Heat and Mass Transfer, R.K.Rajput, S.Chand & Company Pvt. Ltd-New Delhi
2. Fundamentals of Engineering, Heat& Mass Transfer by R.C. Sachdeva, New Age International

Reference Books:

1. Heat Transfer -A Practical Approach, Yunus A Cenegal, Tata McGraw Hill, 2nd Edition, 1998
2. Heat transfer, J.P. Holman, Tata McGraw Hill Publication, New Delhi, 2010
3. Heat and Mass Transfer, R S Yadav, Centre Publishing House, 1992
4. Heat Transfer, P.K. Nag, TMH publications, 2011
5. Heat And Mass Transfer Data Book, C.P. Kothandaraman 2018

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20ME32005 - Mechatronics
(Professional Elective –I)

B. Tech, ME - III Year II Semester
Pre-requisites: Nil

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

Course Objectives: This course covers

1. Fundamental knowledge of mechatronic systems
2. Construction and applications of mechatronic systems

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

1. identify key elements of Mechatronics system (block diagrams) and apply Time/ Frequency domain analysis for control applications
2. explain signal processing and use of interfacing systems such as electronic and computing elements
3. select an appropriate design model of a Mechatronic system, suitable for customized applications such as pick and place robot, automatic car parking system, engine management system etc.
4. illustrate mechatronic systems used in manufacturing industry leading to automation

UNIT – I:

Introduction: Evolution of Mechatronics, components of Mechatronic systems, Concepts of Mechatronics approach, Need for Mechatronics, Emerging areas of Mechatronics, Advantages and disadvantages of mechatronics, applications of mechatronics systems
Sensors: Static and dynamic performance characteristics, internal sensors, external sensors and micro-sensors - sensors for displacement, position and proximity, velocity, motion, force, fluid pressure, liquid flow, liquid level, temperature, light sensors; selection of Sensors

UNIT – II:

Electronic Elements: Conductors, insulators and semiconductors, passive electrical components, resistors, capacitor and inductor, transformer, active elements, semiconductor devices, transistors and integrated circuits, digital electronic components - logic gates, flip-flops, shift registers, multiplexer and counter
Computing Elements: Analog computer, timer, analog to digital converter, digital to analog converter, digital computer, microprocessor and its architecture, micro-controllers, Programming Logic Controllers and their basic structures

UNIT – III:

System Modelling and Analysis: Control system concepts, transfer function of physical systems, representation of systems - block diagram, transfer function of a system, standard input signals, time response of first and second order systems to a step input, frequency response analysis, automatic control systems, digital control systems

Motion Control Devices: Actuator types – hydraulic, pneumatic and electrical actuators; DC servomotor, AC servomotor and stepper servomotor, micro actuators; drive selection and applications

UNIT – IV:

Stages in Designing Mechatronic Systems: Traditional and mechatronic design, possible design solutions, case studies of mechatronic systems - pick and place robot, automatic car parking system, engine management system

UNIT – V:

Mechatronics in manufacturing- Features, applications of mechatronics in manufacturing systems - Flexible Manufacturing Systems, Computer Integrated Manufacturing; challenges in mechatronic production units

Text Books:

1. Mechatronics Electronic control system in Mechanical and Electrical Engineering, William Bolton, Sixth edition Pearson education Ltd. 2015
2. Introduction to Mechatronics, A Kuttan, Oxford University Press, 2010.
3. Introduction to Mechatronics & Measurement Systems, Alciatore & Histand, 4e, McGraw-Hill Education, 2014.

Reference Books:

1. Mechatronics, Bradley D. A., Dawson D., Buru N.C. and. Loader A.J., Chapman and Hall, 1993.
2. Mechatronics, Dan Necsulesu, Pearson Education Asia, 2002 (Indian Reprint).
3. Mechatronics, Nitaigour Premchand Mahadik, McGraw-Hill Education, 2015.
4. Understanding Electro – Mechanical Engineering An introduction to Mechatronics, Lawrence J. Kamm, Prentice Hall of India Pvt., Ltd., 2000.
5. Fundamentals of Mechatronics, M Jouaneh, Cengage Learning, 2013.

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20ME32006 – Refrigeration and Air Conditioning
(Professional Elective-I)

B.Tech. ME - III Year II Semester

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

Prerequisites: 20ME21004 - Thermodynamics
20ME22001 - Thermal Engineering

Note: Refrigeration And Air-Conditioning Data Book by Anand V. Domkundwar and V.M. Domkundwar is permitted in examination

Course Objectives: This Course covers:

1. Basics of Refrigeration
2. Vapor compression Refrigeration (VCR)
3. Refrigerants used in VCR
4. Non-Conventional Refrigeration systems
5. Cooling/ heating load calculations for a given application

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

1. explain various components of refrigeration system and air conditioning system.
2. derive the expression for coefficient of performance (COP) in various refrigeration systems.
3. identify the desirable properties of refrigerants and suggest a suitable refrigerant for any given heat load.
4. evaluate performance of vapour absorption refrigeration system and compare with vapour compression refrigeration system.
5. calculate the heating load and design air-conditioning system using psychometric properties.

UNIT-I:

Introduction: Necessity and applications, Unit of refrigeration, Mechanical Refrigeration systems
Air Refrigeration Cycles: Bell Coleman cycle and Brayton cycle; Open and Dense air refrigeration systems, Actual air refrigeration system, Refrigeration needs for Air crafts

UNIT-II:

Vapour Compression Refrigeration (VCR): Working principle and essential components for VCR plant, Simple Vapour compression refrigeration cycle, Coefficient of Performance (COP), Representation of cycle with T-S and P-H charts, Effect of sub cooling and super heating, Cycle analysis, Actual cycle, Influence of various parameters on system performance

UNIT-III:

Components of VCR system: Classification and Working Principle of Compressors, Condensers, Expansion devices, Evaporators
Refrigerants: Desirable properties, common refrigerants, Nomenclature, Ozone Depletion, Global Warming, Azeotropes and Zeotropes, General classification, comparison, Advantages and Disadvantages; Introduction to Nano refrigerants

UNIT-IV:

Vapour Absorption Refrigeration: Calculation of maximum COP, Description and working principle of NH_3, Water systems, Li – Br system; Principle and operation of Three Fluid absorption system, salient features, Steam Jet Refrigeration System – Working Principle and Basic Components

Non-Conventional Refrigeration Systems: Principle and operations of (i) Thermoelectric refrigerator (ii) Vortex tube or Hilsch tube

UNIT-V:

Air Conditioning: Psychometric Properties and 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 their requirements, Load Calculations; Air Conditioning systems - Classification of equipment based on cooling, heating, humidification and dehumidification

TEXT BOOKS:

1. Refrigeration and Air Conditioning, CP Arora, TMH, 2008
2. A course in Refrigeration and Air- Conditioning, Domkundwar, Arora, Dhanpat Rai and Co, 2018

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 Hill, 2009
4. Refrigeration & Air conditioning, F.Stoecker & Jerold. W. Jones, McGraw Hill, 1982
5. Refrigeration And Air-Conditioning - Data Book, Anand V. DomkundwarV.M. Domkundwar, Dhanpat Rai and co publishers

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20ME32007 - Advanced Mechanics of Solids
(Professional Elective-I)

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

B Tech, ME - III Year II Semester

Prerequisites: 20ME11001- Engineering Mechanics
20ME21002- Mechanics of Solids

Course Objectives: This course covers

1. Fundamentals of Mechanics of Deformable Solids like Stress, Strain, Stress – Strain relations, Theories of failure and Energy methods
2. Concepts of shear center and un-symmetrical bending
3. Analysis of curved beams
4. Application of theory of elasticity to plates
5. Torsion of non circular bars

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

1. formulate relation between stress and strain in unsymmetrical bending, and curved beams
2. apply theory of elasticity and design flat plates
3. design shafts of complex geometry

UNIT – I:

Analysis of Stress and Strain: Introduction to stress analysis in elastic solids, stress at a point, stress tensor, stress components in rectangular and polar coordinate systems, Cauchy's equations, stress transformation, hydrostatic stress components, octahedral shear stress, equations of equilibrium, Strain deviator and its invariants

UNIT – II:

Shear Center and Unsymmetrical Bending: Bending axis and shear center, shear center for axi-symmetric sections. Unsymmetrical bending, bending stresses in Beams subjected to Non-symmetrical bending, Deflection of straight beams due to non-symmetrical bending

UNIT – III:

Curved Beam Theory: Winkler Bach formula for circumferential stress – Limitations-Correction factors; radial stress in curved beams, closed ring subjected to concentrated and uniform loads stresses in chain links.

UNIT – IV:

Theory of Plates: Introduction, Stress resultants in a flat plate, Strain - Displacement relations for plates, Strain-Equilibrium equations for small displacement theory of flat plates, Temperature relation for isotropic plates, strain energy of plate, Boundary conditions for plate, Solution of rectangular, circular plate problems.

UNIT – V:

Torsion: Torsion of a cylindrical bar of circular cross section, Saint-Venant's semi-inverse methods, Linear elastic solution, Prandtl elastic membrane, Analogy-Narrow rectangular cross

Section, Hallow thin wall torsion members, Multi connected Cross section, thin wall torsion members with restrained ends Axi-Symmetric Problems. Disc of uniform thickness, Discs of uniform strength

Text Books:

1. Advanced Mechanics of Solids, L.S. Srinath, Tata McGraw Hill, 2007
2. Strength of Materials, Sadhu Singh, Khanna Publishers, 2015

Reference Books:

1. Theory of elasticity, S. P. Timoshenko, J. N. Goodier, McGraw Hill, 1970
2. Engineering Solid Mechanics: Fundamentals and applications, A.R. Ragab and S. E. Bayoumi, CRC Press, 1999
3. Advanced Strength of Materials, J. P. Den Hartog, McGraw Hill, 1987

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20ME32008 - Automation in Manufacturing
(Professional Elective –I)

B. Tech, ME - III Year II Semester
Pre-requisites: 20ME22003 - Manufacturing Technology

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

Course Objectives: This course covers

1. The basic concepts of automation in manufacturing systems
2. The fundamental concepts of automated flow lines and their analysis
3. Automated material handling, automated storage and retrieval systems.
4. Automated assembly systems
5. Fundamental knowledge on automated inspection methods and quality control systems

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

1. explain the principles of manufacturing, automation, storage, assembly and quality control systems based on the product of an industry.
2. select suitable transport mechanism, material handling equipment, automatic identification method, and coordinate measuring method based on the product nature.
3. analyze material handling system, automated flow lines and transfer lines with / without buffer storage, and assembly systems to suit a desired production system.
4. explain group technology and flexible manufacturing systems, followed in design and manufacturing sectors.

UNIT- I:

Manufacturing and Automation: Production systems, Manufacturing operations, production facilities; Automation in production systems, Automation principles and strategies, 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: 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 Production 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 - conveyors, automated guided vehicles

Storage Systems: Storage systems, performance and location strategies, automated storage and retrieval systems; Automatic identification methods, Barcode technology, RFID

UNIT- IV:

Assembly Systems: Fundamentals, Analysis of Assembly systems, Cellular manufacturing, part families, coding, 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

Text Books:

1. Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover, PE/PHI.
2. CAD/CAM/CIM, P. Radha Krishnan, S. Subrahamanyan, 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.

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20ME32L01- Mechanical Measurements and Instrumentation Lab

B. Tech, ME – III Year II Semester

L	T	P/D	C
-	-	2	1

Pre-requisites: 20ME31001- Mechanical Measurements and Instrumentation

Course Objectives: This course covers

1. The necessary skills for calibration and testing of different gauges and instruments.
2. The necessary skills to collect data, perform analysis and interpret results to draw valid conclusions through standard test procedures using various metrology instruments

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

1. devise plan of experimentation encompassing process variables identification, preparatory sketches, and methodology
2. conduct the experiment to i) evaluate different types of errors and uncertainty in mechanical measurements ii) test and calibrate different gauges/ measuring instruments as per industry practices
3. compare the measurements with secondary standards and conclude the results
4. describe the principle of operation of various gauges and instruments that would measure pressure, force, temperature, flow, frequency, linear and angular variations
5. demonstrate the experimental learning through presentation/ project submission.

Note: Students should perform at least 10 experiments

Section - A: Mechanical Measurements

1. Use of gear teeth vernier callipers for checking the chordal addendum and chordal height of the spur gear.
2. Measurement of tool angles using tool makers microscope
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.
6. Surface finish Measurement

Note: Minimum five experiments will be performed by a student among the above (Section A)

Section - B: Mechanical Instrumentation

1. Calibration of pressure gauges
2. Calibration of resistance temperature detector for temperature measurement
3. Calibration of thermocouple for temperature measurement
4. Calibration of transducer for temperature measurement (thermistor)
5. Study and calibration of LVDT transducer for displacement measurement
6. Calibration of capacitive transducer for angular displacement
7. Study and calibration of a rotometer for flow measurement
8. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
9. Calibration of strain gauge for temperature measurement

10. Study and use of a seismic pickup for the measurement of vibration amplitude of an engine bed at various loads
11. Study and calibration of McLeod gauge for low pressure

Note: Minimum five experiments will be performed by a student among the above (Section B)

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20ME32L02 – CAD/CAM Lab

B. Tech, ME - III Year II Semester

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

Pre-requisites: 20ME21002 - Mechanics of Solids,
20ME32001 - Finite Element Methods

Course Objectives: This course covers

1. Fundamentals of CAD tools for geometric modelling
2. Computer Aided Analysis of structural and thermal systems
3. Development of part programming for CNC machines

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

1. devise plan of experimentation encompassing CAD Tools application, preparatory sketches, sequence of operations and methodology
2. conduct the experiment to i) develop geometric models for the analysis of stress, deformation and heat transfer using CAD and ANSYS ii) Develop CNC programming for turning and milling operations
3. compare the results with the intent proposed
4. describe geometric modeling techniques, G codes and M Codes
5. demonstrate the experimental learning through presentation/ project submission.

Section A: Computer Aided Design (CAD):

1. Generation of various 3D geometric models of machine components involving extrusion, revolve, sweep - 1 Exercise (Piston, Connecting Rod, Cylinder of an IC Engine)
2. Preparation of part drawings - Drafting orthographic projection of machine parts- 1 Exercise
3. Assembly of Machine parts - I C Engine mechanism- 1 Exercise
4. Stress analysis of a Bar of constant cross sectional area, tapered bar and stepped bar - 1 Exercise
5. Determination of reactions, displacements and stresses in a Truss system- 1 Exercise
6. Analysis of stresses and strains in different types of Beams- cantilever beam with Concentrated load, Simply supported beam with UDL - 2 Exercises
7. Steady state heat conduction in a fin- 1 Exercise

Section B: Computer Aided Manufacturing (CAM)

1. Development of CNC part program for step turning and machining of a component.
2. Development of CNC part program for taper turning and machining of a component.
3. Development of CNC part program for slot milling and machining of a component.
4. Development of CNC part program for profile milling and machining of a component.

Note: A student will perform minimum10 experiments

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20ME32L03 – Heat Transfer Laboratory

B.Tech, ME- III Year II Semester

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

Prerequisites: 20ME21004 - Thermodynamics
20ME32004 - Heat Transfer
20ME21003- Fluid Mechanics and Hydraulic Machinery

Course Objectives: This Course covers:

1. Concepts of heat energy in industrial, and domestic systems
2. Concepts of Conductive and Convective heat transfer
3. Condensing mechanisms of heat transfer
4. Concepts of radiation in heat transfer

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

1. devise plan of experimentation encompassing process variables identification, preparatory sketches, and methodology
2. conduct the experiment to i) study heat transfer through steady state conduction, convection and radiation modes, ii) study heat transfer in transient heat conduction mode
3. perform model calculations, evaluate heat transfer rate and interpret the results
4. describe dimensionless numbers and modes of heat transfer
5. demonstrate the experimental learning through presentation/ project submission.

List of Experiments:

1. Determination of Thermal Conductivity of a given metal rod
2. Determination Overall heat transfer co-efficient in Composite Slab Apparatus
3. Determine the Thermal Conductivity and Heat transfer through lagged pipe
4. Determine the Thermal Conductivity and Heat Transfer through a Concentric Spheres
5. Determination of Heat transfer co-efficient in pin-fin apparatus
6. Determination of Heat transfer co-efficient in Transient Heat Conduction
7. Determination of Heat transfer co-efficient in forced convection apparatus
8. Determination of Heat transfer co-efficient in natural convection apparatus
9. Determination of Effectiveness in Parallel and counter flow heat exchanger
10. Determination of Emissivity
11. Determination of Stefan Boltzman constant(σ)
12. Determination of Heat transfer co-efficient in Film and drop wise condensation
13. Determination of Heat transfer rate in Critical Heat flux apparatus.
14. Study of heat pipe and its demonstration.
15. Determination of Heat transfer co-efficient in pin-fin (Natural convection).

Note: Student will perform any 10 experiments among the above

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20MA32P01 – Logical Reasoning-II

Common to All Branches

L	T	P/D	C
0	0	4	2

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

Prerequisite(s): 20MA31P01 - Logical Reasoning-I

Course Objectives: Develop ability to

1. Distinguish between permutation and combination and demonstrate how to determine each; Understand the basic concept of probability and illustration of Venn diagram; Classify the numbers and compute LCM, HCF, Square Roots, Cube Roots, Surds and Indices; Understand the concepts of allegation and mixture.
2. Distinguish between the linear and circular sitting arrangements and also understand the coding and decoding problems; Understand the pattern of number and letter series.
3. Understand concepts of calendars; Classify the different forms of Alphabet Arrangements; Interpret the clues in the form of direction wise.
4. Identify the placements of numerals and hands on clock; Understand the various properties of cubes; Understand the concepts of data sufficiency and data interpretation.

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

1. Apply logical thinking and analytical abilities to solve quantitative aptitude questions.
2. Critique and evaluate quantitative arguments that utilize mathematical, statistical and quantitative information.
3. Think constructively and apply logic to solve problems.

Quantitative Aptitude:

1. **Permutation and Combinations:** Fundamental Principle of Counting, Counting Methods, Definition of permutation, Linear Permutations, Rank of a word, Circular Permutations, Definition of Combinations, Problems on Combinations.
2. **Probability:** Definitions of Probability, Addition and Multiplication Theorems. Deductions: Introduction, expressing different types of statements using Venn diagrams, Definition of complimentary pairs, finding the conclusions using Venn diagrams for two and more statements.
3. **Number system:** Classification of numbers, Divisibility rules, Finding the units digit, Finding remainders in divisions involving higher powers, LCM and HCF Models**,** Decimal fractions, Simplifications, Square Roots & Cube Roots, Surds and Indices.
4. **Allegation and Mixture:** Definition of allegation, mean price, rules of allegation on quantity and cost price, diagrammatic explanation, removal and replacement.

Logical Reasoning:

5. **Sitting Arrangement:** Problems on Linear arrangement, Problems on Circular arrangement, Problems on Double line-up, Problems on Selections, Problems on Comparisons. **Coding and decoding:** Coding using same set of letters, Coding using different set of letters, Coding into a number Comparison & Elimination.
6. **Number and letter Series:** Difference series, Product series, Squares series, Cubes series, Alternate series, Combination series, Miscellaneous series, Place values of letters.
7. **Day sequence/Calendars**: Definition of a Leap Year, Finding the number of Odd days, framing the year code for centuries, finding the day of any random calendar date.
8. **Alphabet Test:** Alphabetical order of verbs, letter-word problems, rule-detection, alphabetical quibble, word formation.
9. **Direction sense Test:** Direction from the initial point: directions, cardinal directions, problems on distances, problems on clocks, problems on angles, problems on shadows.
10. **Clocks**: Finding the angle when the time is given, Finding the time when the angle is known, Relation between Angle, Minutes and Hours, Exceptional cases in clocks.
11. **Cubes:** Basics of a cube, finding the minimum number of cuts when the number of identical pieces are given, Finding the maximum number of pieces when cuts are given, Problems on painted cubes of same and different colours, Problems on cuboids, Problems on painted cuboids, Problems on Dice.
12. **Data Sufficiency:** Different models in Data Sufficiency, Problems on Data sufficiency, Problems on data redundancy. **Data Interpretation:** Problems on tabular form, Problems on Line Graphs, Problems on Bar Graphs, Problems on Pie Charts.

Text Books:

1. A modern approach to Logical reasoning, R S Agarwal, S. Chand Publications, 2013.
2. Quantitative Aptitude for Competitive Examinations, Dinesh Khattar. Pearson Education, 4th Edition, 2019.

Reference Books:

1. Quantitative Aptitude and Reasoning, R. V. Praveen, PHI Learning Private Ltd, 2nd Edition, 2013.
2. Quantitative Aptitude for competitive examinations, Abhijith Guha, McGraw Hill Education, 6th Edition, 2017.
3. Analytical & Logical Reasoning, Peeyush Bhardwaj, Arihant Publications, 4th Edition, 2015.
4. Logical Reasoning for the CAT, Arun Sharma, McGraw Hill Education, 2nd Edition 2014.

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20EN32P01 - English for Professional Success

Classroom Activity based Course. Hence, Lab. is not required.

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

B.Tech, ME- III Year II Semester.

Course Objectives:

The students would develop ability to

1. Identify and practice the most commonly used Phrases, Phrasal verbs, Idioms and Technical vocabulary.
2. Read critically and comprehend the given text.
3. Understand the importance of presentation skills to prepare an effective presentation.
4. Realize the importance of organizational communication.

Course Outcomes: At the end the students would be able to

1. Use Phrases, Phrasal verbs, Idioms and Technical vocabulary befitting the context in communication.
2. Review a book and an article by analyzing arguments and viewpoints.
3. Prepare and deliver engrossing and impressive presentations.
4. Correspond formally in a given context.

Module-I

Advanced Vocabulary

Vocabulary: Idioms and phrases, phrasal verbs: practice exercises. Jargon-Technical Vocabulary

Module- II

Critical Reading

Reading: Book review/Article review: reviewing skills.

Module-III

Oral Skills

Oral Technical Presentations, Project Presentations: genre, originality and accountability.

Module-IV Official Correspondence

Writing: Circulars, notices, memos, Agenda, Minutes of Meeting (MoM) Letter of Recommendation.

Books Recommended

1. Objective English by Edger Thorpe and Showick Thorpe, Pearson, 6thEdition.
2. All About Words: an adult approach to vocabulary by Maxwell Nurnberg, Prentice-Hall.

Reference book(s):

1. Oxford Collocation Dictionary by Diana Lea.
2. EdSwick, Writing Better English for ESL Learners, McGrawHill,2nd ed.

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20CS32M03- Introduction to Cyber Security

(Mandatory Course)

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

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

Course objectives:

1. To familiarize various types of cyber-attacks and cyber-crimes
2. To give an overview of the cyber laws
3. To study the defensive techniques against these attacks

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

1. Explain different aspects of cyber security ecosystem
2. Explain Indian and International laws for cyber security and basics of cyber forensics
3. Explain cyber security related threats to organizations in general and when using mobile and wireless devices and organizational policies to protect against them.
4. Analyze various case studies in the area of cyber crime

UNIT - I:

Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT - II:

Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy.
Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.

UNIT - III:

Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

UNIT- IV:

Cyber Security: Organizational Implications: Introduction, cost of cybercrimes and IPR issues,

web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations. **Cybercrime and Cyber terrorism:** Introduction, intellectual property in the cyberspace, the ethical dimension of cybercrimes the psychology, mindset and skills of hackers and other cyber criminals.

UNIT - V:

Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc.

Cybercrime: Examples and Mini-Cases

Examples: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances.

Mini-Cases: The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.

Text Book(S):

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

Reference Book(S):

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
2. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

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20MB32M04 – Professional Ethics

(Mandatory Course)

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

B. Tech, ME- III Year II Semester.

Pre-requisites: None

Course Objective: Develop ability to

1. imbibe and internalize the Values and Ethical Behaviour in the personal and Professional lives.

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

1. Describe the importance of value and ethics in their personal lives and professional careers.
2. Analyze the rights and responsibilities as an employee, team member, and a global citizen
3. Identify and analyze the global issues in Professional 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.

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B.Tech (ME)
IV Year I Semester
Detailed Syllabus

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20ME41001- Additive Manufacturing

B. Tech, ME - IV Year I Semester

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

Pre-requisites: 20ME22003 - Manufacturing Technology

Course Objectives: This course covers

1. Fundamental knowledge on Additive manufacturing Technology
2. Process capabilities of various Additive manufacturing processes
3. Applications of Additive manufacturing and supporting data formats.

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

1. explain the need, classification and applications of Additive Manufacturing (AM)
2. explain working principles of different additive manufacturing techniques such as SLA, SGC, SLM, LOM, MJM, LENS, EBM etc. and summarize their specific applications
3. illustrate different CAD data file formats, AM softwares and extraction of *.STL* files from CAD data

UNIT-I:

Introduction: Need for Additive Manufacturing (AM), Historical development, Fundamentals of Additive Manufacturing, AM Process Chain, Advantages and Limitations of AM, commonly used Terms, Classification of AM process, Fundamental Automated Processes: Distinction between AM and CNC, other related technologies.

UNIT- II:

Stereo Lithography (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, advantages, limitations and applications Polyjet Process, working principle, applications, advantages and disadvantages.

UNIT- III:

Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Fused Deposition Modelling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages.
Multi-Jet Modelling (MJM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages.

UNIT- IV:

Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Three-dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages.
Laser Engineered Net Shaping (LENS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages

Electron Beam Melting (EBM): Models and specifications, Process, working principle, Applications, Advantages and limitations

UNIT – V:

AM Data Formats: Reengineering for Digital Representation, STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Mesh Refining by Sub division Techniques.
AM Software: Need for AM Software, features of various AM Software's like Magics, MIMICS, Solid View, 3D view, View Expert, Velocity 2, Rhino, STL View 3 Data Expert and 3D Doctor, Surgi Guide, Simplant, Mesh lab.

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.

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20MB41004- Engineering Economics and Accounting

B. Tech, ME - IV Year I Semester

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

Prerequisite(s): None

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

1. Apply micro and macroeconomic concepts of business entities.
2. Explain elasticity of demand and types of market structures in business operations.
3. Apply the concepts of theories of production and demand forecasting in decision-making.
4. Categorize sources of raising capital and analyze the methods of capital budgeting.
5. Evaluate and interpret the financial statements.

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.

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20ME41002 – Unconventional Machining Processes

(Professional Elective - II)

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

B. Tech, ME - IV Year I Semester

Pre-requisites: 20ME22003 - Manufacturing Technology

Course Objectives: This course covers

1. Knowledge of different un-conventional machining processes
2. The process capabilities of different un-conventional machining processes
3. The working principles of various finishing techniques.

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

1. identify the need of modern machining processes and their machining abilities.
2. explain the working principle of mechanical, chemical, electro chemical and thermal machining processes.
3. analyze the control parameters of EDM, EDG, EBM, LBM and PAM, application point of view.
4. evaluate the metal cutting processes such as LBM, EBM, PAM and surface finishing processes.

UNIT-I:

Introduction: Need for Unconventional machining methods- Classification of UCM – considerations in process selection, Materials, Applications

Abrasive Jet Machining, Water Jet Machining and Abrasive Water Jet Machining: Basic principles, equipment's, process variables, and 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 Processes: Principle, maskants applying techniques, etchants, and 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, Electric Discharge Grinding (EDG), Wire Cut EDM-principle and applications.

UNIT-IV:

Electron Beam, Laser Beam and Plasma Arc Machining: Generation and control of Electron Beam for Machining (EBM), theory of electron beam machining, Applications of EBM
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:

Finishing Processes: Magnetic abrasive finishing, Abrasive Flow Finishing, Electro Stream drilling, shaped tube electrolytic machining (STEM)

Text Books:

1. Advanced machining processes, VK Jain, Allied publishers
2. Modern Machining Processes, 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.

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20ME41003- Gas Dynamics
(Professional Elective – II)

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

B. Tech. ME- IV Year I Semester

Prerequisites: 20ME21003 - Fluid Mechanics and Hydraulic Machinery

Course Objectives: This Course covers:

1. Governing equations for Compressible flow
2. Effects of Friction on Compressible flow
3. Working of gas turbines

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

1. derive Navier-stokes equations using continuity, momentum and energy principles.
2. evaluate the effect of normal shocks and friction on fluid properties with an intent to reduce their effects on physical system.
3. apply the concepts of thermodynamics and compressible fluids to analyse the performance of gas turbines.

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 one dimensional flow with several effects like mass addition, friction and heat transfer

UNIT-V:

Study of Gas Turbines: Concept of gas turbine, analysis of turbine stage, characterization of blades, designing of multistage axial flow turbine, Performance analysis of turbine

Text Books:

1. Modern Compressible Flow, J.D. Anderson, McGraw-Hill, 2nd Edition, 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. Dynamics and Thermodynamics of Compressible Fluid Flow, Shapiro A.H., Willey
2. Gas Dynamics, M.J. and Hoffman. J.D., New York-1976
3. Fundamentals of Gas Dynamics, Zucker,R.D, and Biblarz.O, John Wiley & Sons, 2nd edition, 2002

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20ME41004 – Industrial Robotics
(Professional Elective-II)

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

B. Tech, ME –IV Year I Semester

Prerequisite(s): 20ME11001- Engineering Mechanics
20ME22002- Kinematics of Machinery

Course Objectives: This course covers

1. Components and construction of Robots
2. Various robots and their operational details.

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

1. explain anatomy, specifications and types of Robots
2. analyse motion using forward and inverse kinematic models of robotic manipulators
3. plan trajectories in joint space and Cartesian space to avoid obstacles while robots are in motion
4. select suitable configuration and list the technical specifications of a robot used in manufacturing applications

UNIT – I:

Introduction: An overview of Automation and Robotics – present and future applications
Components of the Industrial Robotics: common types of arms. Components, Architecture
End effectors: General considerations of end effectors selection and design, classification - mechanical, magnetic, vacuum and adhesive gripper, gripper force analysis and design
Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity

UNIT – II:

Motion Analysis: Basic Rotation Matrices, Composite rotation matrices, rotation matrix about arbitrary axis, Euler Angle representation, Homogeneous transformations as applicable to rotation and translation – problems
Manipulator Kinematics: D - H notation- D-H method of Assignment of frames, Composite Homogeneous Transformation Matrix, joint coordinates and world coordinates
Forward Kinematics: Displacement Matrices for Standard Configurations, Forward kinematics of manipulators up to 3 degrees of freedom
Inverse kinematics: Inverse kinematics analysis of planar manipulator

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: types of actuators - Pneumatic, Hydraulic and Electric Actuators, D.C. motors, A.C. motors, Stepper motors, A.C. servomotors, D.C servomotors; Advantages and limitations of drive system

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 and spray painting, Assembly and Inspection.

Text Books:

1. Industrial Robotics, Groover M P, Mc Graw Hill
2. Introduction to Industrial Robotics, Ramachandran Nagarajan, Pearson publishers

Reference Books:

1. Robot Dynamics and Controls, Spony and Vidyasagar, John Wiley publishers
2. Robot Analysis and control, Asada, Slotine, Wiley Inter-Science
3. Robotics, Fu et al, TMH Publications.
4. Robotics and Control, Mittal R K and Nagrath I J, TMH publishers.

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20ME41005 - Tool Design

(Professional Elective –II)

B. Tech, ME - IV Year I Semester

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

Pre-requisites: Nil

Course Objectives: This course covers

1. Mechanical properties of different tool materials
2. The knowledge of different tool design methods
3. The knowledge on design of jigs and fixtures for different types of machine tool
4. The knowledge on design of different kinds of dies and moulds

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

1. demonstrate materials suitable for press tools, dies, molds, gauges, jigs and fixtures.
2. Suggest manufacturing methods suitable for press tools, dies, molds, gauges, jigs and fixtures.
3. design press tools based on working stresses, wear rate and working temperatures.
4. design jigs and fixtures used in mass production.

UNIT-I:

Tool Materials: Introduction - cutting tools, properties of cutting tool materials; the selection of carbide cutting tools

Gauges and gauge design: Fixed gauges, gauge tolerances, the selection of material for gauges.

UNIT-II:

Tool Design Process: Introduction, design procedure - statement of the problem, needs analysis, tentative design solutions, finished design, drafting and design techniques; punch and die manufacturing techniques.

UNIT-III:

Design of Jigs: 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 exercises of designing jigs for given components

UNIT-IV:

Design of Fixtures: Fixture Design turning fixtures, milling fixtures, grinding and broaching fixtures, indexing fixtures. Design of fixtures for simple component

UNIT-V:

Dies: Design fundamentals, blanking and piercing die construction, pilots, strippers and pressure pads, presswork materials, bending dies, forming dies, drawing operations.

Mould design: Splits in mould, split locking, two - cavity and multi - cavity moulds, and design details of injection moulds.

Forging Dies: Types of forging dies, open die forming closed die forming. Methods of open die forging - allowance and tolerance applicable to closed die forging - Factors to be considered - Forging equipment.

Text Books:

1. Tool Design, Donaldson Cyrll, George H. Le Cain and Goold V.C., TMH, 36th Reprint, 2006.
2. Fundamentals of Tool Design, Wilson F.W., ASTME, Prentice Hall, India, 2010.

Reference Books:

1. Principles of Machine Tools, G.C. Sen and A. Bhattacharya, New Central Book Agency, Kolkata, 2009.
2. Machine Tool Design (vol. 1,2 & 3), Acharkan, MIR Publishers, Moscow, 1973.
3. Design of Machine Tools, S.K. Basu, Allied Publishers, India, 1961.

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20ME41006– Operations Research

(Professional Elective –III)

B. Tech, ME - IV Year I Semester

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

Pre-requisites: None

Course Objectives: This course covers

1. Significance of Operations Research and formulation of LPP models.
2. Algorithms of Graphical and Simplex Methods.
3. Transportation and Assignment techniques.
4. The concepts of sequencing and replacement models.
5. The concepts of Game theory and Inventory Control.
6. The concepts of queuing theory and DPP.

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

1. formulate linear programming models and solve issues related to service, managerial and manufacturing sectors
2. develop transportation and assignment models from engineering and managerial case studies.
3. apply sequencing and replacement concepts for solutions of industry problems.
4. apply decision making methods, and inventory concepts to solve industry problems.
5. formulate Queuing models for service and manufacturing systems, solve multi-level decision problems using dynamic programming method.

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
3. Operations Research: Theory & Practice, Dr NVS Raju, BS publications, 2017

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20ME41007 –Mechanics of Composite Materials

(Professional Elective-III)

B. Tech, ME-IV Year I Semester

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

Prerequisites: NIL

Course Objectives: This course covers

1. An insight on necessity of classification of composites and their applications
2. Understand the role of reinforcement in the enhancement of mechanical properties of composite material
3. Macro mechanical analysis of Lamina and Laminates

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

1. describe composite materials and their distinctiveness from the conventional materials such as metals and alloys.
2. select an appropriate matrix and reinforcement for the synthesis of composite material.
3. analyze induced stresses and strains, and predict the failure of lamina / laminate under applied loads.
4. Understand the failure analysis of 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 2D 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 and Morozov, Elsevier, Second Edition

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20ME41008 - Tribology

(Professional Elective –III)

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

B. Tech, ME - IV Year I Semester

Pre-requisites: 20ME11001- Engineering Mechanics
20ME21001- Materials Technology
20ME22003- Manufacturing Technology
20ME31003- Design of Machine Elements

Course Objectives: This course covers

1. Theories/laws of sliding and rolling friction and the effect of viscosity of lubricants.
2. Wear, wear mechanisms and wear theories.
3. The principles of lubrication, lubrication regimes, theories of hydrodynamic and the advanced lubrication techniques.
4. The factors influencing the selection of bearing materials.
5. The concepts of surface engineering and its importance in tribology.

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

1. explain friction, wear, lubrication, and lubrication theories
2. choose proper materials and lubricants for tribological applications.
3. explain surface modifications required for reduced friction

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 nonmetals; 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:

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 Sommerfield diagram

UNIT-V:

Surface Engineering: Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes - Surface coatings - Plating and anodizing - Fusion Processes - Vapour Phase processes

Materials for Bearings - 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.

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20ME41009- Power Plant Engineering

(Professional Elective-III)

B. Tech. ME - IV Year I Semester

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

Prerequisites: 20ME21004 - Thermodynamics
20ME22001 - Thermal Engineering

Course Objectives: This Course covers:

1. Steam Power Plant and the Combustion processes
2. Diesel Power Plants and Gas Turbine power plants
3. Hydroelectric power plant and Power from Non-Conventional Sources
4. Nuclear Power Plants
5. Power plant economics and Environmental considerations

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

1. explain the basic components, working principles, combustion process, demand and safety issues of power plants.
2. Analyze the economics, influencing factors and performance of power plants.
3. Infer the demand for various non-conventional power plants to meet the power demand and to meet the environmental concerns.

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, and choice of handling equipment, coal storage, and Ash handling systems
Combustion Process: Properties of coal – overfeed and underfeed fuel beds, travelling 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:

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

UNIT- III:

Hydro Electric Power Plant: Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways. Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants

Power From Non-Conventional Sources: Solar Energy-Fuel cells-Thermo electric and Thermo ionic- Magneto hydrodynamic Generator **(**MHD) -Wind Energy -Tidal Energy

UNIT- IV:

Nuclear Power Plant: Nuclear fuel, breeding, fertile materials, nuclear reactors
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, and load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor, related exercises, Effluents from power plants and Impact on environment, pollutants and pollution standards, Methods of Pollution control

Text Books:

1. Power Plant Engineering, P. C. Sharma, S. K. Kataria Publications, 2019
2. Power Plant Engineering, P. K. Nag, McGraw Hill Education, 4th edition

Reference Books:

1. Power Plant Engineering, Rajput, Laxmi Publications
2. Power plant Engineering, Ramalingam, Sci-tech Publishers
3. Power Plant Engineering, Arora and S. Domkundwar, Dhanpat Rai & co

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20CE41071 – Green Buildings

(Open Elective-II)

B.Tech. ME - IV Year I Semester
Prerequisite(s): None.

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

Course objectives: Develop ability to

1. Impart knowledge on the sustainable construction strategies.
2. Understand green building assessment and LEED certification process.
3. Understand effective energy management systems for a smart building.
4. Learn emerging building materials and their application.
5. Understand green building implementation concepts.

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

1. Explain the scope and importance of a green building, green building movement.
2. Differentiate between conventional and green buildings and its rating system.
3. Describe the conservative use of environmental components and identify the materials for green building.
4. Explain green buildings implementation strategies.

UNIT – I:

Introduction to Green Buildings: Definition of green buildings and sustainable development– typical features of green building– Increased CO_2 trade – Sustainable construction – Major environmental and resource concerns – Green building movement and obstacles – Green building requirements – Perceived use of greenbuilding.

UNIT – II:

Green Building Process and Assessment: Conventional versus green building delivery systems – Execution of green building process – Integrated design process – Ecological design –Merits and demerits – Historical perspective – Green building rating systems – GRIHA, IGBC and LEED, Overview of the criteria as per these rating systems. International building assessment standards – Building rating system and its future – Case study of a green building.

UNIT – III:

Sustainable landscaping, Energy and Atmosphere: Land and landscape approaches for green buildings – Sustainable landscapes – Enhancing ecosystems – Storm water management – Heat Island mitigation – Building energy issues – Building energy design strategies – Buildingenvelope – Active mechanical systems – Electrical power systems – Innovative energy optimization strategies – Smart buildings and energy management systems – Ozone depleting chemicals in HVAC & R and fire suppression.

UNIT – IV:

Building Hydrologic System and Material Loops: Energy policy act of 1992 – High performance building hydrologic strategy - High performance building water supply strategy - High performance building wastewater strategy – Landscaping water efficiency – Green building

materials issues and priorities – Difference between green building buildings and green building materials – Waste Management–Handling of construction waste materials, separation of household waste, on-site and off-site organic waste management.

UNIT – V:

Green Building Implementation: Site protection planning – Health and safety planning – Construction and demolition – Waste management – Reducing the footprint of construction operations – Essentials of building commissioning – Costs and benefits of buildingcommissioning – Case study for high performance green buildings – The economics of green buildings – Quantifying green building costs – Future directions in green buildings.

Text Books:

1. Sustainable Construction: Green Building Design and Delivery, Charles.J.Kibert, John Wiley & Sons, New Jersey, 2016
2. Green Building: Guidebook for Sustainable Architecture, M.Bauer, P. Mosle and M. Schwarz, Springer, Verlag Berlin Heidelberg, 2010.

Reference Books:

1. Marketing Green Building Services: Strategies for success, Jerry Yudelson, Elsever, 2008
2. IGBC Green Homes Rating System, Version 2.0., Abridged reference guide, 2013, Indian Green Building Council Publishers.
3. Marketing Green Buildings: Guide for Engineering, Construction and Architecture, Jerry Yudelson, The Fairmont Press Inc., 2006.
4. GRIHA version 2015, GRIHA rating system, Green Rating for Integrated Habitat Assessment.
5. Green by Design: Creating a Home for Sustainable Living, Angela M. Dean, Gibbs Smith Publication, 2003.

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20EE41072– Energy Conservation and Management

(Open Elective-II)

B.Tech. ME - IV Year I Semester
Prerequisite(s): None

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

Course Objectives: Develop ability to

1. Understand different basic terms related to Indian Energy Scenario.
2. Understand the importance of energy conservation.
3. Understand different acts and policies related to energy conservation.
4. Understand about energy management and types of audits.
5. Understand basic types of management schemes in energy conservation.

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

1. Identify the demand supply gap of energy
2. Interpret the importance of energy conservation and the schemes to conserve energy along with different policies
3. Explain the need of energy audit, prepare a report suggesting appropriate conservation scheme which include energy planning

UNIT-I:

General aspects of energy: Introduction – Types of Energy – Primary and Secondary, Commercial and Non-Commercial, Renewable and Non-Renewable – Global Primary Reserves and Commercial Energy Production - Energy Scenario – Sector Wise Energy Production and Consumption in India – Energy Needs of Growing Economy – Energy Security.

UNIT-II:

Energy Conservation and Its Importance: Energy Conservation – Definition – Benefits – Identification of Energy Conservation Opportunities – Technical and Economic Feasibility – Classification of Energy Conservation Measures: Low Cost-High Return, Medium Cost-Medium Return, High Cost-High Return.

UNIT-III:

Energy Conservation Act and Its Policies: Introduction – Salient Features of Energy Conservation Act (EC Act),2001 – Schemes of BEE Under the EC Act-2001 – Electricity Act, 2003 – Integrated Energy Policy – National Action Plan on Climate Change (NAPCC).

UNIT-IV:

Energy Management and Audit: Definition and Objectives of Energy Management – Need for Energy Audit – Types of Energy Audit and Approach – Understanding Energy Costs – Benchmarking – Energy Performance – Matching Energy Usage to Requirement – Maximizing System Efficiencies – Optimizing Input Energy Requirements – Fuel and Energy Substitution.

UNIT-V:

Energy Action Planning, Management, Monitoring And Targeting: Steps Involved in Energy Action Planning – Financial Analysis Techniques – Cash Flow – Sensitivity and Risk Analysis – Financing Options – Energy Performance Contracting and Role of Energy Service Companies (ESCOs) – Developing a Typical ESCO Contract – Project Management – Project Development

Cycle (PDC) – Project Planning Techniques – Monitoring and Targeting – Setting up M&T – Key Elements of M&T System.

Text Books:

1. "Energy Management – Conservation and Audits", Anil Kumar, Om Prakash, Prashant Singh Chauhan and, Samsher Gautam, CRC Press, 2020
2. "Energy Management Handbook", Wayne C. Turner and Steve Doty, Fairmont Press; Distributed by CRC Press/Taylor & Francis.

Reference Books:

1. "General Aspects of Energy Management and Energy Audit", Guide Book for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency.
2. "Handbook of Energy Audits", Albert Thumann, Terry Niehus, William J. Younger, Fairmont Press, Inc.

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20EC41074 – Principles of Communication Systems

(Open Elective-II)

B.Tech. ME - IV Year I Semester
Prerequisite(s): None

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

Note: Only Block Diagram Approach with Qualitative Treatment of the topics is required.
Detailed mathematical treatment is not required.

Course Objectives:

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

1. Explain the concepts of AM, FM, PAM and PWM modulation techniques
2. Explain the fundamental aspects of wired and wireless networks
3. Describe the functional aspects of satellite, optical and cellular 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.

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20CS41075 – Knowledge 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 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:

1. Explain fundamental concepts of Knowledge Management Systems and their life cycle.
2. Apply knowledge capturing and knowledge codification techniques.
3. Explain methods, tools and protocols for knowledge transfer and sharing.

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 Book:

1. Elias.M. Awad & Hassan.M.Ghaziri–"Knowledge Management" Pearson Edition.

Reference Books:

1. Guus Schreiber , Hans Akkermans, AnjoAnjewierden, Robert de Hoog , Nigel Shadbolt, Walter Van de Velde and Bob Wielinga, "Knowledge Engineering and Management", Universities Press, 2001.
2. C.W. Holsapple, "Handbooks On Knowledge Management", International Handbooks on Information Systems, Vol 1and 2 , 2003.

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20MB41076– Supply Chain Management

(Open Elective-II)

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

B.Tech. ME - IV Year I Semester
Prerequisite(s): None

Course Objectives: Develop ability to

1. Distinguish the different functional areas in business 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 the 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

1. Develop and understand the role of supply chain management and logistics in business.
2. Identify the best practices in logistics operations and design distribution network and channel structure.
3. Analyse the effectiveness of functional and cross-functional operations in business.
4. Determine the supply chain drivers and logistics performance indicators.
5. Compare domestic and global supply chain management.
6. Evaluate the role of technologies in supply chain 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.

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20ME41L01 – Digital Manufacturing Lab

B. Tech. ME-IV Year, I Semester

L	T	P/D	C
-	-	2	1

Pre-requisites: 20ME32L02 - CAD/CAM lab

Course Objectives: Develop ability to

1. To apply Program for digital fabrication.
2. Make a prototype from digital data.
3. Recognize the implications of mass manufacturing when designing a prototype.
4. To familiarize the working operation of machines to develop prototypes.

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

1. devise plan of experimentation encompassing process variables identification, preparatory sketches, and methodology
2. conduct the experiment to i) create 3D printed physical models from geometric models/ scanned data and ii) develop geometric slicing using DF tools
3. compare physical models with Geometric models and reason, deviations if any
4. describe geometric modelling tools and digital fabrication tools
5. demonstrate the experimental learning through presentation/ project submission.

List of Experiments:

1. Basic 3D modelling techniques.
2. Free style modelling using 3D modelling software.
3. 3D Modelling of Machine components using parametric design Concepts (2 Experiments)
4. Creating geometric model of physical component using 3D Modelling software (2 Experiments)
5. To perform 3D Printing of the designed model (2 Experiments).
6. To perform the 3D Scanning using laser scanners (2 Experiments).
7. To understand and implement 3D Printing concepts for conversion of CAD model into real part: slicing, effect of part orientation.

Note: Student will perform any ten experiments among the above

Project:

Project involving ideation, design and final fabrication using 3D printing

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20ME41L02 - Computer Aided Production Drawing Practice Lab

B. Tech, ME- IV Year I Semester

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

Pre-requisites: 20ME11002 - Engineering Graphics
20ME22L02 - Machine Drawing Lab

Course Objectives: This course covers,

1. AutoCAD software functions to create production drawings using multiple lines, geometric shapes, and curves and use commands to save and plot.
2. Features of AutoCAD that automate the drafting process and facilitate creation of faster and accurate drawings
3. Features of AutoCAD for automated dimensions, tolerances, drawing notes and labels
4. The process sheets of various production drawings
5. Create production drawings of machine parts and process sheets using AutoCAD

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

1. illustrate dimensioning, specifications, conventions and principles of orthographic projections using CAD software.
2. apply the tools of CAD software to draw orthographic projections of machine components for shop floor communication.
3. develop part drawings with accuracy in reduced lead times using CAD tools.
4. demonstrate the experimental learning through presentation/ project submission.

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: 1) Plotting of drawings with dimensioning must be made for each exercise and attached to the records written by students.
2) Any 10 exercises from the above will be performed by the student

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.

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20ME41P01 -Project Seminar

B. Tech. ME- IV Year I Sem.

L	T	P/D	C
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Prerequisites: None

There shall be a Project seminar presentation in Fourth year First semester, for which, the student shall collect the information on the Project topic, prepare a 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 or his nominee, seminar supervisor and a senior faculty member. The Project seminar report shall be evaluated for 100 marks as CIE. There shall be no SEE for the Project seminar. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Project Seminar if the student:

i. Secures not less than 40% of the total marks allocated for the course in the evaluation by Departmental Evaluation Committee.
ii. Makes a presentation of the Project Seminar carried out before the Departmental Evaluation Committee as per schedule.
iii. Submits a report on his Project Seminar.

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

CO1. **Research** independently in collecting the required information through various resources.
CO2. **Review** and consolidate the research literature to identify and formulate the engineering problem with clear statements of problem definition and the expected deliverables
CO3. **Assess** societal, health, safety, legal and cultural issues in finding a solution for the identified engineering problem
CO4. **Formulate** a sustainable solution to the identified engineering problem taking into account the societal and environmental factors.
CO5. **Demonstrate** compliance to the prescribed standards/ safety norms in the implementation of the identified engineering problem
CO6. **Apply** knowledge of mathematics/ science/ engineering to arrive at design and development of solution(s) for the identified engineering problem
CO7. **Investigate** multiple methods of finding solutions to the identified engineering problem taking into consideration; the cost, power requirement, durability, product life, etc.
CO8. **Apply** appropriate techniques, resources, and modern engineering and IT tools in finding a solution to the identified engineering problem
CO9. **Apply** engineering and management principles in preparing time line of activities for completion of the project and the budget analysis.
CO10. **Exhibit** oral communication skills during presentations of the proposed project work, and writing skills in the preparation of the project report.

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20EC41P02 –Mini Project

B. Tech. ME- IV Year I Sem.

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

Prerequisites: None

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 the form of a report, 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 Head of the Department or his nominee, supervisor of the mini project and a senior faculty member of the department. There shall be no internal marks (CIE) for Mini Project.

A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Mini-Project if the student:

i. Secures not less than 40% of the total marks allocated for the course in the evaluation by Departmental Evaluation Committee.
ii. Makes a presentation of the Mini-Project carried out before the Departmental Evaluation Committee as per schedule.
iii. Submits a report on his Mini-Project.

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

CO1. **Research** independently in collecting the required information through various resources.
CO2. **Review** research literature to identify and formulate the engineering problem with clear statements of problem definition and the expected deliverables
CO3. **Assess** societal, health, safety, legal and cultural issues in finding a solution for the identified engineering problem
CO4. **Formulate** a sustainable solution to the identified engineering problem taking into account the societal and environmental factors.
CO5. **Demonstrate** compliance to the prescribed standards/ safety norms in the implementation of the identified engineering problem
CO6. **Apply** knowledge of mathematics/ science/ engineering to arrive at design and development of solution(s)for the identified engineering problem
CO7. **Investigate** multiple methods of finding solutions to the identified engineering problem taking into consideration; the cost, power requirement, durability, product life, etc.
CO8. **Apply** appropriate techniques, resources, and modern engineering and IT tools in finding a solution to the identified engineering problem
CO9. Apply engineering and management principles in preparing time line of activities for completion of the project and the budget analysis.
CO10. **Exhibit** oral communication skills during presentations of the project work, and writing skills in the preparation of the project report.
CO11. **Function** effectively as an individual or as a member to lead the project team and expand the networking platform of professionals.
CO12. **Exhibit** the industry culture abiding by the norms of professional ethics and engineering practice.

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B.Tech (ME)
IV Year II Semester
Detailed Syllabus

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20ME42001 - Industrial Management

(Professional Elective –IV)

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

B. Tech, ME - IV Year II Semester

Pre-requisites: Nil

Course Objectives: This course covers

1. Management, evolution, approaches and principles for various industries
2. Different types of organizational structures
3. Industrial operations and management
4. Objectives and steps in work study
5. Network analysis –PERT and CPM

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

1. explain theories, principles and concepts of - modern, scientific, operation and project management.
2. describe the system of approach, social responsibilities, marketing management, styles of leadership, and American/ Japanese management
3. explain- plan and design of organization structure, plant layout, work study methods and types of production systems.
4. apply the value analysis, Shewhart control Charts, Statistical Quality Control tools to maintain stock, and find the Probability of Completing the project by using network analysis.

UNIT – I:

Introduction: Evolution of industry and professional management, Nature and importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management, American and Japanese Style of Management

UNIT – II:

Organizational Structure: Departmentation And Decentralization, Organization And Type 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 - Their Merits, Demerits and Suitability; Entrepreneurship

Marketing Management: Marketing management process, Market segmentation, Targeting and Positioning, 4P's of marketing mix, Product Life Cycle and marketing strategies

UNIT – III:

Operations Management: Objectives, product design process, Process selections, Types of production systems - 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, FAST Diagram

Inventory Management: Functions of Inventory Management, Relevant inventory costs, Selective control techniques – ABC Analysis, VED analysis, FSN analysis, EOQ models, P - Systems and Q – Systems

UNIT – IV:

Work Study : Introduction, definition, objectives, steps in work study - Method study – definition, objectives, steps of method study; Work Measurement (Time Study) – purpose, types of study - stop watch methods, steps- key rating, allowances, standard time calculations, work sampling, Job evaluation and merit rating

Quality Management: Variables, attributes, Shewhart control Charts for variables - $\bar{X}$- chart, R-chart attributes, Defective, Defect charts for attributes, p-chart, c-chart - simple problems, Acceptance Sampling - Single sampling, Double sampling plans, OC curves

UNIT – V:

Project Management (PERT/CPM): Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing

Text books:

1. Industrial Engineering and Management, O. P. Khanna, 2nd Edition, Dhanpat Rai, 2014
2. Industrial Engineering and Management, M. Mahajan, 2nd Revised Edition, Dhanpat Rai, 2007

Reference Books:

1. Industrial Engineering and Management, NVS Raju, 1st Edition, Cengage Learning India, 2013
2. Industrial Engineering and Management, Dr. I Ravi Shanker, 2nd Edition, Galgotia Publications, 2009
3. Motion and Time Study, Ralph M. Barnes, 7th Edition, John Willey & Sons, 1980
4. Marketing Management, Kotler P., 15thEdition, Prentice Hall, New Delhi, 2017
5. Essentials of Management, Koontz H. and Weihrich H., 10thEdition, McGraw-Hill, 2015

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20ME42002 – Advanced Metal Forming

(Professional Elective - IV)

B. Tech, ME - IV Year II Semester

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

Pre-requisites: 20ME21001 - Materials Technology
20ME22003 - Manufacturing Technology

Course Objectives: This course covers a deeper insight into design and analysis aspects of metal forming.

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

1. explain the mechanism of deformation in different metal forming processes and develop analytical relations between input and output parameters.
2. design process specific dies, for metal forming in extrusion, forging and sheet metal work
3. describe various forging and sheet metal operations

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: Rolling processes, forces and geometrical relationship in rolling, simplified analysis, rolling load, rolling variables, torque and power calculations

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, problems on flow stress, true strain and forging load

UNIT- V:

Sheet Metal Forming: Formability studies, Conventional processes, HERF techniques, Super plastic forming techniques – Hydro forming, Stretch forming, Water hammer forming; Principles and process parameters, Advantages, Limitations and applications

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

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20ME42003 - Mechanical Vibrations and Acoustics

(Professional Elective-IV)

B Tech, ME – IV Year II Semester

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

Prerequisites: 20ME11001- Engineering Mechanics
20ME12001- Mechanics and Mechanical Drives
20PH11002-Engineering Physics

Course Objectives: This course covers

1. Understand various levels of vibrations and devise remedies for each of them
2. Fundamentals of design for quietness

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

1. develop schematic models of physical systems and formulate governing equations of single/ two/ multi degree freedom vibration systems.
2. illustrate the role of damping, stiffness and inertia in vibration isolators and absorbers of a mechanical system.
3. analyse sound generation, transmission, absorption, insulation and control of noise.

UNIT- I:

Fundamentals of vibrations: Simple harmonic motion, combination of two simple harmonic motions, beats, Fourier analysis
Single degree of freedom system: Free un-damped vibrations: Equivalent systems linear and torsional, natural frequency estimation, energy methods
Damped vibrations: Damping models, structural, coulomb, and viscous damping, critically, under and over-damped system, logarithmic decrement
Forced vibrations: Harmonic excitation, support motion, vibration isolation, critical speeds of shafts in bending

UNIT- II:

Two degree of freedom system: Free vibrations of spring coupled system, general solution, torsional vibrations, two degree of freedom, mass coupled system, bending vibrations in two degree of freedom system, forced vibrations of an undamped two degree of freedom system, dynamic vibration absorber, forced damped vibrations

UNIT- III:

Multi-degree of freedom system: Free un-damped analysis
Numerical methods: Dunkerley's, Rayleigh, Holzer methods
Experimental methods in vibration analysis: Vibration measurement devices and analyzers, balancing of rigid rotors

UNIT- IV:

Analysis and measurement of sound: One dimensional waves in a gas; sound perception and the decibel scale, the ear, combining sound levels in decibels, octave bands, loudness, weightings, directionality of acoustic sources and receivers, directivity index

UNIT- V:

Noise control: Noise criteria, sound absorption and insulation, noise barriers, acoustic enclosures, silencers

Text Books:

1. Mechanical Vibrations, W.T. Thomson, Prentice Hill, India
2. Theory and Practice of Mechanical Vibrations, J.S. Rao and Gupta, New Age International

Reference Books:

1. Mechanical Vibrations, G.K. Grover, S. Chand and CO
2. Acoustics for Engineers, Turner and Pretlove, Macmillan
3. Acoustics and Noise Control, Smith Peters and Owen, Addison-Wesley-Longman, 2nd Edition
4. Industrial Noise Control: Fundamentals and Applications, Bell and Bell, Marcel-Dekker

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20ME42004-Computational Fluid Dynamics
(Professional Elective – IV)

L	T	P	C
3	-	-	3

B. Tech. ME - IV Year II Semester

Prerequisites: 20ME21003 - Fluid Mechanics and Hydraulic Machinery
Chemistry
20ME32004 - Heat Transfer

Course Objectives: This Course covers:

1. Governing Equations of Heat and Mass Transfer
2. 1-D and 2-D Steady State/ Transient Heat Conduction
3. FDM to solve 1-D Transient Heat Conduction
4. Numerical Method to solve stream function and Vorticity for incompressible flow

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

1. analyze and identify Partial Differential equations and numerical methods to model Heat transfer and fluid flow problems.
2. model and Solve 1-D and 2-D heat transfer problems using FDM and numerical methods.
3. solve fluid flow problem using numerical methods

UNIT -I:

Introduction: Review of Modes of Heat Transfer – Governing Equations – Initial and boundary conditions;
Methods to solve a physical problem, Relative advantages and disadvantages of experimental, analytical and Numerical Methods; Scope of CFD, its applications and limitations; Brief comparison between different Numerical Methods - FDM, FEM & FVM Methods to solve a System of Simultaneous Linear Algebraic Equations; Direct Method – Banded Matrices, Thomas algorithm TDMA, Iterative schemes of Matrix Inversion

UNIT-II:

Classification of PDE: Elliptic, Parabolic and Hyperbolic PDE Governing Equations and their Physical Significance; FDM- Discretization of Partial Derivative using Taylor's Series; Finite Difference Formulae–Application and implementation aspects of Finite Difference equations, Consistency; Application of FDM to Elliptic equations- Laplace Equations; Solution of 1-D steady state Heat Conduction using FDM – Systems with heat generation, variable Thermal Conductivity, Fins

UNIT – III:

Application of FDM to solve 1-D steady state Heat Conduction in Curvilinear Geometry, Treatment of Singularities, and Application of FDM to solve 2-D steady state Heat Conduction with and without heat generation subjected to different Boundary Conditions

UNIT – IV:

Transient Heat Conduction: Parabolic Equations – Use of Explicit, implicit and semi-implicit methods; Errors and Stability analysis, application of FDM to solve 1-D Transient Heat Conduction Equations, ADI Scheme – Treatment and Implementation

UNIT-V:

Incompressible flow: Numerical methods for Incompressible flow – Governing equations, Difficulties in solving Navier Stoke equations, Stream function; Vorticity Method – Advantages and disadvantages, treatment of Boundary Conditions; Determination of Pressure for Viscous flows – Advantages and Disadvantages, Staggered Grid, SIMPLE Algorithm for Pressure liked Equations

Text Books:

1. Computational Fluid Flow and Heat Transfer, Muralidharan & Sundarajanan, Narosa Publications
2. Finite Difference Method in Heat Transfer, Necati Ozisik, CRC Press

Reference Books:

1. Computational Fluid Dynamics Basics with Applications, John. D, Anderson, McGraw Hill
2. Computational Methods for Fluid Dynamics, Firziger & Peric, Springer
3. Computer Simulation of Flow and Heat Transfer, Ghoshdastidar, Tata McGraw Hill
4. Numerical Methods, Chapra and Canale, TMH Publishers

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20ME42005 - Production Planning and Control
(Professional Elective - V)

B. Tech, ME -IV Year II Semester

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

Pre-requisites: 20ME22003 - Manufacturing Technology
20ME21001 - Materials Technology

Course Objectives: This course covers

1. The basic concepts of production planning and control functions and systems
2. The knowledge of production planning and control methods currently in use by industries
3. Principles and techniques in the design, planning and control of systems to optimize/make best use of resources in achieving their objectives
4. Systematic approach to the solution of planning and control problems for a wide variety of industrial and business organizations
5. Effectiveness, areas for improvement, development and implementation of PPC for production systems

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

1. explain the principles, functions, and elements of PPC, forecasting, inventory management, routing and dispatching followed in an industry.
2. describe-the types of production, forecasting systems and inventory control systems.
3. apply- inventory management techniques, MRR & ERP, LOB, JIT inventory, Japanese concepts and scheduling policies, to manufacturing industry.
4. explain the procedures of routing and dispatching, functions and applications of computers in PPC.

UNIT – I:

Production Planning and Control - Definition, Objectives, Functions, Elements of production control, Types of production systems, Organization of production planning and control department, internal organization of department.

UNIT – II:

Forecasting: Importance of forecasting, types of forecasting, their uses, General principles of forecasting, forecasting techniques – qualitative methods and quantitative methods

UNIT – III:

Inventory management: Functions of inventories, relevant inventory costs – ABC analysis, VED analysis; EOQ model - Inventory control systems, P–Systems and Q-Systems
Introduction to MRP & ERP, LOB (Line of Balance), JIT inventory, and Japanese concepts

UNIT –IV:

Routing - definition, procedure, Bill of material, Factors affecting routing procedure, Route sheets

Scheduling Policies – definition, techniques, Standard scheduling methods, job shop, flow shop, difference with loading, Line Balancing, Aggregate planning, Chase planning, Expediting, controlling aspects

UNIT – V:

Dispatching: Definition, Activities of dispatcher, dispatching procedure, follow-up - types, Reasons for existence of functions, application of computers in production planning and control

Text Books:

1. Elements of Production Planning and Control, Samuel Eilon. Macmillan, 1962
2. Modern Production/ operation managements, Baffa & Rakesh Sarin Wiley, 1987, 8th edition

Reference Books:

1. Production and Operations Management, S.N. Chary, Tata McGraw-Hill Education, 1995
2. Inventory Control Theory and Practice, Martin K. Starr and David W. Miller, Prentice-Hall Inc, Englewood, 1962
3. Production Control A Quantitative Approach, John E. Biegel, Prentice-Hall, 1971

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20ME42006–Renewable Energy Sources
(Professional Elective-V)

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

B.Tech. ME - IV Year II Semester

Prerequisites: 20ME41009 - Power Plant Engineering

Course Objectives: This Course covers:

1. Outline utilization of renewable energy sources for both domestic and industrial applications
2. Analyze the environmental effects and cost economics of renewable energy sources
3. Demonstrate knowledge of various geothermal wells and their applications
4. Understand the principles of direct energy conversion and its significance

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

1. comprehend the importance and utilization of renewable energy resources for both domestic and industrial applications.
2. analyse the environmental effects and cost economics of renewable energy resources and compare their prospects and limitations.
3. deduce resources and potential of wind energy, geothermal energy and tidal and wave energy for renewable energy generation.
4. apply concepts and laws of thermodynamics to solar energy collectors and OTEC, DEC and power generation system to design cost effective and efficient RES.

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 tilted surface, Instruments for measuring solar radiation-sun shine and solar radiation data

UNIT – II:

Solar Energy Collection: Flat plate and concentrating collectors; classification of concentrating collectors, orientation and thermal analysis, advanced collectors

Storage and Applications: Different methods – sensible latent heat, stratified storage and solar ponds; Solar applications, solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion

UNIT – III:

Wind Energy: Sources and potentials, horizontal and vertical axis windmills - performance and characteristics, Bertz criteria

Bio-mass: Principles of Bio conversion - Anaerobic/Aerobic digestion, types of biogas digesters, gas yield, combustion characteristics of biogas, utilization for cooking, I.C engine operation, economic aspects

UNIT – IV:

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India

Ocean Energy: Ocean Thermal Energy Conversion (OTEC), Utilization of Principles -setting of OTEC plants, thermodynamic cycles

Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, economics

UNIT– V:

Direct Energy Conversion: Need for DEC, Carnot cycle, limitations, and principles of DEC Thermoelectric generators - See beck, peltier and Joule Thompson effects; Magneto Hydro Dynamic (MHD) generators – principles, MHD accelerator, MHD engine

Power Generation System: Electron gas dynamic and conversion, economic aspects, Fuel cell - Principles, Faraday's laws, Thermodynamic aspects; selection of fuels and operation conditions

Text Books:

1. Renewable Energy Resources, Twidell &Wier, Taylor & Francis, 2nd Special Indian Edition
2. Non-Conventional Energy Sources, G.D.Rai, DhanpatRai and sons

Reference Books:

1. Energy Resources Utilization and Technologies, Anjaneyulu and Francis, BS Publications, 2012
2. Solar Energy, Sukhatme, McGraw-Hill, 3rd edition, 2008
3. Fundamentals of Renewable Energy systems, D. Mukherjee, S. Chakrabarty, New age International
4. Non-Conventional Energy, Ashok V Desai, Wiley Eastern New International (P) Limited, 2003

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20ME42007-Automobile Engineering

(Professional Elective-V)

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

B. Tech. ME - IV Year, II Semester

Prerequisites: 20ME21004 - Thermodynamics
20ME22001 - Thermal Engineering

Course Objectives: This Course covers:

1. Basic knowledge about the automobiles and their sub-systems
2. Different types of engines and automobile bodies
3. Basic awareness on the automotive industry and its terminology
4. Idea of utilization of resources duly reducing emission levels

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

1. explain evolution and terminology of automobiles.
2. explain fuels, fuel supply systems, pollution standards and pollution control methods
3. describe ignition systems and cooling systems of an automobile.
4. illustrate transmission system, lubrication systems, braking systems, steering systems and suspension systems of an automobile.

UNIT – I:

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 and .YosufAli, Frontline Publications
2. Internal Combustion Engine Fundamentals, J.B. Heywood, McGraw Hill Co, 1988

Reference Books:

1. Automobile Engineering, Gupta S.K. ,S Chand publications, Kindle Edition, 2016
2. Automobile Engineering, A K Babu and Ajit Pal Singh, S Chand, 2013
3. Automobile Engineering, Sudhir Kumar Saxena , Laxmi Publications, 1st edition ,2015
4. A Text Book of Automobile Engineering, R K Raj put, Laxmi Publications.

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20ME42008 – Fluid Power Systems

(Professional Elective –V)

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

B. Tech. ME- IV Year II Semester

Prerequisites: 20ME21003 - Fluid Mechanics and Hydraulic Machinery

Course Objectives: This Course covers:

1. Concepts governing fluid power.
2. Common hydraulic and pneumatic components.
3. Mathematical models of hydraulic and pneumatic circuits.
4. Simple fluid power systems.
5. Actual components and fluid power circuits used in industrial applications.

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

1. enunciate the purpose and applications of fluid power systems.
2. select hydraulic and pneumatic power systems for a required application.
3. analyse the hybrid circuits to develop the methods for troubleshooting 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, Selection-actuators, valves, pressure control, flow control and direction control valves; Hydraulic Accessories, Hydraulic Accumulator

UNIT-II:

Pneumatic Systems: Introduction to Pneumatics, Types of Compressors, Air treatment, Filter Regulator, Lubricator (FRL) unit, Air Dryer, Control Valves, Logic valves, Time delay valve and quick exhaust valve; Types of Pneumatic Sensors, 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 or pneumatic circuits applied to machine tools, presses, material handling systems, Automotive systems, packaging industries, manufacturing automation; Maintenance in fluid power systems –

preventive, break down, procedures; Trouble shooting of fluid power systems - fault finding process, tools used, causes and remedies; Safety aspects involved

Text Books:

1. Oil Hydraulics, Majumdar S R., Tata Mc Graw Hill, 2003
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

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20CE42081– 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. Acquire knowledge on disaster and assess their impact.
2. Comprehend the monitoring techniques of disasters.
3. Understand the issues and policies involved in the disaster management.
4. Evaluate the pre-disaster risk and vulnerability reduction strategies.
5. Assess the role of NGO's, Government bodies and Public in the disaster mitigation and management.

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

1. Explain Environmental and Man-made Hazards happening in India and globally.
2. Differentiate between Hazards & Disasters, such as endogenous, exogenous, planetary hazards.
3. Describe the causes and effects of hazards, identify safety measures.
4. Apply special measures to rebuild the environment using disaster management techniques.

UNIT–I:

Introduction: Meaning and Concept of Environmental hazards, Environmental Disasters and Environmental stress. Different approaches and relation with human Ecology – Landscape Approach – Ecosystem Approach – Perception approach – Human ecology and its application in geographical researches.

UNIT–II:

Types of Environmental Hazards & Disasters: Natural and Man induced. Natural Hazards – Planetary Hazards/Disasters – Extra Planetary Hazards/ Disasters – Planetary Hazards – Endogenous Hazards – Exogenous Hazards.

UNIT–III:

Endogenous Hazards/ Disasters: Volcanoes – Earthquakes – Landslides – Earthquake Hazards/ Disasters – Causes of Earthquakes – Distribution of Earthquakes – Hazardous effects of Earthquakes – Earthquake Hazards in India - Human adjustment, perception & mitigation of earthquake.

UNIT–IV:

Exogenous Hazards/ Disasters: Infrequent events – Cumulative atmospheric hazards/ disasters.
Infrequent events: Cyclones – Lightening – Hailstorms.
Cyclones: Tropical cyclones & Local storms – Destruction by tropical cyclones & local storms (causes, distribution, human adjustment, perception & mitigation)
Cumulative Atmospheric Hazards/ Disasters: Floods – Droughts – Cold waves – Heat waves.

Floods: Causes of floods – Flood hazards – Flood control measures (Human adjustment, perception & mitigation).
Droughts: Impact of droughts – Drought hazards in India – Drought control measures.
Extra Planetary Hazards/ Disasters: Man induced hazards/ Disasters – Physical Hazards/ Disasters – Soil Erosion.
Soil Erosion: Mechanics & forms of soil erosion – Factors & causes of soil erosion – conservation measures of soil erosion.
Chemical Hazards/ Disasters: Release of toxic chemicals, nuclear explosion – Sedimentation processes: Global sedimentation problems – Regional sedimentation problems – Sedimentation & Environmental problems – Corrective measures of Erosion & Sedimentation.
Biological Hazards/ Disaster: Population Explosion.

UNIT–V:

Emerging approaches in Disaster Management – Three Stages
1) Pre- Disaster Stage (Preparedness)
2) Emergency Stage
3) Post Disaster Stage – Rehabilitation

Text Books:

1. 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)
2. Disaster Management, Dr. Mrinalini Pandey, Wiley India Pvt Ltd., 2014.
3. Disaster Science and Management, Tushar Bhattacharya, McGraw Hill Education, 2015.

Reference Books:

1. Disaster Mitigation: Experiences and Reflections, Pardeep Sahni, PHI Learning, 2010.
2. Natural Hazards and Disasters, Donald Hyndman and David Hyndman, Cengage Learning, 2013.
3. Disaster Management Global Challenges and Local Solutions, Rajib, S and Krishna Murthy, R.R, University Press Hyderabad, 2009.
4. Earth and Atmospheric Disaster Management: Nature and Manmade, Navale Pandharinath & C. K. Rajan, B.S. Publications, Hyderabad, 2009.
5. Disaster Risk Reduction in South Asia, Sahni and Pardeep, PHI learning Pvt Ltd, 2003.

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20EE42082– Micro-Electro-Mechanical Systems

(Open Elective-III)

B.Tech. ME - IV Year II Semester
Prerequisite(s): None

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

Course Objectives:

1. To introduce to basics of Micro-electro-mechanical systems
2. To understand properties of materials involved in MEMS
3. To pertain fabrication methods involved in MEMS manufacturing
4. To apply the concepts for various applications

Course Outcomes: Upon completion of the course, the student will be able to

1. Explain the basic concepts involved in MEMS technologies
2. Describe the properties of various materials involved in MEMS technologies
3. Apply the concepts and technologies involved in designing of MEMS
4. Explain different manufacturing processes involved in the fabrication of MEMS
5. Explain the functional aspects of various MEMS structures and devices.

UNIT I:

Introduction to MEMS: What is MEMS, Historical Background, classification, Micro-engineering, importance of micro-engineering. Technological advancements in MEMS, advantages and disadvantages of MEMS.

UNIT II:

MEMS materials: Materials used in MEMS. Material properties: electrical, mechanical, thermal, chemical, biological, optical and processing. Reliability issues of materials

UNIT III:

Designing of MEMS: Design and analysis process for MEMS. Initial design process, structured design process. Commonly used design flow, structured design flow. Design flow for MEMS cad design. Design and verification flow for integrated MEMS.

UNIT IV:

MEMS fabrication Techniques: Photolithography, materials for micromachining, bulk micromachining Surface micromachining, High aspect-ration-micromachining, assembly and system integration.

UNIT V:

MEMS structures and devices: Mechanical sensors, mechanical actuators, micro-fluidic devices, optical/photonic micro-systems, biological transducers.

Text Books:

1. Adams TM, Layton RA., *"Introductory MEMS: Fabrication and applications",* 2010.
2. Tobergte DR, Curtis S., *"An Introduction to Micro-electro-mechanical Systems Engineering"* Second Edition. vol. 53. 2013.

Reference Books:

1. Kreith F, Kreider JF., *"The MEMS Handbook*‖ CRC Press 2002.
2. Reza Ghodssi, Pinyen Lin, *"MEMS Materials and Processes Handbook"* Springer 2013
3. Gad-el-Hak M, *"MEMS applications"* 2nd edition, CRC press 2006.

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20EC42084– Biomedical Instrumentation

(Open Elective-III)

B.Tech. ME - IV Year II Semester
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

1. Describe the functioning of different human physiological systems.
2. Analyze the operations of transducers and recorders used for bio-medical applications.
3. Describe the functionality of medical imaging systems.
4. Illustrate the working principles of monitoring instruments used for bio-medical applications.
5. Describe the need for biomedical supporting instruments.

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. Cromwell, "Bio-Medical Instruments and Measurements", Prentice Hall of India, 1990.
2. Dr.Arumugam, "Bio-Medical Instrumentation", Anuradha Agencies, 1994.

Reference Books:

1. Prof.Venkataram.S.K, "Bio-Medical Electronics & Instrumentation", 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

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20CS42085– Database Systems

(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. 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

1. Design simple database using ER modelling and analyse the RDBMS approach towards database design.
2. Apply theoretical and practical database querying languages to efficiently retrieve data stored in the database.
3. Apply functional dependency and normalization techniques to arrive at a minimally redundant database.
4. Apply concepts of concurrency control and data recovery in database transactions.
5. Apply indexing techniques to organize the data on the secondary storage devices enabling efficient data retrieval.

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 Data bases: Data analysis, data mining, data warehousing, spatial and geographical, multimedia database, mobility and personal database, distributed information system. World Wide Web, OLAP

Text Book:

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.

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20MB42086– Entrepreneurship

(Open Elective-III)

B. Tech. ME - IV Year II Semester
Prerequisite(s): None

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

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 frame work
5. Apply strategic perspectives in entrepreneurship.

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

1. Identify and apply the concepts of entrepreneurship.
2. Evaluate and use the concepts of IPR and opportunities to launch new ventures.
3. Justify the nature of the creativity process and innovation as an entrepreneur.
4. Evaluate entrepreneurial challenges and analyze new ventures.
5. Develop strategic plans for business and entrepreneurship.
6. Design and develop strategies for entrepreneurial sustainability.

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. D F Kuratko and T V Rao "Entrepreneurship- A South - Asian Perspective "Cengage Learning, 1/e, 2012.
2. Vasanth Desai "Small Scale industries and entrepreneurship" Himalaya Publishing 2012.

Reference Books:

1. Stuart Read, Effectual Entrepreneurship, Routledge, 2013.
2. Nandan H, Fundamentals of Entrepreneurship, PHI, 2013.

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Open Electives

Offered by

Mechanical Engineering

to other branches of Engineering

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20ME22063/20ME31063/20ME32063– NANOMATERIALS AND TECHNOLOGY

(Open Elective - I)

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

B. Tech-CE/EEE/ECE/CSE

Pre-requisites: None

Course Objectives: Develop ability to

1. Expose the students to a highly interdisciplinary subject
2. Enable the students to understand the basic concepts of Nanotechnology
3. Enhance the knowledge of students in nanomaterials, properties and their applications

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

1. identify the need of nano materials in engineering applications
2. explain the synthesis of zero dimensional, one-dimensional and two-dimensional nano structured materials
3. illustrate the synthesis of thin films and special nano materials

UNIT I:

Introduction: Importance of Nano-technology, Emergence of Nano-Technology, Bottom-up and Top-down approaches, challenges in Nano Technology.

UNIT II:

Zero Dimensional Nano-Structures: Nano particles through homogenous nucleation; Growth of nuclei, synthesis of metallic Nano particles, Nano particles through heterogeneous nucleation; Fundamentals of heterogeneous nucleation and synthesis of nano particles using micro emulsions and Aerosol.

UNIT III:

One Dimensional Nano-Structures: Nano wires and nano rods, Spontaneous growth: Evaporation and condensation growth, vapor-liquid-solid growth, stress induced re-crystallization.
Template based synthesis: Electrochemical deposition, Electro-phoretic deposition. Electro-spinning and Lithography

UNIT IV:

Two Dimensional Nano-Structures: Fundamentals of film growth. Physical vapour Deposition (PVD): Evaporation molecular beam epitaxy (MBE), Sputtering, Comparison of Evaporation and sputtering.
Chemical Vapour Deposition (CVD): Typical chemical reactions, Reaction kinetics, transportant phenomena, CVD methods, diamond films by CVD.

UNIT V:

Thin Films: Atomic layer deposition (ALD), Electro-chemical deposition (ECD), Sol-Gel films.
Special Nano Materials: Carbon fullerence and nano tubes. Carbon fullerness: formation, properties and applications. Carbon nano tubes: formation and applications.

Text Books:

1. Nano structures and Nano materials: Synthesis, properties and applications, Guozhong Cao, Imperial College press in 2004, 2nd edition.
2. Nanotechnology, Rechard Booker and Earl Boysen, Willey, 2006.

References:

1. Nano: The Essentials; T. Pradeep, Tata McGraw-Hill, 2008.
2. Nanotechnology and Nano electronics, W.R. Fahrner, Springer, 2006.

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20ME31073/20ME32073/20ME41073– Digital Fabrication

(Open Elective-II)

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

B. Tech- CE/EEE/ECE/CSE

Pre-requisites: NIL

Course Objectives: Develop ability to,

1. Introduce basics of geometric modelling of physical objects,
2. Convert digital data to obtain physical components by metal subtraction and addition processes.

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

1. prepare a geometric modelling scheme required for additive/ subtractive manufacturing
2. develop process codes required in subtractive manufacturing and additive manufacturing
3. illustrate additive manufacturing methods-SLA, SLS, FDM and their superiority over subtractive manufacturing methods
4. explain the robotic manipulations in cutting, bending, folding, stacking, weaving, stitching, Bio printing, and Food Printing
5. Select suitable polymer for additive manufacturing

UNIT I:

Geometric modelling-2D, 2 ½ D, 3D Modelling; Solid representations-CSG, Boundary representations, VOXEL representations; Overview of digital manufacturing processes

UNIT II:

Subtractive Manufacturing –Introduction to G codes and M codes; Operations on CNC Lathe-Turning and facing; operations on CNC Mill-Planing, grooving and drilling; Introduction to simple CNC Program (Demonstration only);

UNIT III:

Additive Manufacturing- Stereo lithography, Selective Laser Sintering, Fused Deposition Modelling; Conversion of Geometric model to .stl for 3D printing (Demonstration only)

UNIT IV:

Robotic manipulations: Cutting- Laser Cutting, Plasma Cutting, Water jet cutting; bending; folding; stacking; weaving; stitching, Bio printing, Food Printing;

UNIT-V:

Introduction to Engineering polymers- acetals (polyoxymethylenes), ABS, (Acrilonitrile-Butadiene-Suyrene), polycarbonates, polyphenylene ethers and oxides, polyamides (nylons); and thermoplastic polyesthers.

Text Books:

1. Digital Fabrication, Philip F. Yuan, Neil Leach, Tonji University press
2. Digital Fabrication in Architecture, Luca Caneparo, Engineering and Construction, Springer

Reference Books:

1. Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing, Gibson, I, Rosen, D W., and Stucker, B., Springer, 2010.
2. Rapid Prototyping – Laser Based and Other Technologies, Venu vinod, PK., Ma, W., Kluwer, 2004.
3. Fundamentals of electronic materials and devices, Safa O Kasap, Mc Graw Hill, 3rd ed

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20ME42083-Principles of Automobile Engineering

(Open Elective-III)

B. Tech, CE/EEE/ECE/CSE, IV Year II Semester

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

Pre-requisites: None

Course Objectives: Develop ability to,

1. Introduction to Engineering analysis of the automobiles and their sub systems.
2. Applications of engineering principles to automotive design.
3. Improves ability to understand the different types of engines and automobile bodies.
4. Familiarization with the automotive industry and its terminology.
5. 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:

1. explain evolution and terminology of automobiles.
2. describe fuel supply systems, ignition systems and cooling systems of an automobile.
3. illustrate transmission system, lubrication system, braking system, and steering system of an automobile.

UNIT – I:

Introduction: History of Automobiles, Classification of Automobiles. Chassis and body building, Engine Terminology, Classification of Engines

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

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-III:

Ignition System: Function of an ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser and spark plug – Magneto coil ignition system, Battery ignition system

UNIT-IV:

Transmission System: Clutch principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, gear boxes, types. Propeller shaft, Hotch Kiss drive, Torque tube drive, universal joint, differential, live and dead axles, wheels and tyres.

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: Types of steering mechanism, Ackerman steering mechanism, Davis steering mechanism

Text Books:

1. Kirpal Singh, Automobile Engineering, Vol.1 and 2, Standard Publishers, New Delhi, 2003.
2. A Text Book of Automobile Engineering by R K Rajput. Laxmi Publications.

Reference Books:

1. Automotive Engines / Srinivasan
2. A Text Book of Automobile Engineering By Khalil U Siddiqui New Age International
3. Automobile Engineering / William H Crouse
4. A Text Book Automobile Engineering–Manzoor,. Nawazish Mehdi & .Yosuf Ali, Frontline Publications.

M Tech Electives

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20ME4110/20MOE303 – OPERATIONS RESEARCH

B. Tech -ME/CE - IV Year I Semester/ M Tech CSE

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

Pre-requisites: None

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:

1. Describe the importance of Operations Research, Formulate a managerial decision problem into a mathematical model to solve by simplex method;
2. Formulate and apply transportation and assignment problems for engineering and managerial situations.
3. Apply sequencing and replacement concepts in industry applications
4. Apply game theory and inventory concepts in industry applications
5. 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

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20MOE305 – Composite Materials

M. Tech CSE, II Year- I Semester

Pre-requisites: None

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

Course objectives: Develop ability to

1. Overview engineering materials
2. Understand the concept of tailored properties of materials
3. Select or devise a manufacturing method to synthesize composite materials
4. Test and evaluate mechanical properties of composite materials

Course Outcomes: Upon completion of this course, a student will be able to:

1. Classify the materials and identify the necessity to adopt composite materials
2. Identify the role of reinforcement in the composites to enhance mechanical properties of materials
3. Comprehend on reinforced composites and select application specific composite
4. Select a manufacturing method for synthesis of composite material
5. Infer on testing of composite materials in the evaluation of mechanical properties of composite materials

UNIT-I:

Introduction: Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc.

UNIT-II:

Reinforcements/Fibers: Role and Selection or reinforcement materials, Types of fibres, Glass fibers, Carbon fibers, Aramid fibers , Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc., Mechanical properties of fibres. Material properties that can be improved by forming a composite material and its engineering potential

UNIT-III:

Types of composites: Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC); Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites, Comparison with Metals, Advantages & limitations of Composites

UNIT-IV:

Fabrication methods: Processing of Composite Materials: Overall considerations, Autoclave curing, Other Manufacturing Processes like filament welding, compression molding, resin-transplant method, Pultrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrix

performs, Manufacturing Techniques: Tooling and Specialty materials, Release agents, Peel plies, release films and fabrics, Bleeder and breather plies, bagging films

UNIT-V:

Testing of Composites: Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc

Text Books:

1. Composite Materials – Science & Engineering, K.K. Chawla, Springer-Verlag, New York, 1987.
2. Mechanical Metallurgy, G. E. Dieter, Mc-Graw Hill

Reference Books:

1. Thermal Analysis of Materials, R.F. Speyer, Marcel Decker,
2. Engineering Materials: Polymers, Ceramics and Composites, A.K Bhargava, Prentice Hall India
3. Materials characterization, Vol. 10, ASM hand book