CMR COLLEGE OF ENGINEERING& TECHNOLOGY

(UGC Autonomous)

Kandlakoya, Medchal Road, Hyderabad – 501 401

ACADEMIC REGULATIONS - R 22

FOR CBCS & OUTCOME BASED B.TECH (REGULAR, HONOURS and MINOR) PROGRAMMES

(Effective for the students admitted into I year from the Academic Year 2022-23)

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

CMR College of Engineering & Technology, Hyderabad offers 4 Years (8 Semesters) Bachelor of Technology (B.Tech.) Regular, Honours and Minor degree Programmes, under Choice Based Credit System (CBCS), with effect from the Academic Year 2022-23 and onwards, in the Branches of Engineering.

2.0 Eligibility for Admission:

2.1 Admissions will be done as per the norms prescribed by the Government of Telangana. The Government orders in vogue shall prevail.

2.2 The candidate should have passed the qualifying examination Intermediate or equivalent on the date of admission.

2.3 Seats in each program in the college are classified into Category–A (70% of intake) and Category-B (30% of intake) besides Lateral Entry. Category-A seats will be filled by the Convener, TSEAMCET Admissions. Category-B seats will be filled by the College as per the guidelines of the Competent Authority.

2.4 Lateral Entry seats for 10% of the candidates from the approved strength of the course shall be admitted into the III Semester directly based on the rank secured by the candidate in TSECET in accordance with the guidelines from the Competent Authority.

2.5 The medium of instructions for the entire undergraduate programme in Engineering &Technology will be **English** only

3.0 B.Tech. Programme Structure:

3.1 A student after securing admission shall complete the B.Tech. programme in a minimum period of **four** academic years (8 semesters), and a maximum period of **eight** academic years (16 semesters) starting from the date of commencement of first year first semester, failing which student shall forfeit seat in B.Tech. course. Each student shall secure 160 credits (with CGPA ≥ 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 listed below.

3.2.1 **Semester Scheme:**

Each undergraduate programme is of 4 academic years (8 semesters) with the academicyear divided into two semesters (First/Odd and Second/Even). Each Semester shall have a minimum of 90 Instructional Days.

Semester - 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)' under Choice Based Credit System (CBCS) and Credit Based Semester System(CBSS) indicated by UGC, and curriculum/course structure suggested by AICTE are followed.

3.2.2 **Credit Courses:**

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

- One credit for one hour/ week/ semester for Theory/ Lecture (L) courses or Tutorials.

- One credit for two hours/ week/ semester for Laboratory/ Practical (P) courses.

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

3.2.3 Subject Course Classification:

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

S. No.	Broad Course Classification	Course Group/ Category	Course Description
1	Foundation Courses (FnC)	BSC – Basic Sciences	Includes Mathematics, Physics and Chemistry subjects
2		ESC - Engineering Sciences	Includes Fundamental Engineering Subjects
3		HSMC – Humanities and Social Sciences	Includes subjects related to Humanities, SocialSciences and Management
4	Core Courses (CoC)	PCC – Professional Core	Includes core subjects related to the parent Discipline / department / branch of Engineering.
5	Elective Courses (EℓC)	PEC – Professional Electives	Includes elective subjects related to the parent Discipline / department / branch of Engineering.
6		OEC – Open Electives	Elective subjects which include inter- disciplinary subjects or subjects in an area outside the parent discipline / department / branch of Engineering.
7	Core Courses (PROJ)	Project Work	B.Tech. Project or UG Project or UG Major Project or Project Stage I & II
8		Industry Training/ Internship/ Mini- project/ Mini- Project/ Skill Development Courses	Industry Training/ Internship/ Mini-Project/ Mini-Project/ Skill DevelopmentCourses
9		Seminar	Seminar/ Colloquium based on core contents related to parent discipline/ department/ branch of Engineering.
10	Minor Courses	-	1 or 2 Credit Courses (subset of HSMC)
11	Mandatory Courses (MC)	-	Mandatory Courses (non-credit)

4.0 Course Registration:

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

4.2 The academic section of the college invites 'registration forms' from students before the beginning of the semester through 'on-line registration', ensuring 'date and time stamping'. The online registration requests for any 'current semester' shall be **completed before the commencement of SEEs (Semester End Examinations) of the'preceding semester'**.

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

4.4 A student may be permitted to register for all the subjects/ courses in a semester as specified in the course structure with maximum additional subject(s)/course(s) limited to 6 Credits (any 2 elective subjects), based on **progress** and SGPA/ CGPA, and completion of the '**pre-requisites'** as indicated

for various subjects/ courses, in the department course structure and syllabus contents.

4.5 Choice for '**additional subjects/courses**', not more than any 2 elective subjects in any Semester, must be clearly indicated, which needs the specific approval and signature of the Faculty Advisor/Mentor/HOD.

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

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

4.8 Dropping of subjects/ courses may be permitted, only after obtaining prior approval from the faculty advisor/ counselor 'within a period of 15 days' from the beginning of the current semester.

4.9 **Open Electives**: The students have to choose three Open Electives (OE-I, II & III) from the list of Open Electives given by other departments. However, the student can opt for an Open Elective subject offered by his own (parent) department, if the student has not registered and not studied that subject under any category (Professional Core, Professional Electives, Mandatory Courses etc.) offered by parent department in any semester. Open Elective subjects already studied should not repeat/should not match with any category (Professional Core, Professional Electives, and Mandatory Courses etc.) of subjects even in the forthcoming semesters.

4.10 **Professional Electives**: The students have to choose six Professional Electives (PE-I to VI) from the list of professional electives given.

5.0 Subjects/ courses to be offered:

5.1 A subject/ course may be offered to the students, **only if** a minimum of 15 students opt for it.

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

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

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

6.0 Attendance requirements:

6.1 A student shall be eligible to appear for the semester end examinations, if the student acquires a minimum of 75% of attendance in aggregate of all the subjects/ courses (including attendance in mandatory courses and Additional courses if any) for that semester. **Two periods** of attendance for each theory subject shall be considered, if the student appears for the mid-term examination of that subject.

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 for condoning of shortage of attendance.

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

6.5 **Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examinations of that semester. They get detained and their registration for that semester shall stand cancelled,** including all academic credentials (internal marks etc.) of that

semester. **They will not be promoted to the next semester**. They may seek re-registration for all those subjects registered in that semester, in which the student is detained, by seeking re-admission into that semester asand when offered; if there are any professional electives and/ or open electives, the same may also be re-registered if offered. However, if those electives are not offered inlater semesters, then alternate electives may be chosen from the **same** set of elective subjects offered under that category.

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

7.0 Academic Requirements:

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

7.1 A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course, if student secures not less than 35% (14 marks out of 40 marks) in the Continuous Internal Evaluation (CIE), not less than 35% (21 marks out of 60 marks) in the semester end examinations (SEE), 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 A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Real-time Research Project (or) Field Based Research Project (or) Mini Project (or) Internship (or) Technical Seminar, if the student secures not less than 40% marks (i.e. 40 out of 100 allotted marks) in each of them. The student is deemed to have failed, if he (i) does not submit a report on Mini Project/Internship, or (ii) not make a presentation of the same before the evaluation committee as per schedule, or (iii) secures less than 40% marks in Real-time ResearchProject (or) Field Based Research Project (or) Mini Project (or) Internship (or) Technical Seminar evaluations.

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

7.3 Promotion Rules:

S. No.	Promotion	Conditions to be fulfilled
1	First year first semester tofirst 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 yearsecond semester. (ii) Must have secured at least 20 credits outof 40 credits i.e., 50% credits up to first yearsecond semester from all the relevantregular and supplementary examinations, whether the student takes thoseexaminations 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 semesterto Third year first semester	(i) Regular course of study of second year second semester. (ii) Must have secured at least 48 credits outof 80 credits i.e., 60% credits up to second year second semester from all the relevant regular and supplementary examinations, whether the student takes thoseexaminations 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 semesterto Fourth year first semester**	**(i) Regular course of study of third year second semester.** **(ii) Must have secured at least 72 credits outof 120 credits i.e., 60% credits up to third year second semester from all the relevant regular and supplementary examinations, whether the student takes thoseexaminations 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 course structure, (ii) fulfills all the attendance and academic requirements for 160 credits, (iii) earn all 160 credits by securing SGPA □ 5.0 (in each semester), andCGPA ≥ 5 (at the end of 8 semesters), (iv) **secured satisfactory grade in 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 consolidated grade cum credit sheet.

7.5 If a student registers for '**extra subjects'** (in the parent department or other departments/branches of Engg.) other than those listed subjects totaling to 160 credits as specified in the course structure of his department, the performances in those '**extrasubjects**' (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 subjects'** registered, percentage of marks and letter grade alone will beindicated in the grade card / marks memo as a performance measure, subject to completion of the attendance and academic requirements as stated in regulations Items6 and 7.1 – 7.4 above.

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

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.

8.0 Evaluation - Distribution and Weightage of Marks:

8.1 The performance of a student in every subject/course (including practicals and ProjectStage – I & II) will be evaluated for 100 marks each, with 40 marks allotted for CIE (Continuous Internal Evaluation) and 60 marks for SEE (Semester End-Examination).

8.2 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/short answer paper for 10 marks.
   b. Part - B : Descriptive paper for 20 marks.

The objective/quiz/short answer paper is set with multiple choice, fill-in the blanks, match the following type of questions and short answer questions for a total of 10 marks (10 questions). The descriptive paper shall contain6 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/quiz 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 shallbe 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 Over all 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 Computer Based Test (CBT)/onetime improvement test of mid examinations for R22 regulations.

The details of the end semester question paper pattern are as follows:

8.2.1 The semester end examinations (SEE), for theory subjects, will be conducted for 60marks 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 unitscarrying 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.

8.3 For practical subjects there shall be a Continuous Internal Evaluation (CIE) during thesemester for 40 marks and 60 marks for semester end examination. Out of the 40 marksfor internal evaluation:

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 shallbe 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) PrototypePresentation 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 cluster / other colleges which will be decided by the examination branch of the University.

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 Over all 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.

8.4 The evaluation of courses having ONLY internal marks in I Year I Semester and II Year II Semester is as follows:

1. I Year I Semester course ***(ex., Elements of CE/ME/EEE/ECE/CSE etc)*:** The internal evaluation is for 50 marks and it shall take place during I Mid-Term examination and II Mid-Term examination. The average marks of two Mid-Term examinations is the final for 50 marks. Student shall have to earn 40%, i.e 20 marks out of 50 marks from average of the two examinations. There shall be NO external evaluation. The student is deemed to have failed, if he (i) is absent as per schedule, or (ii) secures less than 40% marks in this course.

   For CSE/IT and allied branches the Continuous Internal Evaluation (CIE) will be for 50 marks. Each Mid-Term examination consists of two parts i) Part – A for 20 marks, ii) Part – B for 20 marks with a total duration of 2 hours.

   Part A: Objective/quiz paper is set with multiple choice, fill-in the blanks and match the following type of questions for a total of 20 marks.

   Part B: Descriptive paper shall contain 6 full questions out of which, the student has to answer 4 questions, each carrying 5 marks.

   The remaining 10 marks of Continuous Internal Evaluation are for Assignment (5 marks) and Subject Viva-Voce/PPT/Poster Presentation/ Case Study (5 marks) and the evaluation pattern will remain same as for other theory subjects.

   For all other branches, the Continuous Internal Evaluation (CIE) will be for 50 marks. Out of the 50 marks for internal evaluation:

   a) **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.**
   b) **10 marks for viva-voce (or) tutorial (or) case study (or) application (or) poster presentation of the course concerned.**
   c) **Internal practical examination conducted by the laboratory teacher concerned shall be evaluated for 15 marks.**
   d) **The remaining 15 marks are for Laboratory Report/Project and Presentation, 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.**

2. II Year II Semester *Real-Time (or) Field-based Research Project* course: The internal evaluation is for 50 marks and it shall take place during I Mid-Term examination and II Mid-Term examination. The average marks of two Mid-Term examinations is the final for 50 marks. Student shall have to earn 40%, i.e 20 marks out of 50 marks from average of the two examinations. There shall be NO external evaluation. The student is deemed to have failed, if he (i) does not submit a report on the Project, or (ii) does not make a presentation of the same before the internal committee as per schedule, or
   (ii) secures less than 40% marks in this course.

8.5 There shall be Industry training (or) Internship (or) Mini-project (or) Skill Development Courses (or) Paper presentation in reputed journal in collaboration with an industry of their specialization. Students shall register for this immediately after II-Year II Semester Examinations and pursue it during summer vacation/semester break & during III Year without effecting regular course work. Internship at reputed organization (or) Skill development courses (or) Paper presentation in reputed journal (or) Mini Project shall be submitted in a report form and presented before the committee in III-year II semester before end semester examination. It shall be evaluated for 100 external marks. The committee consists of an External Examiner, Head of the Department, Supervisor of the Mini Project (or) Internship etc, Internal Supervisor and a Senior Faculty Member of the Department. There shall be **NO internal marks** for Industry Training (or) Internship (or) Mini-Project (or) Skill Development Courses (or) Paper Presentation in reputed journal.

8.6 There shall be a **Technical Seminar** presentation in the VIII Semester. For the Technical Seminar, the student shall collect the information on a specialized topic related to his branch other than the Real-Time (or) Field-based Research Project/ Mini project/ Internship/ Major Projects Phase-I & II topic with due approval of the Head of the department and prepare a technical report and submit to the department. The presentation demonstrating understanding of the topic and technical report shall be evaluated by a Departmental committee consisting of the Head of the department, Technical Seminar supervisor and a senior faculty member from the department. The Technical Seminar will be evaluated for 100 marks.

8.7 The UG project shall be initiated at the end of the IV Year I Semester and the duration of the project work is one semester. The student must present Project Stage – I during IV Year I Semester before II Mid examinations, in consultation with his supervisor, the title, objective and plan of action of his Project work to the departmental committee for approval before commencement of IV Year II Semester. Only after obtaining the approval of the departmental committee, the student can start his project work.

8.8 UG project work shall be carried out in two stages: Project Stage – I for approval of project before Mid-II examinations in IV Year I Semester and Project Stage – II during IV Year II Semester. Student has to submit project work report at the end of IV Year II Semester. The project shall be evaluated for 100 marks before commencement of SEE Theory examinations.

8.9 For Project Stage – I, the departmental committee consisting of Head of the Department, project supervisor and a senior faculty member shall approve the project work to begin before II Mid-Term examination of IV Year I Semester. The student is deemed to be not eligible to register for the Project work, if he does not submit a report on Project Stage - I or does not make a presentation of the same before the evaluation committee as per schedule.

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

8.10 For Project Stage – II, the external examiner shall evaluate the project work for 60 marks and the internal project committee shall evaluate it for 40 marks. Out of 40 internal marks, the departmental committee consisting of Head of the Department, Project Supervisor and a Senior Faculty Member shall evaluate the project work for 20 marks and Project Supervisor shall evaluate for 20 marks. The topics for Mini Project/ Internship/SDC etc. and the main Project shall be different from the topic already taken. The student is deemed to have failed, if he (i) does not submit a report on the Project, or (ii) does not make a presentation of the same before the External Examiner as per schedule, or (iii) secures less than 40% marks in the sum total of the CIE and SEE taken together.

For conducting viva-voce of project, The External Examiner shall be nominated by the Controller of Examinations from the panel of 3 names of external faculty members (Professors or Associate Professors outside the College) submitted by the HoD.

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

8.11 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 Viva- voce / PPT / Poster presentation / Case Study on a topic in the concerned subject) areless 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 class work 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.

8.12 **For mandatory courses, a student has to secure 40 marks out of 100 marks (i.e. 40% of the 100 marks allotted) in the Continuous Internal Evaluation for passing the subject/course.**

8.13 **No marks or letter grades shall be allotted for mandatory/non-credit courses. Only Pass/Fail shall be indicated in Grade Card.**

9.0 Grading Procedure:

9.1 Grades will be awarded to indicate the performance of students in each Theory Subject, Laboratory/Practicals/ Mini Project/Internship/SDC and Project Stage. Based on the percentage of marks obtained (Continuous Internal Evaluation plusSemester End Examination, both taken together) as specified in item 8 above, a corresponding letter grade shall be given.

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

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

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

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

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

9.6 A student earns Grade Point (GP) in each subject/ course, on the basis of the letter gradesecured in that subject/ course. The corresponding 'Credit Points' (CP) are computed by multiplying the grade point with credits for that particular subject/ course.

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

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

9.8 The Semester Grade Point Average (SGPA) is calculated by dividing the sum of creditpoints (CP)

secured from all subjects/ courses registered in a semester, by the total number of credits registered during that semester. SGPA is rounded off to **two** decimalplaces. SGPA is thus computed as

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

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

9.9 The Cumulative Grade Point Average (CGPA) is a measure of the overall cumulative performance of a student in all semesters considered for registration. The CGPA is the ratio of the total credit points secured by a student in **all** registered courses (of 160) in **all** semesters, and the total number of credits registered in **all** the semesters. CGPA is rounded off to **two** decimal places. CGPA is thus computed from the I year II semesteronwards at the end of each semester as per the formula

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

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

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

Illustration of calculation of SGPA:

Course/Subject	Credits	Letter Grade	Grade Points	Credit Points
Course 1	4	A	8	4 x 8 = 32
Course 2	4	O	10	4 x 10 = 40
Course 3	2	C	5	2 x 5 = 10
Course 4	3	B	6	3 x 6 = 18
Course 5	1	A+	9	1 x 9 = 9
Course 6	1	C	5	1 x 5 = 5
Course 7	1	O	10	1 x 10 = 10
Course 8	2	A	8	2 x 8 = 16
Course 9	1	B^+	7	1 x 7 = 7
Course 10	1	B^+	7	1 x 7 = 7
	20			154

SGPA = 154/20 = 7.7

Illustration of Calculation of CGPA up to 3rd Semester:

Semester	Course/ Subject Title	Credits Allotted	Letter Grade Secured	Corresponding Grade Point (GP)	Credit Points (CP)
I	Course 1	4	A	8	32
I	Course 2	4	O	10	40
I	Course 3	2	B	6	12
I	Course 4	3	A	8	24
I	Course 5	1	A+	9	9
I	Course 6	1	C	5	5
I	Course 7	1	B	6	6

I	Course 8	2	A	8	16
I	Course 9	1	C	5	5
I	Course 10	1	O	10	10
II	Course 11	2	B+	7	14
II	Course 12	4	B	6	24
II	Course 13	4	A	8	32
II	Course 14	3	O	10	30
II	Course 15	1	A	8	8
II	Course 16	1.5	C	5	7.5
II	Course 17	1.5	O	10	15
II	Course 18	1.5	B+	7	10.5
II	Course 19	1.5	B	6	9
III	Course 20	4	A	8	32
III	Course 21	3	B+	7	21
III	Course 22	3	A	8	24
III	Course 23	3	O	10	30
III	Course 24	3	A	8	24
III	Course 25	2	C	5	10
III	Course 26	1	O	10	10
III	Course 27	1	B+	7	7
	Total Credits	**60**		**Total Credit Points**	**467**

CGPA = 467/60 = 7.78

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

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

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

10.0 Passing Standards:

10.1 A student shall be declared successful or 'passed' in a semester, if he secures a GP ≥ 5(**'C'** grade or above) in every subject/course in that semester (i.e. when the student gets an SGPA ≥ 5.0 at the end of that particular semester); and he shall be declared successful or 'passed' in the entire undergraduate programme, only when gets a CGPA ≥ 5.00 (**'C'** grade or above) for the award of the degree as required.

10.2 After the completion of each semester, a grade card or grade sheet shall be issued to allthe registered students of that semester, indicating the letter grades and credits earned. It will show the details of the courses registered (course code, title, no. of credits, gradeearned, etc.) and credits earned. **There is NO exemption of credits in any case.**

11.0 Declaration of results:

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

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

used.

% of Marks = (final CGPA – 0.5) x 10

12.0 Award of Degree:

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

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

12.3 A student with final CGPA (at the end of the undergraduate programme) 8.00, and fulfilling the following conditions - shall be placed in '**First Class with Distinction'**.

However, he

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

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

A student not fulfilling any of the above conditions with final CGPA 8 shall beplaced in **'First Class'.**

12.4 Students with final CGPA (at the end of the undergraduate programme) 7.0 but < 8.00 shall be placed in **'First Class'.**

12.5 Students with final CGPA (at the end of the undergraduate programme) 6.00 but < 7.00, shall be placed in '**Second Class'**.

12.6 All other students who qualify for the award of the degree (as per item 12.1), with finalCGPA (at the end of the undergraduate programme) 5.00 but < 6, shall be placed in '**pass class**'.

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

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

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

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(within 4 years from the date of admission) upto B.Tech. II Year II Semester, if the student want to exit the 4-Year B.Tech. Program and *requests for the 2 -Year* B. Tech. (*UG) Diploma Certificate.*
2. The student **once opted and awarded 2-Year UG Diploma Certificate, the student will 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 ONLY in the next academic year along with next batch students. *However, if any student wishes to continue the study after opting for exit, he/she should register for the subjects/courses in III Year I Semester before commencement of classwork for that semester.*
3. *The students, who exit the 4-Year B. Tech. program after II Year of study and wish to re-join the B.Tech. Program, must submit the 2 -Year* B. Tech. (*UG) Diploma Certificate awarded to him, subject to the eligibility for completion of Course/Degree.*
4. 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 university 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).

13.0 Withholding of results:

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

14.0 Transitory Regulations:

A. For students detained due to shortage of attendance:

1. A Student who has been detained in I year of R18 Regulations due to lack of attendance, shall be permitted to join I year I Semester of R22 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 to VIII semesters of R18 regulations for want of attendance, shall be permitted to join the corresponding semester of R22 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 R22 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 R18 Regulations, who has been detained due to lack of credits, shallbe promoted to the next semester of R22 Regulations only after acquiring the required number of credits as per the corresponding regulations of his/her first admission. 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 R22 Academic Regulations are applicable to a student from the year of readmission. See rule (C) for further Transitory Regulations.

C. For readmitted students in R22 Regulations:

4. A student who has failed in any subject under any regulation has to pass those subjects in the same regulations.
5. The maximum credits that a student acquires for the award of degree, shall be thesum of the total number of credits secured in all the regulations of his/her study including R22 Regulations. **There is NO exemption of credits in any case**.
6. If a student is readmitted to R22 Regulations and has any subject with 80% of syllabus common with his/her previous regulations, that particular subject in R22Regulations will be substituted by another subject to be suggested by the Board of Studies.
7. The total credits required are 160 including both R18 & R22 regulations, and if the total credits are less than 160 including both R18 & R22 Regulations then an additional course(s) suggested by the Board of Studies may be given to fulfill the minimum requirements of 160 credits.

Note: If a student readmitted to R22 Regulations and has not studied any subjects/topicsin his/her earlier regulations of study which is prerequisite for further subjects in R22 Regulations, the remedial classes shall be conducted to cover those subjects/topics for the benefit of the students.

15.0 Student Transfers:

15.1 There shall be no Branch transfers after the completion of Admission Process.

15.2 Transfer of candidates from other Institutions will be governed by the regulations of Telangana State Government issued from time to time.

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

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

15.5 The autonomous affiliated colleges have to provide one chance to write the internal examinations in the equivalent subject(s) to the students transferred from other universities/institutions to JNTUH

autonomous affiliated colleges who are on rolls, as per the clearance (equivalence) letter issued by the University.

16.0 Scope:

i) Where the words "he", "him", "his", occur in the write-up of regulations, they include "she", "her", "hers".

ii) Where the words "Subject" or "Subjects", occur in these regulations, they also imply "Course" or "Courses".

iii) The Academic Regulations should be read as a whole, for the purpose of any interpretation.

iv) In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal/College Academic Council/Honourable Vice-Chancellor of JNTUH is final.

v) The College may change or amend the Academic Regulations, Course Structure or Syllabi at any time, and the changes or amendments made shall be applicable to all Students with effect from the dates notified by the College Authorities.

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ACADEMIC REGULATIONS FOR B.TECH (LATERAL ENTRY SCHEME)

(Applicable for the students admitted into II Year B.Tech (Lateral Entry Scheme) from the Academic Year 2023-24 and onwards)

1. **Eligibility for the award of B.Tech Degree (LES)**
   The LES students after securing admission shall pursue a course of study for not lessthan 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 II year to IV-year B.Tech. programme (LES) for the award of B.Tech. degree.
3. The students, who fail to fulfil the requirement for the award of the degree in sixacademic years from the year of admission, shall forfeit their seat in B.Tech.
4. The attendance requirements of B. Tech. (Regular) shall be applicable to B.Tech.(LES).
5. **Promotion rule**

S. No	Promotion	Conditions to be fulfilled
1	Second year first semester tosecond year second semester	Regular course of study of second yearfirst semester.
2	Second year second semester tothird year first semester	(i) Regular course of study of secondyear second semester. (ii) Must have secured at least 24 creditsout of 40 credits i.e., 60% credits up to second year second semester from all therelevant regular and supplementary examinations, whether the student takesthose examinations or not.
3	Third year first semester tothird year second semester	Regular course of study of third yearfirst semester.
4	Third year second semester to fourth year first semester	(i) Regular course of study of third yearsecond semester. (ii) Must have secured at least 48 creditsout of 80 credits i.e., 60% credits up to third year second semester from all the relevant regular and supplementary examinations, whether the student takesthose examinations or not.
5	Fourth year first semester tofourth year second semester	Regular course of study of fourth yearfirst semester.

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

7. **LES students are not eligible for 2-Year B. Tech. Diploma Certificate.**

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MALPRACTICE RULES

Disciplinary Action for Malpractices/Improper Conduct in Examinations:

	Nature of Malpractices / Improper conduct	Punishment
1.(a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers, smart watches, electronic gadgets or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only. Confiscation of Cell phones, pager, palm computers, smart watches, electronic gadgets etc. and the same would be handed over only after punishment finalized by Malpractice Committee.
(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, pager, palm computers, smart watches, electronic gadgets 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 subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him. Confiscation of Cell phones, pager, palm computers, smart watches, electronic gadgets etc. and the same would be handed over only after punishment finalized by Malpractice Committee.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers, cell phones, smart watches, electronic gadgets or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations excluding Project work/ Mandatory Courses /Technical Seminar and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket of the candidate is to be cancelled. Confiscation of Cell phones, pager, palm computers, smart watches, electronic gadgets etc. and the same would be handed over only after punishment finalized by Malpractice Committee.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate Who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the Remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all end semester examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.

4.	Smuggles the answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all end semester 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 subject
6.	Refuses to obey the orders of the Chief Superintendent/Assistant– Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the or organizes a walk out or instigates others **to** examination hall-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 subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates are also debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all Semester End Examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects 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	If the student belongs to the college, expulsion from the examination performance in that subject and all other subjects shall and cancellation of the

	malpractice or improper conduct mentioned in clause 6 to 8.	candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a state of inebriated/drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for other remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations excluding Project work/ Mandatory Courses /Technical Seminar of that semester/year.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the College Academic Committee for further action to award suitable punishment.	

Malpractices identified by squad or special invigilators:

Punishments to the candidates as per the above guidelines:

Malpractice identified at Spot center during valuation:

1) The following procedure is to be followed in the case of malpractice cases detected during valuation, scrutiny etc. at spot center. Malpractice is detected at the spot valuation. The case is to be referred to the malpractice committee. Malpractice committee will meet and discuss/question the candidate and based on the evidences, the committee will recommend suitable action on the candidate.
2) A notice is to be served to the candidate(s) involved through the principal regarding the malpractice and seek explanations.

3) The involvement of staff who are in charge of conducting examinations, invigilators valuing examination papers and preparing / keeping records of documents relating to the examinations in such acts (inclusive of providing in correct or misleading information) that infringe upon the course of natural justice to one and all concerned at the examinations shall be viewed seriously and recommended for award of appropriate punishment after thorough enquiry.

4) Based on the explanation and recommendation of the committee action may be initiated.

Malpractice committee:

(a) Chief Superintendent	Chairman
(b) Controller of Examinations	Member
(c) Dean Academics	Member
(d) Chief Examiner of the Course/ Subject Expert	Member
(e) Concerned Head of the Department	Member
(f) Observer	Member

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CMR COLLEGE OF ENGINEERING AND TECHNOLOGY
(AUTONOMOUS)
DEPARTMENT OF MECHANICAL ENGINEERING

Institute Vision:

To be a premier academic institution striving continuously for excellence in technical education, research and technological services to the nation

Institute Mission:

1. Create and sustain a community of learning in which students acquire knowledge and learn to apply it professionally with a concern for the society.
2. Pursue and disseminate research findings and offer knowledge-based technological services to satisfy the needs of society and the industry.
3. Promote professional ethics, leadership qualities and social responsibilities.

Department Vision:

To produce technically competent engineers and become a center of excellence in the field of Mechanical Engineering and related fields

Department Mission:

1. To educate and empower the students with the state of art knowledge in the area of mechanical engineering and allied fields.
2. To create, explore and develop innovations through research and consultancy.
3. To develop self learning abilities, leadership qualities and professional ethics among the students to service the society.

Program Educational Objectives:

PEO1: Excel in their professional career and in higher education in Mechanical Engineering and related fields.

PEO2: Imbibe professional ethics, Communicative skills and the team spirit to work independently or cohesively with a group.

PEO3: Demonstrate lifelong learning skills for sustainable development and service to the society.

Program Outcomes:

1. **Engineering Knowledge:** Ability to apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems in mechanical engineering.
2. **Problem Analysis:** Ability to Identify and formulate research literature and analyze complex engineering problems in Mechanical Engineering using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/Development of Solutions:** Ability to design solutions for complex engineering problems and design system components or processes that meet the specified needs considering public health and safety, and cultural, societal, and environment.

4. Ability to use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to obtain solutions to Mechanical engineering problems.
5. Ability to create, select and apply appropriate techniques, resources and modern engineering activities, with an understanding of the limitations.
6. Ability to apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Ability to understand the knowledge of contemporary issues related to Mechanical Engineering and their impacts on societal and environmental contexts and to progress for sustainability.
8. Ability to apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Ability to communicate effectively oral, written and in graphic forms on complex engineering activities.
11. Ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one‘s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Ability to recognize the need for and having the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES:

PSO-1: Ability to formulate and analyze complex engineering problems in various domains of Mechanical Engineering like Thermal, Design, Production and Industrial Engineering.

PSO-2: Capability to build and apply innovative ideas in design for development of industrial products with the aid of contemporary computerised tools, while ensuring paramount manufacturing traditions.

CMR COLLEGE OF ENGINEERING & TECHNOLOGY

(UGC AUTONOMOUS)

B. Tech- Mechanical Engineering

CBCS & OUTCOME BASED COURSE STRUCTURE

(Effective for the students admitted into I year from the Academic Year 2022-23)

SEMESTER - I

S. No	Course Code	Course Title	Category	Hours per Week			Credits	Maximum Marks	
				L	T	P		CIE	SEE
1	A400101	English for skill Enhancement	HSMC	2	0	0	2	40	60
2	A400001	Matrices and Calculus	BSC	3	1	0	4	40	60
3	A400008	Applied Physics	BSC	3	1	0	4	40	60
4	A403201	Engineering Mechanics	ESC	3	0	0	3	40	60
5	A403501	Elements of Mechanical Engineering	ESC	0	0	2	1	50	-
6	A403503	Engineering Workshop	ESC	0	1	3	2.5	40	60
7	A400503	English Language and Communication Skills Laboratory	HSMC	0	0	2	1	40	60
8	A400501	Applied Physics Laboratory	BSC	0	0	3	1.5	40	60
9	A400505	Introduction to Social Innovation	HSMC	0	0	2	1	40	60
10	A400704	Universal Human Values	HSMC	2	0	0	0	-	-
		Total:		**13**	**3**	**12**	**20**		
		Total hours per Week:		**28**					

SEMESTER - II

S. No	Course Code	Course Title	Category	Hours per Week			Credits	Maximum Marks	
				L	T	P		CIE	SEE
1	A400002	Ordinary Differential Equations and Vector Calculus	BSC	3	1	0	4	40	60
2	A400009	Engineering Chemistry	BSC	3	1	0	4	40	60
3	A403301	Engineering Materials	PCC	2	0	0	2	40	60
4	A405202	C Programming and Data Structures	ESC	3	0	0	3	40	60
5	A403202	Engineering Graphics	ESC	1	0	3	2.5	40	60
6	A400502	Engineering Chemistry Laboratory	BSC	0	0	2	1	40	60
7	A403505	Fuels & Lubricants Laboratory	PCC	0	0	2	1	40	60
8	A405503	C Programming and Data Structures Laboratory	ESC	0	0	2	1	40	60

9	A400506	Engineering Exploration & Practice	HSMC	0	0	3	1.5	40	60
10	A400703	Constitution of India	MC	2	0	0	0	-	-
		Total:		**14**	**2**	**12**	**20**		
		Total hours per Week			**28**				
		Total Credits in I Year: 40							

SEMESTER - III

S.No.	Course Code	Course Title	Category	Hours per Week			Credits	Maximum Marks	
				L	T	P		CIE	SEE
1	A403303	Metallurgy & Material Science	PCC	3	0	0	3	40	60
2	A403304	Thermodynamics	PCC	3	0	0	3	40	60
3	A403305	Mechanics of Solids	PCC	3	0	0	3	40	60
4	A401201	Fluid Mechanics & Hydraulic Machinery	ESC	3	0	0	3	40	60
5	A402204	Basic Electrical and Electronics Engineering	ESC	3	0	0	3	40	60
6	A401506	Fluid Mechanics & Hydraulic Machinery Laboratory	ESC	0	0	2	1	40	60
7	A402504	Basic Electrical and Electronics Engineering Laboratory	ESC	0	0	2	1	40	60
8	A400507	Social innovation in Practice	HSMC	0	0	2	1	40	60
9	A405506	Python Programming Laboratory	ESC	0	1	2	2	40	60
10	A400702	Gender Sensitization	MC	2	0	0	0	-	-
		Total:		**17**	**1**	**8**	**20**		
		Total hours per Week:			**26**				

SEMESTER - IV

S.No.	Course Code	Course Title	Category	Hours per Week			Credits	Maximum Marks	
				L	T	P		CIE	SEE
1	A400004	Probability, Statistics & Complex Variables	BSC	3	1	0	4	40	60
2	A403302	Manufacturing Processes	PCC	2	0	0	2	40	60
3	A403306	IC Engines & Gas Turbines	PCC	3	0	0	3	40	60
4	A403307	Kinematics of Machinery	PCC	3	0	0	3	40	60
5	A403309	Instrumentation & Control Systems	PCC	2	0	0	2	40	60
6	A403506	Material Science & Mechanics of Solids Laboratory	PCC	0	0	2	1	40	60
7	A403507	Manufacturing Processes Laboratory	PCC	0	0	2	1	40	60
8	A403508	Computer Aided Machine Drawing	PCC	0	0	2	1	40	60
9	A403509	Instrumentation & Control Systems Laboratory	PCC	0	0	2	1	40	60

10	A400701	Environmental Science	MC	2	0	0	0	-	-
11	A403801	Real-Time Research Project/Field Based Project-I	PROJ	0	0	4	2	40	60
		Total:		**15**	**1**	**12**	**20**		
		Total hours per Week			**28**				
		Total Credits in II Year: 40							
	SEMESTER - V								
S.No.	**Course Code**	**Course Title**	**Category**	**Hours per Week**			**Credits**	**Maximum Marks**	
				L	**T**	**P**		**CIE**	**SEE**
1	A403308	Dynamics of Machinery	PCC	3	0	0	3	40	60
2	A403312	Design of Machine Elements	PCC	3	0	0	3	40	60
3	A403310	Metrology & Machine Tools	PCC	3	0	0	3	40	60
4	A400102	Business Economics & Financial Analysis	HSMC	3	0	0	3	40	60
5	A403311	Steam Power & Jet Propulsion	PCC	3	0	0	3	40	60
6	A403314	CAD/CAM	PCC	2	0	0	2	40	60
7	A403510	Thermal Engineering Laboratory	PCC	0	0	2	1	40	60
8	A403511	Metrology & Machine Tools Laboratory	PCC	0	0	2	1	40	60
9	A403512	Theory of Machines Laboratory	PCC	0	0	2	1	40	60
		Total:		**17**	**0**	**6**	**20**		
		Total hours per Week:			**23**				
	SEMESTER - VI								
S.No.	**Course Code**	**Course Title**	**Category**	**Hours per Week**			**Credits**	**Maximum Marks**	
				L	**T**	**P**		**CIE**	**SEE**
1	A403313	Machine Design	PCC	3	0	0	3	40	60
2	A403315	Heat Transfer	PCC	3	0	0	3	40	60
3	A403316	Finite Element Methods	PCC	3	0	0	3	40	60
4	A403317	Refrigeration & Air Conditioning	PCC	3	0	0	3	40	60
5		**Professional Elective-I**	PEC	3	0	0	3	40	60
6	A400504	Advanced English Communication Skills Laboratory	HSMC	0	0	2	1	40	60
7	A403513	Heat Transfer Laboratory	PCC	0	0	2	1	40	60
8	A403514	Computer Aided Engineering Laboratory	PCC	0	0	2	1	40	60
9	A400705	Intellectual Property Rights	MC	2	0	0	0	-	-

10	A403802	Industry Oriented Mini Project/Internship	PROJ	0	0	4	2	-	-
		Total:		**17**	**0**	**10**	**20**	**-**	**-**
		Total hours per Week			**27**				
		Total Credits in III Year: 40							

	SEMESTER - VII								
S.No.	**Course Code**	**Course Title**	**Category**	**Hours per Week**			**Credits**	**Maximum Marks**	
				L	**T**	**P**		**CIE**	**SEE**
1	A403318	Industrial Management	PCC	2	0	0	2	40	60
2		**Professional Elective-II**	PEC	3	0	0	3	40	60
3		**Professional Elective-III**	PEC	3	0	0	3	40	60
4		**Professional Elective-IV**	PEC	3	0	0	3	40	60
5		**Professional Elective-V**	PEC	3	0	0	3	40	60
6		**Open Elective-I**	OEC	3	0	0	3	40	60
7	A403803	Major Project Phase-I	PROJ	0	0	6	3	40	60
	Total:			**17**	**0**	**6**	**20**		-
	Total hours per Week:				**23**				
	SEMESTER - VIII								
S.No.	**Course Code**	**Course Title**	**Category**	**Hours per Week**			**Credits**	**Maximum Marks**	
				L	**T**	**P**		**CIE**	**SEE**
1		**Professional Elective- VI**	PEC	3	0	0	3	40	60
2		**Open Elective-II**	OEC	3	0	0	3	40	60
3		**Open Elective-III**	OEC	3	0	0	3	40	60
4	A403804	**Major Project Phase-II**	PROJ	0	0	18	9	40	60
5	A403805	**Technical Seminar**	PROJ	0	0	4	2	100	
		Total:		**9**	**0**	**22**	**20**		
		Total hours per Week			**31**				
		Total Credits in IV Year: 40							

FINAL TOTAL CREDITS : 160

PROFESSIONAL ELECTIVES OFFERED IN R22

PROFESSIONAL ELECTIVE – I

A403401	Unconventional Machining Processes
A403402	Production Planning & Control
A403403	Operations Research
A403404	Microprocessors in Automation

PROFESSIONAL ELECTIVE – II

A403405	Additive Manufacturing
A403406	Automation in Manufacturing
A403407	Artificial Intelligence in Mechanical Engineering
A403408	Mechatronics

PROFESSIONAL ELECTIVE – III

A403409	Power Plant Engineering
A403410	Automobile Engineering
A403411	Non-Conventional Energy Sources
A403412	Solar Energy Technology

PROFESSIONAL ELECTIVE – IV

A403413	Re Engineering
A403414	Turbo Machinery
A403415	Fluid Power Systems
A403416	Computational Fluid Dynamics

PROFESSIONAL ELECTIVE – V

A403417	Industrial Robotics
A403418	Composite Materials
A403419	Energy Conservation and Management
A403420	Mechanical Vibrations

PROFESSIONAL ELECTIVE – VI

A403421	Industry 4.0
A403422	Electric and Hybrid Vehicles
A403423	Total Quality Management
A403424	Fuzzy Logic and ANN

List of Open Electives- R22

Open Elective-I		
S. No	**Course Code**	**Course Name**
1	A404601	Fundamentals of Internet of Things
2	A404602	Principles of Digital Signal Processing
3	A402601	Renewable Energy Sources
4	A402602	Basics of Power Electronics & Drives
5	A405604	Java Programming
6	A405602	Fundamentals of Operating Systems
7	A403601	Fundamentals of Engineering Materials
8	A403602	Basics of Thermodynamics
9	A400601	Basics of Logistics and Supply Chain Management
10	A400602	Industrial Relations
11	A401601	Disaster Preparedness & Planning Management
12	A401602	Environmental Impact Assessment
Open Elective-II		
1	A404603	Sensors and Transducers
2	A404604	Image Processing
3	A402603	Electrical Vehicle Technology
4	A402604	Basics of Power Plant Engineering
5	A405601	Fundamentals of Database management Systems
6	A405605	Web programming
7	A403603	Fundamentals of Manufacturing Processes
8	A403604	Fundamentals of Automobile Engineering
9	A400603	Entrepreneurship
10	A400604	Ethics in Business & Corporate Governance
11	A401603	Remote Sensing & Geographical Information Systems
12	A401604	Solid Waste Management
Open Elective-III		
1	A404605	Fundamentals of Embedded Systems
2	A404606	Data Communications
3	A402605	Nano Technology
4	A402606	EV Batteries & Charging System
5	A405603	Fundamentals of Computer networks
6	A405606	Fundamentals of DevOps
7	A403605	Industrial safety Engineering
8	A403606	Waste to Energy
9	A400605	Basics of Marketing
10	A405607	Cloud Computing
11	A401605	Energy Efficient Buildings
12	A401606	Environmental Pollution

(A400101) ENGLISH FOR SKILL ENHANCEMENT
(Common to all branches)

B. Tech. (ME): I Semester

L	T	P	C
2	0	0	2

UNIT-I:
Chapter entitled 'Toasted English' by R.K. Narayan from "English: Language, Contextand Culture" published by Orient BlackSwan, Hyderabad.
Vocabulary: The Concept of Word Formation -The Use of Prefixes and Suffixes -Acquaintance with Prefixes and Suffixes from Foreign Languages to form Derivatives -Synonyms and Antonyms
Grammar: Identifying Common Errors in Writing with Reference to Articles and Prepositions.
Reading: Reading and Its Importance- Techniques for Effective Reading.
Writing: Sentence Structures -Use of Phrases and Clauses in Sentences- Importance ofProper Punctuation- Techniques for writing precisely – Paragraph Writing – Types, Structuresand Features of a Paragraph - Creating Coherence-Organizing Principles of Paragraphs inDocuments.

UNIT–II:
Chapter entitled 'Appro JRD 'by Sudha Murthy from "English Language, Context and Culture" published by Orient Black Swan, Hyderabad.
Vocabulary: Words Often Misspelt - Homophones, Homonyms and Homographs Grammar: Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement andSubject-verb Agreement.
Reading: Sub-Skills of Reading – Skimming and Scanning

UNIT–III:
Chapter entitled 'Lessons from Online Learning' by F. HaiderAlvi, Deborah Hurst et alfrom "English: Language, Context and Culture" published by Orient BlackSwan, Hyderabad.
Vocabulary: Words Often Confused - Words from Foreign Languages and their Use inEnglish.
Grammar: Identifying Common Errors in Writing with Reference to Misplaced Modifiers andTenses.
Reading: Sub-Skills of Reading – Intensive Reading and Extensive Reading – Exercises forPractice.
Writing: Format of a Formal Letter-Writing Formal Letters E.g.., Letter of Complaint, Letter ofRequisition, Email Etiquette, Job Application with CV/Resume.

UNIT-IV:
Chapter entitled 'Art and Literature' by Abdul Kalam from "English: Language, Context and Culture" published by Orient BlackSwan, Hyderabad.
Vocabulary: Standard Abbreviations in English Grammar: Redundancies and Clichés in Oraland Written Communication.
Reading: Writing: Survey, Question, Read, Recite and Review (SQ3R Method) - Exercises for Practice Writing Practices
Essay Writing-Writing Introductionand Conclusion -Précis Writing

UNIT-V:
Grammar: Common Errors in English (Covering all the other aspects of grammar which werenot covered in the previous units)
Reading: Writing: Reading Comprehension-Exercises forPractice Technical Reports- Introduction.

NOTE:
Listening and Speaking Skills which are given under in AICTE Model Curriculum are covered in the syllabus of ELCS Lab Course.

- NOTE 1: As the syllabus of English given in AICTE Model Curriculum-2018 for B.Tech FirstYear is Open-ended, besides following the prescribed textbook, it is required to prepareteaching/learning materials by the teachers collectively in the form of handouts based on theneeds of the students in their respective colleges for effective teaching/learning in the class.

- NOTE 2: Based on the recommendations of NEP 2020, teachers are requested to be flexibleto adopt Blended Learning in dealing with the course contents. They are advised to teach 40percent of each topic from the syllabus in blended mode.

TEXT BOOK:

1. "English: Language, Context and Culture" by Orient BlackSwan Pvt. Ltd, Hyderabad. 2022. Print.

REFERENCE BOOKS:

1. Effective Academic Writing, (2nd edition) by Liss and Davis (OUP) 2014.
2. Richards, Jack C. Interchange Series. Introduction, (4th edition), Cambridge University Press 2022
3. Remedial English Grammar by Wood F.T, Macmillan.2007.
4. Learn English: A Fun Book of Functional Language, Grammar and Vocabulary, (2nd edition) Chaudhuri, SantanuSinha, Sage Publications India Pvt. Ltd.2018
5. Technical Communication, (1st edition), Wiley India Pvt. Ltd.2019
6. English for Technical Communication for Engineering, Vishwamohan, Aysha 2013

COURSE OUTCOMES:

On completion of the course students will be able to

1. Understand the importance of vocabulary and sentence structures.
2. Choose appropriate vocabulary and sentence structures for their oral and written communication.
3. Demonstrate their understanding of the rules of functional grammar.
4. Develop comprehension skills from the known passages.
5. Acquire basic proficiency in reading and writing modules of English and take an active part in drafting paragraphs, letters, essays, abstracts, precis, and reports in various contexts.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	2	3	-	-
CO2	-	-	-	-	-	-	-	-	-	2	2	
CO3	-	-	-	-	-	-	-	-	-	2	-	-
CO4	-	-	-	-	-	-	-	-		3	-	2
CO5	-	-								2		3

(A400001) MATRICES AND CALCULUS
(Common to All)

B. Tech. (ME): I Semester

L	T	P	C
3	1	0	4

UNIT-I:
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 equations and non-homogeneous equations by Gauss elimination method, Gauss Seidel Iteration Method.

UNIT-II:
Eigen values and Eigen vectors:
Linear Transformation and Orthogonal transformation: Eigen values, Eigen vectors and their properties, Diagonalization of a square matrix, Cayley-Hamilton theorem (without proof) -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 by orthogonal transformations.

UNIT-III:
Calculus: Mean value theorems: Rolle's theorem, Lagrange's mean value theorem with their geometrical interpretation and applications, Cauchy's mean value theorem, Taylor's series, Applications of definite integrals to evaluate surface areas and volumes of revolutions of curves (only in Cartesian coordinates),
Improper Integral: Beta, Gamma functions and their applications.

UNIT-IV:
Multivariable calculus (Partial Differentiation and applications): Partial differentiation: Euler's Theorem, Total derivative, Jacobian, Functional dependence & independence. Applications: Maxima and minima of functions of two variables and three variables using method of Lagrange multipliers.

UNIT-V:
Multivariable Calculus (Integration): Evaluation of Double Integrals (Cartesian and polar coordinates), change of order of integration (only Cartesian form), Evaluation of Triple Integrals: Change of variables (Cartesian to polar) for double and (Cartesianto Spherical and Cylindrical polarcoordinates) for triple integrals.

TEXT BOOKS:
1. Higher Engineering Mathematics, (36thEdition), B.S. Grewal, Khanna Publishers, 2010.
2. Advanced Engineering Mathematics, (5thEdition), R.K. Jain and S.R.K Iyengar, Narosa Publications, 2016.

REFERENCE BOOKS:
1. Advanced Engineering Mathematics, (9th Edition), Erwinkreyszig, John Wiley& Sons,2006.
2. Calculus and Analytic geometry, (9thEdition), G.B. Thomas and R.L. Finney, Pearson, Reprint, 2002.
3. A text book of Engineering Mathematics, (10th Edition), N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2019.
4. Higher Engineering Mathematics, (11thReprint), Ramana B.V., Tata McGraw Hill New Delhi, 2010.

COURSE OUTCOMES:
On completion of the course students will be able to
1. Solve linear system of equations represented by matrices
2. Obtain Eigen values, Eigen vectors and perform diagonalization of a square matrix.
3. Verify mean value theorems & evaluation of improper integrals by using Beta and Gamma functions.
4. Develop the skill of determining optimal values of multivariable functions using classical methods.
5. Evaluate the multiple integrals and apply the concept to find areas, volumes.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	-	-	-	-	-	-	-	2
CO2	3	2	3	2	-	-	-	-	-	-	-	2
CO3	2	3	2	2	-	-	-	-	-	-	-	2
CO4	3	2	3	3	-	-	-	-	-	-	-	3
CO5	3	2	3	2	-	-	-	-	-	-	-	3

(A400008) APPLIED PHYSICS
(Common to all branches)

B. Tech. (ME): I Semester

L	T	P	C
3	1	0	4

UNIT–I:

QUANTUM MECHANICS: Introduction to quantum physics, blackbody radiation – Stefan-Boltzmann's law, Wein's and Rayleigh-Jean's law, Planck's radiation law - photoelectric effect – de Broglie hypothesis- Davisson and Germer experiment –Heisenberg uncertainty principle - Born interpretation of the wave function – time independent Schrodinger wave equation - particle in one dimensional potential box.

ELECTRIC PROPERTIES OF SOLIDS: Free electron theory (Drude& Lorentz, Sommerfeld) - Fermi-Dirac distribution - Bloch's theorem -Kronig-Penney model – E-K diagram- effective mass of electron-origin of energy bands- classification of solids.

UNIT–II:

SEMICONDUCTORS AND DEVICES: Intrinsic and extrinsic semiconductors, Variation of Fermi level with temperature – Hall Effect - Construction, principle of operation and characteristics of P-N Junction diode, Zener diode

PHOTONIC DEVICES: Direct and indirect band gap semiconductors –LED, PIN diode, avalanche photo diode (APD) and solar cells, their structure, materials, working principle and characteristics.

UNIT–III:

LASERS: Laser beam characteristics-three quantum processes-Einstein coefficients and their relations- lasing action - pumping methods- ruby laser, He-Ne laser, CO_2 laser - semiconductor laser-applications of laser.

FIBER OPTICS: Introductionto optical fiber - advantages of optical fibers - total internal reflection- construction of optical fiber - acceptance angle - numerical aperture- classification of optical fibers- losses in optical fiber - optical fiber for communication system - applications

UNIT-IV:

DIELECTRIC MATERIALS: Dielectric Materials: Basic definitions- types of polarizations (qualitative)–Local field, Clasius-Mossoti Equation ferroelectric, piezoelectric, and pyro electric materials – applications

MAGNETIC MATERIALS: Introduction to magnetic materials - Hysteresis-soft and hard magnetic materials-magnetostriction, magnetoresistance - applications - bubble memory devices, magnetic field sensors and multiferroics

UNIT-V:

ENERGY MATERIALS: Conductivity of liquid and solid electrolytes- superionic conductors - materials and electrolytes for super capacitors - rechargeable ion batteries, solid fuel cells

NANO TECHNOLOGY: Nanoscale, quantum confinement, surface to volume ratio, bottom-up fabrication: sol-gel, precipitation, combustion methods – top-down fabrication: ball milling - physical vapour deposition (PVD) - chemical vapor deposition (CVD) - characterization techniques - XRD, SEM &TEM - applications of nanomaterials.

TEXT BOOKS:

1. Engineering Physics (3rd edition), PK Palanisamy, SciTech Publications, 2015.
2. Essentials of Nan science & Nanotechnology (1st Edition), Narasimha Reddy Katta, Typical Creatives NANO DIGEST, 2021.

REFERENCES:

1. Fundamentals of Physics (6th edition), Halliday, R. Resnick and J. Walker, John Wiley and Sons, 2001.
2. Quantum Physics, (2nd edition), H.C. Verma, TBS Publication, 2012
3. Introduction to Solid State Physics, (7th edition), Charles Kittel, Wiley Eastern, 2019.

COURSE OUTCOMES:

On completion of the course students will be able to

1. Understand the concepts of Quantum mechanics and visualize the differences between the solids by their classification.
2. Identify and analyse the importance of semiconductors and semiconductor devices in Science and Engineering Applications.
3. Appreciate the features and applications of Lasers and Optical fibres.
4. Applying the fundamental properties of dielectric and magnetic materials in different engineering fields.
5. Evaluate various aspects of Energy Materials and Nano-materials and their applications in diverse fields.

CO PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	1	-	-	-	-	-	-	1
CO2	3	3	2	1	1	1	1	-	-	1	-	2
CO3	3	3	2	1	1	1	1	-	-	1	-	2
CO4	3	3	2	1	1	-	-	-	-	1	-	1
CO5	3	3	2	1	1	1	1	1	-	1	-	2

(A403201) ENGINEERING MECHANICS
(Common to Mech & Civil)

B. Tech. (ME): I Semester

L	T	P	C
3	0	0	3

UNIT-I:
Introduction to Engineering Mechanics: Force Systems: Basic concepts, Particle equilibrium in 2-D & 3-D, Rigid Body equilibrium, System of Forces: Coplanar Concurrent Forces, Components in Space – Resultant - Moment of Forces and its Application; Couples and Resultant of Force System.
Equilibrium of System of Forces: Free body diagrams, Equations of Equilibrium of Coplanar Systems.

UNIT-II:
Friction: Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies
Applications of friction: Wedge friction, Screw jack & differential screw jack;

UNIT-III:
Centroid and Centre of Gravity: Centroid of Lines, Areas and Volumes from first principle, Centroid of Composite sections
Centre of Gravity: Centre of gravity of simple bodies, Composite bodies – Theorem of Pappus

UNIT-IV:
Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Parallel Axis Theorem, Perpendicular Axis Theorem
Mass Moment of Inertia: Moment of Inertia of Masses - Transfer Formula for Mass Moments of Inertia – Mass moment of inertia of composite bodies.

UNIT-V:
Work – Energy Method: Equations for Translation, Work-Energy Applications to Particle Motion, Connected Systems. Fixed Axis Rotation and Plane Motion, Impulse momentum method

TEXT BOOKS:

1. Reddy Vijay Kumar K. and J. Suresh Kumar (2011), Engineering Mechanics – Statics & Dynamics, Singer's, 3rd Edition.
2. Bhavikatti S.S (2019), Engineering Mechanics, New age international publishers, 7th Edition,

REFERENCE BOOKS:

1. Dumir P.C, Sengupta, Srinivas (2020), Engineering Mechanics- Universities Press, 1st edition.
2. Hibbeler R.C, Engineering Mechanics, Pearson, 14th Edition.
3. Arshad Noor, Zahid & Goel (2018), Engineering Mechanics, Cambridge University Press, 1st edition
4. Khurmi R.S, Khurmi N. (2018), Engineering Mechanics, S. Chand publishing, 22nd edition.
5. Shames and Rao (2016), Engineering Mechanics, Pearson Education, 4th edition

COURSE OUTCOMES:
At the end of the course, students will be able to
1. Determine resultant of forces acting on a body and analyse equilibrium of a body subjected to a system of forces.
2. Solve problem of bodies subjected to friction.
3. Find the location of Centroid and Centre of gravity of a given section.
4. Calculate moment of inertia and mass moment of inertia of a given section.
5. Solve problems using work energy equations for translation, fixed axis rotation and plane motion.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12
CO1	3	-	3	-	-	2	1	-	-	-	-	1
CO2	3	-	3	-	-	2	1	-	-	-	-	1
CO3	3	-	3	-	-	2	1	-	-	-	-	1
CO4	3	-	3	-	-	2	1	-	-	-	-	1
CO5	3	-	3	-	-	2	1	-	-	-	-	1

(A403501) ELEMENTS OF MECHANICAL ENGINEERING

B. Tech. (ME): I Semester

L	T	P	C
0	0	2	1

List of Experiments to be performed:

1. Measurement of length, height, diameter by vernier calipers.
2. To measure diameter of a given wire and sphere, thickness of a given sheet and volume of an irregular lamina using micrometer screw gauge.
3. Use of straight edge and sprit level in finding the flatness of surface plate.
4. Determination of time period and natural frequency of simple pendulum.
5. Determination of time period and natural frequency of compound pendulum.
6. To measure the coefficients of static and kinetic friction between a block and a plane using various combination of materials.
7. To determine the radius of curvature of a given spherical surface.
8. The experimental determination of the Moment of Inertia of regular and irregular solids.
9. Metal joining process–soldering of metal alloys to any PCB board
10. A simple composite geometry preparation by hand layup method.
11. Grouping of Dry cells for a specified voltage and current and its measurement using ammeters and voltmeters etc.
12. Demonstration of lathe, milling, drilling, grinding machine operations.
13. Study of transmission system –gear box
14. Assembly /disassembly of Engines
15. Study of Boilers

Note: Perform any 10 out of the 15 Exercises.

COURSE OUTCOMES:

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

1. Understand the operation, usage and applications of different measuring instruments and tools.
2. Examine the different characteristics of instruments like accuracy, precision etc
3. Prepare simple composite components and joining different materials using soldering process.
4. Identify tools & learn practically the process of turning, milling, grinding on mild steel pieces.
5. Understand the basic components of IC engine, Gear box and boiler

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1	1	2	3	1	1	2	2
CO2	3	1	1	1	1	1	1	3	1	1	2	3
CO3	3	1	2	2	2	1	1	3	1	1	2	3
CO4	3	-	-	1	-	1	1	3	1	1	1	3
CO5	3	-	2	1	-	1	1	3	2	2	2	3

(A403503) ENGINEERING WORKSHOP
(Common to Mech & Civil)

B. Tech. (ME): I Semester

L	T	P	C
0	1	3	2.5

Pre-requisites: Practical skill

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

I. Carpentry
II. Fitting
III. Tin-Smithy
IV. Foundry
V. Welding Practice
VI. House-wiring
VII. Black Smithy

2. TRADES FOR DEMONSTRATION & EXPOSURE:

Plumbing, Lathe, Power tools

TEXT BOOKS:

1. Workshop Practice, B. L. Juneja, Cengage, 2016
2. Workshop Manual, K. Venugopal, Anuradha Pub, 2012

REFERENCE BOOKS:

1. Work shop Manual, 2nd Edition, P. Kannaiah & K.L. Narayana, Scitech Publishers, 2008
2. Workshop Manual, 6th Edition, Venkat Reddy, BS Publications, 2008

COURSE OUTCOMES:

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

1. Study and practice on trade tools and their operations
2. Practice and prepare components using workshop trades including carpentry, fitting, Tin smithy.
3. Practice and prepare components using workshop trades including Foundry, welding.
4. Practice and prepare components using workshop trades including House wiring, black smithy and Plumbing.
5. Acquire knowledge by exposure to modern Tools.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	3	1	3	1	1	-	3
CO2	3	2	1	1	-	2	1	3	2	1	1	3
CO3	3	2	1	1	-	2	1	3	2	1	1	3
CO4	3	2	1	1	-	2	1	3	2	1	1	3
CO5	3	-	1	1	2	2	1	3	2	1	2	3

(A400503) ENGLISH LANGUAGE AND COMMUNICATION SKILLS LABORATORY
(Common to all branches)

B. Tech. (ME): I Semester

L	T	P	C
0	0	2	1

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

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

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

Listening SkillsObjectives

- To enable students, develop their listening skills so that they may appreciate the role in the LSRW skills approach to language and improve their pronunciation
- To equip students with necessary training in listening, so that they can comprehend the speech of people of different backgrounds and regions. Students should be given practice in listening to the sounds of the language, to be able to recognize them and find the distinction between different sounds, to be able to mark stress and recognize and use the right intonation in sentences.
  - Listening for general content
  - Listening to fill up information
  - Intensive listening
  - Listening for specific information

Speaking SkillsObjectives

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

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

Exercise–I:

CALL Lab: Understand: Listening Skill- Its importance – Purpose- Process- Types- Barriers- Effective Listening. Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants – Minimal Pairs - Past Tense Marker and Plural Marker- Testing Exercises

ICS Lab: Understand: Spoken vs. Written language- Formal and Informal English. Practice: Ice-Breaking Activity and JAM Session- Situational Dialogues – Greetings – Taking Leave – Introducing Oneself and Others.

Exercise-II:

CALL Lab: Understand: Structure of Syllables – Word Stress– Weak Forms and Strong Forms – Stress pattern in sentences – Intonation. Practice: Basic Rules of Word Accent - Stress Shift - Weak Forms and Strong Forms- Stress pattern in sentences – Intonation - Testing Exercises.

ICS Lab: Understand: Features of Good Conversation – Strategies for Effective Communication. Practice: Situational Dialogues – Role Play- Expressions in Various Situations –Making Requests and Seeking Permissions - Telephone Etiquette.

Exercise –III:

CALL Lab: Understand: Errors in Pronunciation-Neutralising Mother Tongue Interference (MTI). Practice: Common Indian Variants in Pronunciation – Differences between British and American Pronunciation -Testing Exercises

ICS Lab: Understand: Descriptions- Narrations- Giving Directions and Guidelines – Blog Writing Practice: Giving Instructions – Seeking Clarifications – Asking for and Giving Directions – Thanking and Responding – Agreeing and Disagreeing – Seeking and Giving Advice – Making Suggestions.

Exercise –IV:

CALL Lab: Understand: Listening for General Details. Practice: Listening Comprehension Tests - Testing Exercises

ICS Lab: Understand: Public Speaking – Exposure to Structured Talks - Non-verbal CommunicationPresentation Skills. Practice: Making a Short Speech – Extempore- Making a Presentation.

Exercise – V

CALL Lab: Understand: Listening for Specific Details. Practice: Listening Comprehension Tests -Testing Exercises

ICS Lab: Understand: Group Discussion Practice: Group Discussion

Minimum Requirement of infrastructural facilities for ELCS Lab:

1. **Computer Assisted Language Learning (CALL) Lab:** The Computer Assisted Language Learning Lab has to accommodate 30 students with 30 systems, with one Master Console, LAN facility and English language learning software for self- study by students. System Requirement (Hardware component): Computer network with LAN facility (minimum 40 systems with multimedia) with the following specifications: i) Computers with Suitable Configuration ii) High Fidelity Headphones
2. **Interactive Communication Skills (ICS) Lab:** The Interactive Communication Skills Lab: A Spacious room with movable chairs and audiovisual aids with a Public Address System, a T. V. or LCD, a digital stereo –audio & video system and camcorder etc. Source of Material (Master Copy): • Exercises in Spoken English. Part 1, 2, 3. CIEFL and Oxford University Press Note: Teachers are requested to make use of the master copy and get it tailor-made to suit the contents of the syllabus

REFERENCE BOOKS:

1. English Language Communication Skills Lab Manual cum Workbook,(1st edition), by Rajesh Kumar,Cengage Learning India Pvt. Ltd, 2022
2. Communicative English - A workbook, (Revised Edition)byShobha, KN &Rayen, J. Lourdes, Cambridge University Press, 2019.
3. Communication Skills: A Workbook. Kumar, (2nd edition) by Sanjay &Lata, Pushp, Oxford University Press, 2019.
4. ELCS Lab Manual: A Workbook for CALL and ICS Lab Activities,(Board of Editors), Orient Black Swan Pvt. Ltd, 2016
5. English Language Skills: A Practical Approach, Mishra, Veerendra et al., Cambridge University Press, 2020.

COURSE OUTCOMES:

On completion of the course students will be able to

1. Understand the nuances of English language through audio- visual experience and group activities.
2. Neutralise their accent for intelligibility.
3. Speak with clarity and confidence which in turn enhances their employability skills
4. Students will learn public speaking skills and overcome stage fear.
5. Express clarity of thoughts, capability to hold the discussion with everyone and develop analytical thinking.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-		2	-	-
CO2	-	-	-	-	-	-	-	-	-	2	-	-
CO3	-	-	-	-	-	-	-	-	-	3	2	-
CO4	-	-	-	-	-	-	-	-	-	3	-	2
CO5	-	-	-	-	-	-	-	-	-	2	-	2

(A400501) APPLIED PHYSICS LABORATORY

B. Tech. (ME): I Semester

L	T	P	C
0	0	3	1.5

(Any 8 experiments are to be performed)

1. Determination of work function and Planck's constant using photoelectric effect.
2. Determination of Hall co-efficient and carrier concentration of a given semiconductor.
3. Characteristics of series and parallel LCR circuits.
4. V-I characteristics of a p-n junction diode and Zener diode
5. a) V-I and L-I characteristics of light emitting diode (LED)b)V-I Characteristics of solar cell
6. Determination of Energy gap of a semiconductor.
7. Determination of the resistivity of semiconductor by two probe method.
8. Study of B-H curve of a magnetic material.
9. Determination of dielectric constant of a given material
10. a) Determination of the beam divergence of the given LASER beam, b) Determination of Acceptance Angle and Numerical Aperture of an optical fiber.
11. Understanding the method of least squares – torsional pendulum as an example.
12. Diffraction grating: Determination of wavelength of a source (LASER).

LABORATORY MANUAL:

1. Applied Lab (2nd Edition) Dr M Chandra Shekhar Reddy, Dr NeelimaPatnaik, Jaya Prakash Reddy Kasu, Skytech Publications, 2022.

COURSE OUTCOMES:

On completion of the course students will be able to

1. Appreciate quantum physics in optoelectronics.
2. Determine the Planck's constant using Photo electric effect
3. Determine energy gap of a semiconductor diode and magnetic fields.
4. Identify the material whether it is n-type or p-type by Hall experiment.
5. Evaluate the basic properties of lasers and optical fibers.

CO - PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	-	-	-	-	-	1	-	1
CO2	3	3	2	1	-	-	-	-	-	1	-	1
CO3	3	3	2	1	-	-	1	-	-	1	-	1
CO4	3	3	2	1	-	-	-	-	-	1	-	1
CO5	3	3	2	1	-	-	1	-	-	1	-	1

(A400505) INTRODUCTION TO SOCIAL INNOVATION
(Common to all branches)

B. Tech. (ME): I Semester

L	T	P	C
0	0	2	1

WEEK-1
Types and features of community- Rural, Suburban, Urban and Regional

WEEK-2
Service based learning, Aims of Community based projects, Sustainable Development Goals

WEEK-3
Community visit, Report Writing, Resource Diagram, Chapati Diagram, Transect Walk

WEEK-4
The non-profit sector, public sector, the private sector, the informal sector

WEEK-5
Poster presentation on four sectors

WEEK-6
Process of Design Thinking

WEEK-7
Social organizations and enterprises, social movements

WEEK-8
Social softwares and open-source methods

WEEK-9
Introduction to Ethics, moral values, significance of professional ethicscode of conduct for engineers

WEEK-10
Identify ethical dilemmas in different tasks of engineering, applying moral theories and codes of conduct for resolution of ethical dilemmas

WEEK-11
Case studies on Engineering Ethics

WEEK-12
Documentation, Steps for Patent filing and Startups, Poster presentation

TEXT BOOKS:

1. Social Entrepreneurship for the 21st Century: Innovation Across the Non Profit, Private and Public Sectors; Georgia Levenson Keohane; Tata McGraw Hill
2. Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover – 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author)

REFERENCE BOOKS:

1. Fundamentals of Intellectual Property (English) 1st Edition (Paperback, Dr. Kalyan C. Kankanala) Publisher:Asia Law House ISBN: 9789381849514, 938184951X Edition: 1st Edition, 2012.
2. Indian Patent Law (English, Paperback, Kalyan C. Kankanala) Publisher: Oxford University Press- NewDelhi, ISBN: 9780198089605, 0198089600 Edition: 2012.
3. Social Enterprises: An Organizational Perspective edited; Benjamin Gidron, YeheskelHasenfeld; Palgrave Macmillan
4. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011.
5. Engineering Ethics: An Industrial Perspective; Gail Baura; Elsevier
6. Intellectual Property and Financing Strategies for Technology Startups; Gerald B. Halt, Jr., John C. Donch,Jr., Amber R. Stiles, Robert Fesnak; Springer

COURSE OUTCOMES:

On Completion of the course, the students will be able to

1. Identify community issues through community Interaction
2. Illustrate the factors affecting social innovation in various sectors
3. Apply design thinking concept to analyze the community problems
4. Adopt the ethical values in implementing the Social innovation
5. Describe the process of property rights and patent filing.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						1	2		3	2		
CO2						2	2		3	3		
CO3				2		2	3		2	3		
CO4						2	3	3	2	2		
CO5		2		2		2	3		2	3		

(A400704) UNIVERSAL HUMAN VALUES
(Common to all branches)

B. Tech. (ME): I Semester

L	T	P	C
2	0	0	0

UNIT – I:

Basic Guidelines, Content and Process for Value Education

- Purpose and motivation for the course, recapitulation from Universal Human Values-I
- Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
- Continuous Happiness and Prosperity- A look at basic Human Aspirations
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
- Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

UNIT – II:

Understanding Harmony in the Human Being - Harmony in Myself!

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) • Understanding the characteristics and activities of 'I' and harmony in 'I'
- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure Sanyam and Health. Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

UNIT – III:

Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
- Understanding the meaning of Trust; Difference between intention and competence • Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
- Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals • Visualizing a universal harmonious order in society- Undivided Society, Universal Orderfrom family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, and goal of education etc., Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

UNIT – IV:

Understanding Harmony in the Nature and Existence – Whole existence as Coexistence

- Understanding the harmony in the Nature
- Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature
- Understanding Existence as Co-existence of mutually interacting units in all- pervasive space
- Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT – V:

Implications of the above Holistic Understanding of Harmony on Professional Ethics

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics:

a. Ability to utilize the professional competence for augmenting universal human order
b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems,
c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

- Case studies of typical holistic technologies, management models and production systems
- Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
- Sum up. Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

TEXTBOOKS:

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019.

REFERENCE BOOKS:

1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amar kantak, 1999.
2. A. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi "The Story of My Experiments with Truth"

COURSE OUTCOMES:

On completion of the course students will be able to

1) Students are expected to become more aware of themselves, and their surroundings (family, society, nature)
2) They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. •
3) They would have better critical ability about various issues in life.
4) They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
5) It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						**2**						
CO2			**2**									
CO3									**2**			
CO4								**2**				
CO5												**2**

(A400002) ORDINARY DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS
(Common to All)

B. Tech. (ME): II Semester

L	T	P	C
3	1	0	4

UNIT-I:
First Order ODE: Exact differential equations, Equations reducible to exact differential equations, linear and Bernoulli's differential equations, Orthogonal Trajectories (only in Cartesian Coordinates), Applications: Newton's law ofcooling, Law of natural growth and decay

UNIT-II:
Ordinary Differential Equations of Higher Order: Second and higher order linear differential equations with constant coefficients: Non-Homogeneous terms of thetype e^{ax}, sin ax, cosax, polynomials in x, $e^{a}(x)$and $xV(x)$, methodof variationofparameters.

UNIT-III:
Laplace transforms: Laplace Transforms: Laplace Transform of standard functions, First shifting theorem and Second shifting theorem, Unit step function, Dirac delta function, Laplace transforms of functions when they are multiplied and divided by't'. Evaluation of integrals by Laplace transforms Laplace transform of periodic functions. Inverse Laplace transform by different methods, convolution theorem (without proof). Applications: solving Initial value problems by Laplace Transform method.

UNIT-IV:
Vector Differentiation: Vector point functions and scalar point functions, Gradient, Tangent plane and normal line, Directional derivatives, Divergence and Curl, Solenoida and Irrotational vectors, Scalar potential functions, Vector Identities

UNIT-V:
Vector Integration: Line, Surface and Volume Integrals.Theorems of Green, Gauss and Stoke's (without proofs) and their applications

TEXT BOOKS:
1. Higher Engineering Mathematics, (36thEdition), B.S. Grewal, Khanna Publishers, 2010.
2. Advanced Engineering Mathematics, (5thEdition), R.K. Jain and, S.R.K. Narosa Publications, 2016.

REFERENCE BOOKS:
1. Advanced Engineering Mathematics, (9th Edition), Erwinkreyszig, John Wiley& Sons,2006.
2. Calculus and Analytic geometry, (9thEdition), G.B. Thomas and R.L. Finney, Pearson, Reprint, 2002.
3. A text book of Engineering Mathematics, (10thEdition), N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2019.
4. Higher Engineering Mathematics, (9thEdition), H.K. Dass and Er. RajnishVerma, S Chand and company Limited, New Delhi, 2011

COURSE OUTCOMES:
On completion of the course students will be able to
1. Determine first order differential equations and obtain solutions.
2. Solve the Higher order differential equations and apply the differential equation concepts to real world problems.
3. Use the Laplace transforms techniques for solving ODE's.
4. Evaluate Gradient – Divergence – Curl, Directional derivatives.
5. Evaluate the line, surface and volume integrals and converting them from one to another.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	-	-	-	-	-	-	-	2
CO2	3	3	3	2	-	-	-	-	-	-	-	2
CO3	3	2	3	2	-	-	-	-	-	-	-	2
CO4	3	2	3	2	-	-	-	-	-	-	-	3
CO5	3	2	3	2	-	-	-	-	-	-	-	3

(A400009) ENGINEERING CHEMISTRY
(Common to all Branches)

B. Tech. (ME): II Semester

L	T	P	C
3	1	0	4

UNIT-I: Electrochemistry, Batteries and Corrosion

Electrochemistry: Electrode potential, standard electrode potential and E.M.F of the cell. Electrochemical cell, Nernst equation- derivation and applications, Types of electrodes- Quinhydrone electrode, Calomel electrode and Glass electrode, Electro chemical series and its applications. **Batteries**- primary (Lithium cell), secondary (Lead acid storage battery and Lithium-ion battery) and Fuel cells (H_2-O_2 and methanol-oxygen), Solar cells - Introduction and applications of Solar cells.

Corrosion: Introduction, Definition, Causes and effects of corrosion, Theories of chemical and electrochemical corrosion, Pilling-Bedworth rule, Types of corrosion- Galvanic, Waterline and Pitting corrosion, Factors affecting rate of corrosion, Corrosion control methods- Cathodic protection, Sacrificial anode and impressed current cathodic methods, Surface coatings- Metallic coatings, hot dipping, galvanizing and tinning, Electroplating- Copper plating and electrolessplating - Nickel plating.

UNIT-II: Material Chemistry - High Polymers

Types of polymerizations (addition, condensation and copolymerization)

Plastics: Thermoplastic and Thermosetting resins, Compounding and fabrication of plastics (compression and injection moulding). Preparation, properties, engineering applications of PVC, Teflon and Bakelite

Fibers: Characteristics of fibers - preparation, properties and uses of Nylon-6, 6 and Dacron, Fiber Reinforced Plastics (FRP) - applications.

Rubbers: Natural rubber and its vulcanization. Elastomers: Buna-s, Butyl rubber and Thiokol rubber. **Conducting polymers:** Characteristics and Classification with examples-mechanism of conduction in trans-polyacetylene and applications of conducting polymers.

Biodegradable polymers: Preparation and applications of Polyvinyl acetate, Polylactic acid and poly vinyl alcohol.

UNIT-III: Energy Sources

Introduction, Calorific value of fuel – HCV, LCV- Dulongs formula, Classification- solid fuels: coal – analysis of coal – proximate and ultimate analysis and their significance. Liquid fuels – petroleum and its refining, cracking types – moving bed catalytic cracking. Knocking – octane and cetane rating, synthetic petrol - Fischer-Tropsch's process; Gaseous fuels – composition and uses of natural gas, LPG and CNG, Biodiesel – Transesterification, advantages

UNIT-IV: Water Technology

Sources of water, Impurities in water, Hardness of water, Temporary and permanent hardness, Units of hardness, Estimation of temporary and permanent hardness of water, EDTA method, Numerical problems, Potable water Treatment-Specifications, Steps involved in Treatment-Sedimentation, Coagulation, Filtration, Sterilization, Desalination of Brackish Water, Reverse Osmosis and Electro dialysis.

Industrial water treatment, Boiler Troubles-Scales and sludges, Caustic embrittlement, Boiler corrosion, Priming and foaming, Hot lime and cold lime soda Process-Numerical problems, Zeolite process and Ion exchange process. Internal conditioning methods like Phosphate, Carbonate, Calgon and Colloidal conditioning.

UNIT-V: Engineering Materials

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

Smart materials: Smart materials and their engineering applications

Advanced Glass Technology: Structure and nature of glasses, transformation range behaviour, and dependence of physico-chemical characteristic of glasses on their constituents, Strength of glass and glass articles

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

TEXT BOOKS:

1. Engineering Chemistry (1st edition), Dr. K. Soujanya, Dr. J. Saroja, Lt. D. Divya, Skytech Publishers, 2022
2. Engineering Chemistry (1st edition), P. C. Jain and M. Jain, Dhanapat Rai& Sons.
3. Engineering chemistry (1st edition), Dr. Bharathikumari, Dr. Jyotsna.

REFERENCE BOOKS:

1. Engineering Chemistry (2nd edition), Shikha Agarwal; Cambridge University Press, 2015.
2. Engineering Chemistry (1st edition), Prasanth Rath, Cengage Learning, 2015.
3. Engineering Chemistry (3rd edition), B. Siva Shankar, Tata McGraw Hill Publishing Limited, 2015.
4. Text of Engineering Chemistry (12th edition), S. S. Dara, Mukkanti, S. Chand & Co, New Delhi, 2006.
5. Chemistry of Engineering Materials (5th edition), C. V. Agarwal, C. P. Murthy, A. Naidu, Wiley India, 2013.

COURSE OUTCOMES:

After completion of the course students will be able to

1. Apply the principles of electrochemistry, corrosion science and analyse application of battery technologies, fuel cells in practical applications.
2. Acquire knowledge on polymer technology and uses of key polymers in engineering fields.
3. Analyse various types of energy sources and understand the significance of alternative energy sources, including biodiesel and solar energy.
4. Investigate the impact of water hardness in industries, implement water purification technologies to ensure water quality for industrial and domestic use
5. Illustrate the composition, properties and application of engineering materials, including cement, smart materials, glass, and lubricants

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	2	-	2	-	-	-	-	-
CO2	3	-	2	-	2	-	-	-	-	-	-	1
CO3	3	2	-	-	-	-	3	-	-	-	-	2
CO4	3	-	-	3	-	2	2	-	-	-	-	-
CO5	3	-	2	-	2	-	2	-	-	-	-	-

(A403301) ENGINEERING MATERIALS

B. Tech. (ME): II Semester

L	T	P	C
2	0	0	2

UNIT-I:
Classification of Engineering Materials, Ashby chart, Mechanical Properties of Metals and their testing equipment/procedures, ASTM standards for testing, Stress–Strain Behavior of various materials, Sources of Material Data

UNIT –II:
Metals and Metal Alloys, Classification of Metal Alloys, Classification, composition, properties and usage of Ferrous alloys, steel, HSS, grey cast iron, white cast iron; Classification, composition, properties and usage of Non-ferrous materials, Aluminum, Titanium, Zinc, Copper, Nickel, Cobalt and their alloys

UNIT –III:
Composites: Definitions, Reinforcements and matrices, Types of reinforcements, Types of matrices, Classification of composites, Properties of composites in comparison with standard materials Manufacturing methods: Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting and prepregs.

UNIT – IV:
Ceramics, Classification of ceramic materials, Crystal Structure, Applications and Properties of Ceramics, Ceramic fabrication techniques, Carbon: Diamond and Graphite. Polymer Structures, Chemistry of Polymer Molecules, Classification scheme of polymer molecules, Thermoplastic and Thermosetting Polymers, Characteristics, Applications, and Processing of Polymers, Elastomers

UNIT – V:
Materials in nano technology: Semiconductor Nanomaterials (Zinc oxide nano materials, titanium dioxide nanoparticles, Metal nanoparticles, ceramic nano materials metal nano particles (Silver, gold, iron and copper), applications, bio materials and other recent materials

TEXT BOOKS:

1. "Introduction to Engineering Materials",George Murray, Charles V. White, Wolfgang Weise, CRC Press, 2007
2. Materials Science and Engineering: An Introduction", William. D. Callister, David G. Rethwisch, " John Wiley & Sons, 2018

REFERENCE BOOKS:

1. Mechanical metallurgy. Vol. 3. Dieter, George Ellwood, and David J. Bacon. New York: McGraw-hill, 1986.
2. "Introduction to Physical Metallurgy", Second Edition, Sidney H Avner, McGraw Hill Education,
3. "Material Science and Engineering', V. Raghavan, Prentice Hall ofIndia Private Limited,1999.
4. Material Science and Metallurgy. Jindal, U. C. Pearson Education India,2012.

COURSE OUTCOMES:
On completion of the course students will be able to

1. Classify the various materials that will be essential for the mechanical engineering applications.
2. Express the mechanical properties of metals and their testing procedures.
3. Describe the applications of Composite materials
4. Describe the application of ceramicmaterials and their processing
5. Describe the requirement and need for the development of the nano materials.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2				1						1
CO2	3	2				1						1
CO3	3	2				1						1
CO4	3	2				1						1
CO5	3	2				1						1

(A405202) C PROGRAMMING & DATA STRUCTURES
(Common to ECE, EEE, Mech & Civil)

B. Tech. (ME): II Semester

L	T	P	C
3	0	0	3

Course Objectives

1. Introducing a Programming Language
2. Familiarizing the students with syntax and semantics of various C- programming language constructs.
3. learn to develop solutions to computational problems

UNIT-I

Overview of C: Basic structure of C programs, programming style, executing a C program. **Constants, Variables, and Data Types:** Introduction, Character set, C-Tokens, keywords and identifiers, constants, variables, Data types, declaration of variables, declaration of Storage class, assigning values to variables, defining symbolic constant.
Operators& Expressions: Introduction, ArithmeticOperators, RelationalOperators, LogicalOperators, Assignment Operators, Increment & Decrement Operators, Conditional Operators, Bitwise Operator, Special Operators. Arithmetic Expressions, Evaluation of Expressions, Precedence of Arithmetic Operators.

UNIT-II

Decision Making: Introduction, Decision making with *if*statement, simple*if* statement, the *if---else*---statement, Nesting of ***if---else---***statements.the ***else-if*** ladder, the ***switch*** statement, the?: operator, the goto statement. **Looping:** Introduction, the ***while*** statement, the ***do -while*** statement, ***for*** statement, break and continue statements.
Arrays: Introduction, One-Dimensional Arrays, Declaration of One-Dimensional Arrays, Initialization of One-Dimensional Arrays, Two-Dimensional Arrays, Initializing two dimensional arrays.

UNIT-III

Character Arrays and Strings: Introduction, declaring and initializing string variables, reading strings from terminal, writing strings to screen, string-handling functions. **Functions:** Introduction, definition of functions, return values, function calls, function declaration, scope, visibility and lifetime of variables. **Pointers:** Idea of pointers, Defining pointers, Pointers to Arrays and Structures, Use of Pointers in self-referential structures, usage of self-referential structures in linked list (no implementation)

UNIT-IV

Introduction to Data Structures, abstract data types, Linear list – singly linked list implementation, insertion, deletion and searching operations on linear list, Stacks- Operations, array and linked representations of stacks, stack applications, Queues- operations, array, and linked representations.

UNIT-V

Searching and Sorting: Basic searching in an array of elements (linear and binary search techniques), Basic algorithms to sort array of elements (Bubble, Insertion and Selection sort algorithms), Basic concept of order of complexity through the example programs.

TEXTBOOKS:

1. Programming in ANSI C, 8th Edition, E. Balagurusamy McGraw Hill Educationpublication, 2019.
2. Fundamentals of Data Structures in C, 2nd Edition, E. Horowitz, S. Sahni and Susan Anderson Freed, Universities Press.

REFERENCE BOOKS:

1. C Programming Absolute Beginner's Guide, 3rd Edition, Pearson Education, 2014
2. Learn C the Hard Way,1st Edition, Zed A. Shaw, Pearson Education,2018
3. The C-Programming Language, 2nd Edition, Brian Kernighan and Dennis Ritchie, Pearson Education, 2014
4. Data Structures using C – A. S. Tanenbaum, Y. Langsam, and M.J. Augenstein, PHI/Pearson Education.

COURSE OUTCOMES:

Students shall be able to
CO1: Describe the structure of C program and explainthe various components of it.
CO2: Use iterative statements for writing the C programs.
CO3: Organize data in Arrays and perform operations on data stored in Arrays.
CO4: Define & describe user defined functions in C language.
CO5: Differentiate structures, unions and manipulate data using pointers.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1									
CO2	3	1	3									
CO3	3	2	2									
CO4	2	2	3									
CO5	3	2	2									

(A403202) ENGINEERING GRAPHICS
(Commom to Mech & Civil)

B. Tech. (ME): II Semester

L	T	P	C
1	0	3	2.5

UNIT – I:

Introduction to Engineering Drawing: Principles of Engineering Drawing and their Significance, Introduction to Computer aided drafting – views, commands.

Computer aided drafting of conic Sections: Ellipse, Parabola and Hyperbola – General Method (eccentricity) only.

Computer aided drafting of Cycloid, Epicycloids and Hypocycloid.

Computer aided drafting of Scales – Plain & Diagonal.

UNIT- II:

Orthographic Projections: Introduction to Principles of Orthographic Projections – Conventions – Projections of Points and Lines, Projections of Plane regular geometric figures.

Computer aided orthographic projections – points, lines and planes

UNIT – III:

Projections of Regular Solids: Introduction to Regular Solids – Prism, Cylinder, Pyramid, Cone

Computer aided projections of solids – Regular views

UNIT – IV:

Sections or Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone, and Computer aided projections of solids – sectional views

Development of Surfaces: Development of Surfaces of Right Regular Solids – Prism, Cylinder, Pyramid and Cone, Development of surfaces using computer aided drafting

UNIT – V:

Isometric Projections: Principles of Isometric Projection – Isometric Scale – Isometric Views –Conventions – Isometric Views of Lines, Plane Figures, Simple and Compound Solids – Isometric

Projection of objects having non- isometric lines, Isometric Projection of Spherical Parts using computer aided drafting.

Conversion of Isometric Views to Orthographic Views and Vice-versa – Conventions

Conversion of orthographic projection into isometric view and vice versa using computer aided drafting.

TEXT BOOKS:

1. Engineering Drawing, 51st Edition, N.D. Bhatt, Charotar Pub, 2012
2. Computer Aided Engineering Drawing, 2nd Edition, K. Balaveera Reddy et al, CBS Publishers, 2015

REFERENCE BOOKS:

1. Engineering Drawing, 2nd Edition, Basant Agrawal and C M Agrawal, McGraw Hill, 2014
2. Engineering Drawing, 1st Edition, M. B. Shah, B.C. Rane, Pearson, 2015
3. Engineering Drawing, 1st Edition, N. S. Parthasarathy and Vela Murali, Oxford, 2015
4. Engineering Drawing and graphics Using AutoCAD, 3rd Edition, T. Jeyapoovan, Vikas, S. Chand and Company Ltd, 2000

COURSE OUTCOMES:

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

1. Apply drafting tools to create 2D objects like Conic section and Cycloidal curves
2. Sketch the Orthographic projection of Points, Lines and Planes by drafting tools
3. Create, read and interpret engineering drawings of projections of Solids
4. Create and interpret 2D and 3D Isometric objects by drafting tools
5. Do Conversion of orthographic projection into isometric view and vice versa drafting tools

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	-	3	-	-	2	3	3	1	2
CO2	3	1	3	-	3	-	-	2	3	3	1	2
CO3	3	1	3	-	3	-	-	2	3	3	1	2
CO4	3	1	3	-	3	-	-	2	3	3	1	2
CO5	3	1	3	-	3	-	-	2	3	3	1	2

(A400502) ENGINEERING CHEMISTRY LABORATORY
(Common to all Branches)

B. Tech. (ME): II Semester

L	T	P	C
0	0	2	1

Lab Experiments:

1. Estimation of Hardness of water by EDTA Method.
2. Estimation of Alkalinity of Water.
3. Estimation of Copper by Colorimetric Method.
4. Conductometric Titration of aStrong Acid vs a Strong Base.
5. Conductometric Titration of aWeak Acid vs a Strong Base.
6. Potentiometric Titration of aStrong Acid vs a Strong Base
7. PotentiometricTitration of Ferrous Ammonium Sulphate (FAS) vs Potassium Dichromate.
8. Preparation of Thiokol Rubber.
9. Determination of Viscosity of a Liquid.
10. Determination of Surface Tension of a liquid.
11. Adsorption of acetic acid on Activated charcoal.
12. Estimation of Iodine in Table Salt (by potentiometric)
13. Thin Layer Chromatography (Ortho-Nitro phenol &Para-Nitro phenol).
14. Determination of rate constant of acid catalyzed hydrolysis of methyl acetate.

TEXT BOOKS:

1. Engineering Chemistry Lab Manual (1st edition), Dr. K. Soujanya, Dr. J. Saroja, Lt. D. Divya, Skytech Publishers, 2022

REFERENCE BOOKS:

1. Engineering Chemistry Lab Manual (1st edition), Glaze Publishers 2018.
2. Engineering chemistry (1st edition), B. Rama Devi & Ch. VenkataRamana Reddy; Cengage Learning, 2012.
3. A Textbook of Engineering Chemistry (1st edition), SashiChawla, Dhanapath Rai& Sons.

COURSE OUTCOMES:

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

1. Determine the extent of hardness of water and Assess the alkalinity and its consequences in industrial operations
2. Understand the principles, preparation and applications of key polymers like Thiokol rubber
3. Assess the properties of titrations involving acids, bases, redox reactions using potentiometric and conductometric analysis.
4. Develop proficiency in colorimetric analysis to accurately determine the amount of metals present in various industrial effluents
5. Apply analytical tools such as viscosity, and surface tension measurements to evaluate the physicochemical properties of liquid samples

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	2	-	-	-	-	-	-	-	-
CO2	3	2	2	-	3	-	2	-	-	-	-	-
CO3	3	-	-	3	2	-	-	-	-	-	-	-
CO4	3	-	-	3	3	-	2	-	-	-	-	-
CO5	3	-	-	3	2	-	-	-	-	-	-	-

(A403505) FUELS AND LUBRICANTS LABORATORY

B. Tech. (ME): II Semester

L	T	P	C
0	0	2	1

Prerequisite: Chemistry

Course Objectives: To Understand the fuel and lubricants properties.

List of Experiments:

1. Determination of Flash and Fire points of Liquid fuels/Lubricants using: Abels Apparatus
2. Determination of Flash and Fire points of Liquid fuels/Lubricants using: Pensky Martens Apparatus
3. Carbon residue test for Fuels.
4. Determination of Viscosity of Liquid lubricants and Fuels using: Saybolt Viscometer
5. Determination of Viscosity of Liquid lubricants and Fuels using: Redwood Viscometer-I
6. Determination of Viscosity of Liquid lubricants and Fuels using: Redwood Viscometer-II
7. Determination of Calorific value: of Gaseous fuels using: Junkers Gas Calorimeter.
8. Determination of Calorific value: Solid/Liquid/ fuels using: Bomb Calorimeter.
9. Drop point and Penetration Apparatus for Grease.
10. Distillation Apparatus
11. Cloud and Pour Point Apparatus

COURSE OUTCOMES:

At the end of the course, students will be able to

1. Determine the flash point of liquid fuels.
2. Determine the fire point, of liquid fuels
3. Determine the carbon residue of liquid fuels
4. Find the viscosity of lubricants and its variation with temperature
5. Determine the calorific value of solid, liquid and gaseous fuels

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					1	1	1	2	2		1
CO2	3					1	1	1	2	2		1
CO3	3					1	1	1	2	2		1
CO4	3					1	1	1	2	2		1
CO5	3					1	1	1	2	2		1

(A405503) C PROGRAMMING & DATA STRUCTURES LABORATORY
(Common to ECE, EEE, Mech and Civil)

B. Tech. (ME): II Semester

L	T	P	C
0	0	2	1

[Note: The programs may be executed using any available Open Source/ Freely available IDE
Some of the Tools available are:
CodeLite: https://codelite.org/
Code Blocks: http://www.codeblocks.org/
Dev Cpp: http://www.bloodshed.net/devcpp.html
Eclipse: http://www.eclipse.org
This list is not exhaustive and is NOT in any order of preference]

COURSE OBJECTIVES:
Students will learn the following:

- Work with an IDE to create, edit, compile, run and debug programs
- Analyze the various steps in program development.
- Develop programs to solve basic problems by understanding basic concepts in C like
- Operators, control statements etc.
- Develop modular, reusable and readable C Programs using the concepts like functions, arrays etc.
- Write programs using the Dynamic Memory Allocation concept.
- Create, read from and write to text and binary files

I. OPERATORS AND EVALUATION OF EXPRESSIONS
Demonstration
1. Write a C program to print greetings message on the screen.
2. Write a C program to illustrate usage of comments in C.
3. Write a simple program that prints the results of all the operators available in C (Including pre/post increment, bitwise and/or/not. etc), Read required operand values from standard input
4. Write a C program that converts given data type to another using auto conversion and casting. Take the values from standard input.
5. Write a program for finding the max and min from the three numbers (using ternary operator).

Experiment
6. Write a C program to compute simple, compound interest.
7. Write a C program that declares Class awarded for a given percentage of marks, where mark = 70% = Distinction. (Read percentage from standard input.)

II. Expression Evaluation
Demonstration
1. A building has 10 floors with a floor height of 3 meters each. A ball is dropped from the top of the building. Find the time taken by the ball to reach each floor. (Use the formula $s = ut+(1/2)at^2$ where u and a are the initial velocity in m/sec (= 0) and acceleration in m/sec^2 (= 9.8 m/s^2)).
2. Write a program that asks the user to enter the highest rainfall ever in one season for a country, and the rainfall in the current year for that country, obtains the values from the user, checks if the current rainfall exceed the highest rainfall and prints an appropriate message on the screen. If the current rainfall is higher, it assigns that value as the highest rainfall ever. Use only the single-selection form of the if statement.

Experiment
3. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
4. Write a C program to find the roots of a Quadratic equation.

III. Iterative statements
Demonstration
1. Write a program that reads an integer (5 digits or fewer) and determines and prints how many digits in the integer are 9s.
2. Write a program that keeps printing the powers of the integer 3, namely 3, 9, 27, 91, 273, and so on. Your loop should not terminate (i.e., you should create an infinite loop). What happens when you run this program?
3. Write a program that reads the radius of a circle (as a float value) and computes and prints the diameter, the circumference and the area. Use the value 3.14159 for π

Experiment
4. Write a menu driven C program that allows a user to enter n numbers and then choose between finding the smallest,

largest, sum, or average. The menu and all the choices are to be functions. Use a switch statement to determine what action to take. Display an error message if an invalid choice is entered.
5. Write a C program to construct a pyramid of numbers as follows:

```
1                                   1
1   2                               2   2
1   2   3                           3   3   3
1   2   3   4                       4   4   4   4
1   2   3   4   5                   5   5   5   5   5
```

IV. Arrays, Pointers, and Functions
Demonstration
1. Write a C program to find the minimum, maximum and average in an array of integers.
2. Write a function to compute mean, variance, Standard Deviation, sorting of n elements in a single dimension array.
3. Write a C program that uses functions to perform the following:
   i. Addition of Two Matrices, ii. Multiplication of Two Matrices, iii. Transpose of a matrix.
Experiment
4. Write a C program to find the GCD (greatest common divisor) of two given integers.
5. Write a C program to compute x^n

V. Strings
Demonstration
1. Write a C program to convert a Roman numeral ranging from I to L to its decimal equivalent.
2. Write a C program that converts a number ranging from 1 to 50 to Roman equivalent c.
3. Write a C program that uses functions to perform the following operations:
   - To insert a sub-string into a given main string from a given position.
   - To delete n Characters from a given position in a given string.

Experiment
4. Write a C program to determine if the given string is a palindrome or not (Spelled same in both directions with or without a meaning like madam, civic, noon, abcba, etc.)
5. Write a C program that displays the position of a character ch in the string S or – 1 if S doesn't contain ch.
6. Write a C program to count the lines, words and characters in a given text.

VI Data Structures
Demonstration
1. Write a program that uses functions to perform the following operations on singly linked list
   i) Creation, ii) Insertion, iii) Deletion and iv) Traversal
2. Write a program that implement stack (its operations) using
   i) Arrays, ii) Pointers
3. Write a program that implement Queue (its operations) using
   i) Arrays, ii) Pointers
Experiment
4. Write a program that uses functions to perform the following operations on doubly linked List.
   i) Creation ii) Insertion iii) Deletion iv) Traversal
5. Write a program that uses functions to perform the following operations on circular linked List.
   i) Creation ii) Insertion iii) Deletion iv) Traversal

VII Searching & Sorting
Demonstration
1. Write a C program that uses non recursive function to search for a Key value in a given list of integers using linear search method.
2. Write a C program that uses non recursive function to search for a Key value in a given sorted list of integers using binary search method.
3. Write a C program that implements the Bubble sort method to sort a given list of integers in ascending order.
Experiment
4. Write a C program that sorts the given array of integers using selection sort in descending order
5. Write a C program that sorts the given array of integers using insertion sort in ascending order

TEXTBOOKS:

1) Programming in ANSI C, 8th Edition, E. Balagurusamy McGraw Hill Education publication, 2019
2) Fundamentals of Data Structures in C, 2 nd Edition, E. Horowitz, S. Sahni and Susan Anderson Freed, Universities Press.

REFERENCE BOOKS:

1) C Programming Absolute Beginner's Guide, 3rd Edition, Pearson Education, 2014
2) Learn C the Hard Way,1st Edition, Zed A. Shaw, Pearson Education,2018
3) The C-Programming Language, 2nd Edition, Brian Kernighan and Dennis Ritchie, Pearson Education, 2014.
4) Data Structures using C – A. S. Tanenbaum, Y. Langsam, and M.J. Augenstein, PHI/Pearson Education.

COURSE OUTCOMES:

Students shall be able to:

CO1: formulate the algorithms for simple problems and translate given algorithms to a working and correct program
CO2: correct syntax errors as reported by the compilers identify and correct logical errors encountered during execution
CO3: represent and manipulate data with arrays, strings and structures.
CO4: Develop applications using pointer concept.
CO5: Develop reusable code with the help C-functions

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**1**	**2**	**1**							
CO2			**3**	**3**	**1**						**2**	**2**
CO3	**3**	**3**		**2**								
CO4			**3**		**2**						**2**	
CO5	**2**	**2**	**3**								**1**	**1**

(A400506) ENGINEERING EXPLORATION & PRACTICE
(Common to all branches)

B. Tech. (ME): II Semester

L	T	P	C
0	0	3	1.5

Week-1

Difference between Science and Engineering, Scientist and Engineer needs and wants, various disciplines of engineering, some misconceptions of engineering, Expectation for the 21st century engineer. Significance of teamwork, Importance of communication in engineering profession

Week-2

Engineering Design Process, Need statement to Problem conversion, Pair wise comparison chart, decision matrix, Concepts of reverse engineering

Week-3

Project management tools: Checklist, Timeline, Gantt chart, Requirement Analysis

Week-4

Basic Components of a Mechanism, Degrees of Freedom or Mobility of a Mechanism, 4 Bar Chain, Crank Rocker Mechanism, Slider Crank Mechanism

Week-5

3-D Modelling of a Box with two holes and curvature

Week-6

3-D Modelling of Electronic Enclosure and Assembly of two parts

Week-7

Introduction to various platform-based development, Introduction to basic components, transducers, actuators andsensors, Introduction to Tinkercad

Week-8

Introduction to Arduino, basics of programming

Week-9

Interfacing Arduino with actuators and transducers

Week-10

Interfacing Arduino with Sensors, Liquid Crystal Display (LCD)

Week-11

Assembly and Crafting the Prototype

Week-12

Test and Validate the Prototype, Documentation, Panel Presentation

TEXT BOOKS:

1. Engineering Fundamentals: An Introduction to Engineering (Mind Tap Course List) 5th Edition by Saeed Moaveni
2. Concepts in Engineering Design – 2016; by Sumesh Krishnan (Author), Dr. Mukul Shukla (Author),Publisher: Notion Press.

REFERENCE BOOKS:

1. A Ghosh and AK Malik: Theory of Mechanism and Machine; East West Press (Pvt) Ltd., New Delhi.
2. Arduino Cookbook, 2nd Edition by Michael Margolis: O'Reilly Media
3. Introduction to autocad®2017-2D and 3D design by Bernd S. Palm and Alf Yarwood, Routledge (Taylorand Francis group)
4. Software Project Management (SIE), (Fifth Edition); Bob Hughes, Mike Cotterell, Rajib Mall; Publishedby Tata McGraw-Hill Education Pvt. Ltd (2011) ; ISBN 10: 0071072748 ISBN 13: 9780071072748

COURSE OUTCOMES:

On Completion of the course, the students will be able to

1. Explain the importance of engineering profession in the world.
2. Identify multi-disciplinary approach required in solving an engineering problem
3. Build a mechanism for a given application
4. Create basic 3D models and animations
5. Design a mechatronic system using Arduino and electronic components

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1					3	3	2		3	
CO2		3	1	3	2				3		3	
CO3	3		2		3				3		3	
CO4	2	3	2		3				3	2	3	
CO5			2	1	2		3		3		3	

(A400703) CONSTITUTION OF INDIA
(Common to all branches)

B. Tech. (ME): II Semester

L	T	P	C
2	0	0	0

UNIT - 1
History of Making of the Indian Constitution - History of Drafting Committee

UNIT - 2
Philosophy of the Indian Constitution - Preamble Salient Features

UNIT - 3
Contours of Constitutional Rights & Duties - Fundamental Rights

- Right to Equality
- Right to Freedom
- Right against Exploitation
- Right to Freedom of Religion
- Cultural and Educational Rights
- Right to Constitutional Remedies
- Directive Principles of State Policy
- Fundamental Duties.

UNIT - 4
Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UNIT - 5
Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Panchayat raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO ZilaPanchayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

REFERENCE BOOKS:

1) The Constitution of India, 1950 (Bare Act), Government Publication.
2) Dr. B. R. Ambedkar framing of Indian Constitution, Dr. S. N. Busi, 1st Edition, 2015.
3) Indian Constitution Law (7th Edition), M. P. Jain, Lexis Nexis, 2014.
4) Introduction to the Constitution of India, D.D. Basu, Lexis Nexis, 2015.

COURSE OUTCOMES:
On completion of the course students will be able to

1) Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2) Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3) Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru.
4) Discuss the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution
5) Discuss the passage of the Hindu Code Bill of 1956.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	2
CO3	-	-	-	-	-	2	-	-	-	-	-	-
CO4	-	-	-	2	-	3	-	-	-	-	-	-
CO5	-	2	-	-	-	-	-	-	-	-	-	-

(A403303) METALLURGY & MATERIAL SCIENCE

B. Tech. (ME): III Semester

L	T	P	C
3	0	0	3

UNIT – I

Crystal Structure: Unit cells, Metallic and Ceramic crystal structures. Imperfection in solids: Point, line, surface and volume defects; dislocations, strengthening mechanisms, slip systems, critical resolved shear stress.

UNIT – II

Hume – Rothery Rules: Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, Eutectiod, peritectoid and monotectic reactions. Iron Iron-carbide phase diagram and micro structural aspects of ledeburite, austenite, pearlite, ferrite and cementite.

UNIT –III

Heat treatment of steels: Isothermal transformation diagrams for Fe-C alloys and microstructures development. Martensite, Bainite. Annealing. Normalising, Hardening, Tempering and Spheroidising.

UNIT – IV

Continuous cooling curves and interpretation of final microstructures and properties-Thermo mechanical treatments like austempering, martempering, surface hardening methods like case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening

UNIT – V

Alloy steels, properties and applications of stainless steels and tool steels, maraging steels- Types of cast irons (grey, white, malleable and spheroidal graphite cast irons), copper and its alloys (Brass and bronze)- Aluminium and its alloys (Al-Cu Alloys). Ceramics and Composites: Types, properties and applications.

TEXT BOOKS:

1. V. Raghavan, “Material Science and Engineering’, Prentice Hall of India Private Limited, Fifth Edition.
2. William. D. Callister, David G. Rethwisch, “Materials Science and Engineering: An Introduction”, John Wiley & Sons, 2018.
3. Sidney H Avner, Introduction to Physical Metallurgy, McGraw Hill,2017

REFERENCE BOOKS:

1. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 9th Edition, Indian Reprint, 2009.
2. U. C. Jindal, “Engineering Materials and Metallurgy”, Pearson, 2011.

COURSE OUTCOMES:

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

1. Descericbe the types of Crystal structures and their defects.
2. Learn the necessity of alloying and identify types of alloy phases.
3. Demonstrate importance of critical understanding of heat treatment in achieving required properties.
4. Apply the knowledge of heat treatment to enhance surface properties.
5. Analyze the properties and micro structure of ferrous and non-ferrous alloys.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	1	2		1					1
CO2	2	3	2	1	2		1					1
CO3	2	3	2	1	2		1					1
CO4	2	3	2	1	2		3					1
CO5	2	3	2	1	2		3					1

(A403304) THERMODYNAMICS

B. Tech. (ME): III Semester

L	T	P	C
3	0	0	3

Note: 1. Steam Tables are permitted for examinations.
2. Refrigeration and psychrometry Tables are permitted for examinations.

UNIT-I:
Introduction: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle – Reversibility – Quasi static Process, Irreversible Process, Causes of Irreversibility – Energy in State and in Transition, Types, Displacement & Other forms of Work, Heat, Point and Path functions, Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points – Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale

UNIT-II:
PMM I - Joule's Experiments – First law of Thermodynamics – Corollaries – First law applied to a Process – applied to a flow system – Steady Flow Energy Equation.
Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics

UNIT-III:
Pure Substances, p-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.
Perfect Gas Laws – Equation of State, specific and Universal Gas constants – various Non-flow processes, properties, end states, Heat and Work Transfer, changes in Internal Energy – Throttling and Free Expansion Processes – Flow processes

UNIT-IV
Deviations from perfect Gas Model – Vader Waals Equation of State – Compressibility charts – variable specific Heats – Gas Tables
Mixtures of perfect Gases – Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction, Volume fraction and partial pressure, Equivalent Gas const. And Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour, Atmospheric air – Psychrometric Properties – Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation, Carrier's Equation – Psychrometric chart.

UNIT-V
Power Cycles: Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles, Brayton and Rankine cycles – Performance Evaluation.
Refrigeration Cycles: Bell-Coleman cycle, Vapour compression cycle-performance Evaluation.

TEXT BOOKS:
1. Engineering Thermodynamics / PK Nag / Mc Graw Hill
2. Thermodynamics – An Engineering Approach by Yunus A. Cengel & Michael A. Boles, TMH
3. Fundamentals of Classical Thermodynamics by G. Van Wylan & R.E. Sonntag, John Wiley Pub

REFERENCE BOOKS:
1. Engineering Thermodynamics by Jones & Dugan, PHI, 2007.
2. Thermodynamics by M. Achutan, PHI, 2nd Edition, 2013.
3. Thermodynamics & Heat Engines by R. Yadav, Central Book Depot, Allahabad.
4. Thermodynamics by S.C. Gupta, Pearson Publications.

COURSE OUTCOMES:
Upon successful completion of the course, student will be able to:

1. Describe the basic concepts of thermodynamics.
2. Apply first law of thermodynamics to different systems.
3. Apply second law of thermodynamics to different systems.
4. Analyze properties of pure substances.
5. Analyze air standard cycles and refrigeration cycles.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	1	2	-	2	-	-	2
CO2	3	3	2	3	3	1	2	-	2	-	-	2
CO3	3	3	1	3	1	1	2	-	2	-	-	2
CO4	3	3	1	3	1	1	2	-	2	-	-	2
CO5	3	3	1	3	2	1	2	-	1	-	-	2

(A403305) MECHANICS OF SOLIDS

B. Tech. (ME): III Semester

L	T	P	C
3	0	0	3

Course Pre-Requisites: Engineering Mechanics

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

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

UNIT – III:
Flexural Stresses: Theory of simple bending – Assumptions – Derivation of bending equation: $M/I = f/y = E/R$ Neutral axis – Determination bending stresses – section modulus of rectangular and circular sections (Solid and Hollow), I,T, Angle and Channel sections – Design of simple beam sections.
Shear Stresses: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

UNIT – IV:
Principal Stresses and Strains: Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for biaxial stresses – Two perpendicular normal stresses accompanied by a state of simple shear – Mohr's circle of stresses – Principal stresses and strains – Analytical and graphical solutions.
Theories of Failure: Introduction – Various theories of failure - Maximum Principal Stress Theory, Maximum Principal Strain Theory, Strain Energy and Shear Strain Energy Theory (Von Mises Theory).

UNIT – V:
Torsion of Circular Shafts: Theory of pure torsion – Derivation of Torsion equations: $T/J = q/r = N\theta/L$
– Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts – Combined bending and torsion and end thrust – Design of shafts according to theories of failure.
Columns and Struts: Euler's Theory, Limitations of Euler's theory, Equivalent Length, Rankine's Formula, Secant Formula.

TEXT BOOKS:

1. Egor P. Popov, Toader A. Balan, "Engineering Mechanics of Solids", PHI Learning, 2010Barry J.
2. S. S. Rattan, "Strength of Materials", Second Edition Tata McGraw Hill Education Pvt. Ltd, New Delhi, 2011

REFERENCE BOOKS:

1. U. C. Jindal, "Strength of Materials", Pearson Education India,2012
2. Goodno and James M. Gere, "Mechanics of Materials" Ninth Edition, Cengage Learning,2018.
3. G. H. Ryder, "Strength of Materials", Macmillan Long Man Publications, 1961
4. W. A. Nash and M. C. Potter, "Strength of Materials", Fifth Edition, Schaum's Outline Series,2011

COURSE OUTCOMES:
At the end of the course, students will be able to:
1. Evaluate the internal forces, moments, stresses, strains, and deformations in structures made of various materials acted on by a variety of loads.
2. Draw axial force, shear force and bending moment diagrams for beams and frames.
3. Develop the Bending equation and shear stresses and apply to the design of beams and shafts.

4. Determine principal stresses and understand the different criteria for the safety of the component by applying the theories of elastic failure.
5. Develop the torsion equation, apply it to design of shafts and to determine crippling load in struts and columns

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1			2					1
CO2	3	3	2	1			2					1
CO3	3	3	2	2			2					1
CO4	3	3	2	1			2					1
CO5	3	3	3	1			2					1

(A401201) FLUID MECHANICS & HYDRAULIC MACHINES
(Common to ME and EEE)

B. Tech. (ME): III Semester

L	T	P	C
3	0	0	3

UNIT – I:
Fluid statics: Dimensions and units: physical properties of fluids- specific gravity, viscosity, and surface tension - vapour pressure and their influence on fluid motion- atmospheric, gauge and vacuum pressures – measurement of pressure- Piezometer, U-tube and differential manometers.

UNIT – II:
Fluid Kinematics: Stream line, path line and streak lines and stream tube, classification of flows, steady & unsteady, uniform & non-uniform, laminar & turbulent, rotational & irrotational flows-equation of continuity for one dimensional flow and three-dimensional flows.
Fluid Dynamics: Surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, momentum equation and its application on force on pipe bend.

UNIT – III:
Boundary Layer Concepts: Definition, thicknesses, characteristics along thin plate, laminar and turbulent boundary layers (No derivation) boundary layer in transition, separation of boundary layer, submerged objects – drag and lift.
Closed conduit flow: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line
Measurement of flow: Pitot tube, venturi meter, and orifice meter, Flow nozzle

UNIT – IV:
Basics of turbo machinery: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes. Hydraulic Turbines: Classification of turbines, Heads and efficiencies, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design –draft tube theory- functions and efficiency.
Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

UNIT – V:
Centrifugal pumps: Classification, working, work done – barometric head- losses and efficiencies specific speed- performance characteristic curves, NPSH.
Reciprocating pumps: Working, Discharge, slip, indicator diagrams

TEXT BOOKS:
1. Hydraulics, Fluid mechanics and Hydraulic Machinery - Modi and Seth, 21st Edition, standard Book House.
2. Fluid Mechanics and Hydraulic Machines by Er. R. K. Rajput, S. Chand, 2019

REFERENCE BOOKS:
1. Fluid mechanics and fluid power engineering by d.s. kumar, s.k. kataria & sons,2018
2. Fluid mechanics and machinery by d. rama durgaiah, new age international publishers
3. Hydraulic machines by T.R. Banga & S.C. Sharma, 7 th edition, Khanna publishers

COURSE OUTCOMES:
At the end of the Course, student will be
1. Able to explain the effect of fluid properties on a flow system.
2. Able to identify type of fluid flow patterns and describe continuity equation.
3. Able To analyze a variety of practical fluid flow and measuring devices and utilize Fluid Mechanics principles in design.
4. Able To select and analyze an appropriate turbine with reference to given situation in power plants.
5. To estimate performance parameters of a given Centrifugal and Reciprocating pump.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	-	-	-	-	-	-	1	1
CO2	2	2	1	1	1		1	-	-	-	1	1
CO3	1		2	3	2	1		-	-	-	1	1
CO4	3	2	1	1	1			-	-	-	1	1
CO5	3	2	1	1	1			-	-	-	1	1

(A402204) BASIC ELECTRICAL & ELECTRONICS ENGINEERING
(Common to ME & CE)

B. Tech. (ME): III Semester

L	T	P	C
3	0	0	3

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.
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, Threephase balanced circuits, voltage and current relations in star and delta connections.

UNIT - II: Electrical Installations: Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries, Elementary calculations for energy consumption, power factor improvement and battery backup

UNIT - III: Electrical Machines: Working principle of Single-phase transformer, equivalent circuit, losses in transformers, efficiency, Three-phase transformer connections. Construction and working principle of DC generators, EMF equation, working principle of DC motors, Torque equations and Speed control of DC motors, Construction and working principle of Three-phase Induction motor, Torques equations and Speed control of Three-phase induction motor. Construction and working principle of synchronous generators

UNIT - IV: P-N Junction and Zener Diode: Principle of Operation Diode equation, Volt-Ampere characteristics, Temperature dependence, Ideal versus practical, Static and dynamic resistances, Equivalent circuit, Zener diode characteristics and applications. Rectifiers and Filters: P-N junction as a rectifier - Half Wave Rectifier, Ripple Factor - Full Wave Rectifier, Bridge Rectifier, Harmonic components in Rectifier Circuits, Filters – Inductor Filters, Capacitor Filters, L- section Filters, π- section Filters.

UNIT - V: Bipolar Junction Transistor (BJT): Construction, Principle of Operation, Amplifying Action, Common Emitter, Common Base and Common Collector configurations, Comparison of CE, CB and CC configurations.
Field Effect Transistor (FET): Construction, Principle of Operation, Comparison of BJT and FET, Biasing FET.

TEXT BOOKS:
1. Basic Electrical and electronics Engineering –M S Sukija TK Nagasarkar Oxford University
2. Basic Electrical and electronics Engineering-D P Kothari. I J Nagarath, McGraw Hill Education

REFERENCE BOOKS:
1. Electronic Devices and Circuits – R. L. Boylestad and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
2. Millman's Electronic Devices and Circuits – J. Millman and C. C. Halkias, SatyabrataJit, TMH, 2/e, 1998.
3. Engineering circuit analysis- by William Hayt and Jack E. Kemmerly, McGraw Hill Company, 6th edition.
4. Linear circuit analysis (time domain phasor and Laplace transform approaches) - 2 nd edition by Raymond A. De Carlo and Pen-Min-Lin, Oxford University Press-2004.
5. Network Theory by N. C. Jagan& C. Lakshminarayana, B.S. Publications.
6. Network Theory by Sudhakar, Shyam Mohan Palli, TMH.
7. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011. 8. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
8. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

COURSE OUTCOMES:
Upon the completion of the course the students will be able to
1. analyze and solve electrical circuits using network laws and theorems.
2. understand and analyze basic Electric and Magnetic circuits
3. study the working principles of Electrical Machines
4. introduce components of Low Voltage Electrical Installations
5. identify and characterize diodes and various types of transistors.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	-	-	-	-	3
CO2	3	3	3	-	-	-	-	-	-	-	-	3
CO3	3	3	3	-	-	-	-	-	-	-	-	3
CO4	3	3	3	-	-	-	-	-	-	-	-	3
CO5	3	3	3	-	-	-	-	-	-	-	-	3

(A401506) FLUID MECHANICS AND HYDRAULICS MACHINERY LABORATORY

B. Tech. (ME): III Semester

L	T	P	C
0	0	2	1

List of Experiments

1. Verification of Bernoulli's equation
2. Determination of Coefficient of discharge for a small orifice by a constant head method
3. Calibration of Venturimeter / Orifice Meter
4. Calibration of Triangular / Rectangular/Trapezoidal Notch
5. Determination of Minor losses in pipe flow
6. Determination of Friction factor of a pipe line
7. Determination of Energy loss in Hydraulic jump
8. Determination of Manning's and Chezy's constants for Open channel flow.
9. Impact of jet on vanes
10. Performance Characteristics of Pelton wheel turbine
11. Performance Characteristics of Francis turbine
12. Performance characteristics of Keplan Turbine
13. Performance Characteristics of a single stage / multi stage Centrifugal Pump
14. Study of Water Hammer due to sudden closure of valve

COURSE OUTCOMES:

Upon completion of course the students will be able to

1. determine the coefficient of discharge for venture meter, orifice meter and small orifice meter
2. perform the various notches and assess the losses in pipes
3. verify the Bernoulli's equation and study the flow in open channel
4. analyze the performance of pumps, various turbines and effect of water hammer
5. calculate impact of force of Jet on different types of Vanes

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	3
CO2	3	3	-	-	-	-	-	-	-	-	-	3
CO3	3	3	-	-	-	-	-	-	-	-	-	3
CO4	3	3	-	-	-	-	-	-	-	-	-	3
CO5	3	3	-	-	-	-	-	-	-	-	-	3

(A402504) BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

B. Tech. (ME): III Semester

L	T	P	C
0	0	2	1

Pre-requisites: Basic Electrical and Electronics Engineering

Course Objectives:

1. To introduce the concepts of electrical circuits and its components
2. To understand magnetic circuits, DC circuits and AC single phase & three phase circuits
3. To study and understand the different types of DC/AC machines and Transformers.
4. To import the knowledge of various electrical installations.
5. To introduce the concept of power, power factor and its improvement.
6. To introduce the concepts of diodes & transistors, and
7. To impart the knowledge of various configurations, characteristics and applications.

List of Experiments/ Demonstrations:

PART A: ELECTRICAL

1. Verification of KVL and KCL
2. Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer
3. Measurement of Active and Reactive Power in a balanced Three-phase circuit
4. Performance Characteristics of a DC Shunt Motor
5. Performance Characteristics of a Three-phase Induction Motor
6. No-Load Characteristics of a Three-phase Alternator

PART B: ELECTRONICS

1. Study and operation of (i) Multi-meters (ii) Function Generator (iii) Regulated Power Supplies (iv) CRO.
2. PN Junction diode characteristics
3. Zener diode characteristics and Zener as voltage Regulator 4. Input & Output characteristics of Transistor in CB / CE configuration
4. Full Wave Rectifier with & without filters
5. Half Wave Rectifier with & without filters

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Electronic Devices and Circuits – R. L. Boylestead and Louis Nashelsky, PEI/PHI, 9th Ed, 2006.
2. Millman's Electronic Devices and Circuits – J. Millman and C. C. Halkias, SatyabrataJit, TMH, 2/e, 1998.

COURSE OUTCOMES:

1. To Verify basic laws of electrical circuits and Network theorems.
2. To study the working principles of Electrical Machines.
3. To Verify the transformer principle with suitable practical arrangement.
4. To identify and plot characteristics of diodes and various types of transistors.
5. To understand the operation of Half wave and full wave rectifiers.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	3				1			1
CO2	3	2	1	1	3				1			1
CO3	3	2	1	1	3				1			1
CO4	3	2	1	1					1			1
CO5	3	2	1	1					1			1

(A400507) SOCIAL INNOVATION IN PRACTICE
(Common to all branches)

B. Tech. (ME): III Semester

L	T	P	C
0	0	2	1

Week-1
Identify community issues to be addressed, Requirements Analysis: Extensive User requirements analysis

Week-2
Generating effective System Requirement document

Week-3
Social Innovation – Case Studies

Week-4
Impact of Social Innovation on communities

Week-5
Process of Social Innovation Prompts – identifying needs, Proposals –generating ideas,
Prototyping – testing the idea in practice,

Week-6
Sustaining-developing a business model, Scaling and diffusion-growing social innovations, Systematic change

Week-7
Introduction to sustainability, Sustainability leadership, Life cycle assessment

Week-8
Carbon footprint Calculation

Week-9
Types of Start-Ups, Types of business models, Market risks and Marketing strategies

Week-10
Verification of Business Model and Validation

Week-11
Business Model Development

Week-12
Documentation and Panel presentation

TEXT BOOKS:

1. Requirements Analysis: From Business Views to Architecture; David C. Hay; Prentice Hall Professional
2. Social Enterprises: An Organizational Perspective edited; Benjamin Gidron, Yeheskel Hasenfeld; PalgraveMacmillan

REFERENCE BOOKS:

1. Social Enterprise Law: Trust, Public Benefit and Capital Markets By Dana Brakman Reiser & Steven A. Dean
2. Introduction to Sustainability by Robert Brinkmann, Wiley-Blackwell

COURSE OUTCOMES:

On Completion of the course, the students will be able to

1. Identify several social issues to be addressed
2. Analyze the impact of social innovations on the society
3. Illustrate the process of social innovation for a community problem
4. Demonstrate the solution from sustainability perspectives.
5. Develop a scalable business model

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			2				3					1
CO2			2				3					1
CO3			2				3					1
CO4			2				3					1
CO5			2				3					1

(A405506) PYTHON PROGRAMMING LABORATORY
(Common to CSE, ECE, IT, CSE-DS, CSE-AI&ML, AI&ML, AI&DS, CSE-CS, MECH, CIVIL, EEE)
B. Tech. (ME): III Semester

L	T	P	C
0	1	2	2

Week 1: (Python Language Fundamentals-Installation -Identifiers, Reserved Words, Data Types, Type Casting, Immutability)
Demonstration
Experiment-1: Install Anaconda open-source framework for python.
Experiment-2: Write a program to display 'Hello World'.
Experimentation
Experiment-3: Explore various IDEs for python program development.
Experiment-4: The volume of a sphere with radius r is 4/3 πr^3. Write a Python program to find the volume of a sphere with radius 5?

Week 2: (Arithmetic Operators, Relational Operators, Logical operators, Bitwise operators, Assignment operators, Special operators)
Demonstration
Experiment-1; Write a python program to find minimum and maximum of given three numbers.
Experiment-2: Suppose the cover price of a book is $24.95, but bookstores get a 40% discount.
Shipping costs $3 for the first copy and 75 cents for each additional copy. Write a python program to compute the total wholesale cost for 60 copies?
Experimentation
Experiment-3: Write a Python Program to Find the Square Root of a number with out using sqrt function.
Experiment-4: Python Program to Convert Celsius To Fahrenheit.
Experiment-5: Python program to find themaximum of two numbers using ternary operator

Week 3: (Mathematical Functions, Input and Output statements, Command Line Arguments, String Functions)
Demonstration
Experiment-1: Write a Python program to find area of circle.
Experiment-2: Write a program to read Employee data from the keyboard and print that data.
Experimentation
Experiment-3: Write a program to read 3 float numbers from the keyboard with comma separator and print their sum.
Experiment-4: Write a Program to display Command Line Arguments.

Week 4: (Flow Control Statements-Conditional Statements, Transfer Statements, Iterative Statements)
Demonstration
Experiment-1: Write a Python program to take a single digit number from the key board and print is value in English word?
Experiment-2: Write a Python Program to check whether an n-digit integer is an Armstrong number or not.
Experimentation
Experiment-3: Write a Python program to display *'s in pyramid style (also known as equivalent triangle).
Experiment-4: Write a Python Program to Display the multiplication Table.

Week 5: (Functions-Built in functions, user defined functions, Parameters, return statement, returning multiple values from function, type of arguments, Types of variables-global, local Recursive functions, Lambda functions, filter function, reduce function, Function aliasing, Function decorators, Generators)
Demonstration
Experiment-1: Write a python function to find factorial of given number?
Experiment-2: Write a program to create a lambda function to find square of given number?
Experimentation
Experiment-3: Lambda Function to find biggest of given values.
Experiment-4: Program to filter only even numbers from the list by using filter () function?

Week 6: (Working with Strings-Defining String, Multi-line Strings, accessing characters of a string, Mathematical operators for strings, Membership operator, Comparison of Strings, removing spaces from the string, Finding Substring, String replacement, Splitting of Strings, changing cases of a string, Formatting the strings)
Demonstration
Experiment-1: Write a program to accept some string from the keyboard and display its characters by index wise (both positive and negative index).

Experiment-2: Write a program to access each character of string in forward and backward direction by using while loop?

Experimentation

Experiment-3: Program to display all positions of substring in a given main string.

Experiment-4: Write a program to reverse the given String.

Week 7: (Python Data Structures-List: Creating a list-Accessing elements of a List, Traversing the List, List Manipulation, Ordering the elements of a List, Mathematical Operators for List objects, Membership Operator, Nested Lists, List Comprehensions)

Demonstration

Experiment-1: Write a Python program to display unique vowels present in the given word.

Experiment-2: Write a Python program to Count the Occurrence of an Item in a List.

Experimentation

Experiment-3: Write a Python program to segregate even and odd numbers from the given list of numbers.

Experimnet-4: Write a Python program to find the cumulative sum of elements of the list.

Week 8: (Python Data Structures-Tuple: Creating a Tuple, Accessing the elements of a tuple, mathematical operators for tuple, Tuple packing and Unpacking)

Demonstration

Experiment-1: Python program for adding a Tuple to List and Vice-Versa.

Experiment-2: Write a Python program to perform the summation of all elements of each tuple from the list of tuples.

Experimentation

Experiment-3: Write a Python program to multiply adjacent elements of a tuple.

Experiment-4: Write a Python program to find the maximum element in the tuple list.

Week 9: (Python Data Structures-Set: Creating a Set object, functions of set, Mathematical operations on set, Membership Operators, Set Comprehension, Python Data Structures-Dictionary: Creating a Dictionary Object, accessing data from the dictionary, updating dictionaries, Deleting from dictionary, Functions on dictionary, dictionary comprehension)

Demonstration

Experiment-1: Write a Python program to perform set operations.

Experiment-2: Write a program to print different vowels present in the given word?

Experiment-3: Write a Python program to generate powers of 2 using set comprehensions.

Experiment-4: Write a program to eliminate duplicates present in the list using set

Experiment-5: Write a Python program to enter name and percentage marks in a dictionary and display information on the console.

Experimentation

Experiment-6: Write a program to take dictionary from the keyboard and print the sum of values?

Experiment-7: Write a program to find number of occurrences of each letter present in the given string using dictionary.

Experiment-8: Write a program to accept student name and marks from the keyboard and creates a dictionary. Also display student marks by taking student name as input?

Week 10: (Python Modules-Creating Modules, accessing members, module aliasing, member aliasing, reloading a module,

The special variable: __name___. Working with Math, random modules, Python Packages.Python-File Handling-Types of Files, Opening a file, closing a file, properties of File object, writing data to text file, Reading character data from text files, seek (), tell() functions.)

Demonstration

Experiment-1: Create a module **fibo.py** containing Fibonacci (**n**) function(s) and import fibo module in a python script to print Fibonacci series Upton

Experiment-2: Write a python program to print all the contents of a given module.

Experiment-3: Write a python program to create a package containing two or modules.

Experiment-4: Write a python program to import module from a package created in Experiment-3.

Experimentation

Experiment-5: Write a program to check whether the given file exists or not. If it is available then print its content?

Experiment-6: Write a python Program to print the number of lines, words and characters present in the given file?

Experiment-7: Program to read image file and write to a new image file?

Experiment-8: Write a python program to read and write to a CSV file.

NOTE:
Experiments under Demonstration section is to be demonstrated by the concerned faculty and the experiments under Experimentation section must be performed by the students individually.

REFERENCE BOOKS:

1.Allen B. Downey, "Think Python", 2nd edition, SPD/O'Reilly, 2016.
2. Martin C. Brown, "The Complete Reference: Python", McGraw-Hill, 2018.
3. Kenneth A. Lambert, B.L. Juneja, "Fundamentals of Python", CENGAGE, 2015.
4. R. Nageswara Rao, "Core Python Programming", 2nd edition, Dreamtech Press, 2019.

Web links:

1. https://docs.python.org/3/tutorial/modules.html#packages
2. https://www.includehelp.com/python/programs.aspx.
3. https://www.anaconda.com/products/individual
4. https://www.jetbrains.com/pycharm/

COURSE OUTCOMES:
Students shall be able to:

CO1: Design solutions to computational problems using Python programming language constructs.
CO2: Write python programs to manipulate string objects.
CO3: Use appropriate Data structures to organize and manipulate data items.
CO4: Design modular application using python module & package concepts.
CO5: Develop application to read and write from various file formats.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**1**	**1**	**3**	**2**	**2**							**1**
CO2	**2**	**2**	**3**	**1**	**3**							**1**
CO3	**3**	**2**	**2**	**1**	**3**							**1**
CO4	**1**	**3**	**2**	**2**	**3**							**1**
CO5		**2**	**1**	**1**	**3**							**1**

(A400702) GENDER SENSITIZATION
(Common to all branches)

B. Tech. (ME): III Semester

L	T	P	C
2	0	0	0

UNIT-I:
UNDERSTANDING GENDER: Introduction: Definition of Gender-Basic Gender Concepts and Terminology-Exploring Attitudes towards Gender-Construction of Gender-Socialization: Making Women, Making Men - Preparing for Womanhood-Growing up Male, First lessons in Caste.

UNIT – II:
GENDER ROLES AND RELATIONS: Two or Many? -Struggles with Discrimination-Gender Roles and Relations-Types of Gender Roles-Gender Roles and Relationships Matrix-Missing Women-Sex Selection and Its ConsequencesDeclining Sex Ratio-Demographic Consequences-Gender Spectrum: Beyond the Binary

UNIT – III:
GENDER AND LABOUR: Division and Valuation of Labour-Housework: The Invisible Labor- "My Mother doesn"t Work." "Share the Load."-Work: Its Politics and Economics -Fact and Fiction. Unrecognized and Unaccounted work.– GenderDevelopment Issues-Gender, Governance and Sustainable Development-Gender and Human Rights-Gender andMainstreaming

UNIT – IV:
GENDER - BASED VIOLENCE: The Concept of Violence- Types of Gender-based Violence-Gender-based Violence from a Human Rights, Perspective-Sexual Harassment: Say No!-Sexual Harassment, not Eve-teasing- Coping with Everyday, Harassment- Further Reading: "Chupulu". Domestic Violence: SpeakingOutIs Home a Safe Place? – When Women Unite [Film], Rebuilding Lives. Thinking about Sexual Violence Blaming the Victim-"I Fought for myLife…."

UNIT – V:
GENDER AND CULTURE: Gender and Film-Gender and Electronic Media-Gender and Advertisement-Gender and Popular LiteratureGender Development Issues-Gender Issues-Gender Sensitive Language-Gender and Popular Literature – JustRelationships: Being Together as Equals Mary Kom and Onler. Love and Acid just do not Mix. Love Letters-Mothers and Fathers- Rosa ParksThe Brave Heart.

REFERENCE BOOKS
1. Towards a World of Equals: A Bilingual Textbook on Gender, A. Suneetha, Uma Bhrugubanda, DuggiralaVasanta, Rama Melkote, VasudhaNagaraj, AsmaRasheed, GoguShyamala, DeepaSreenivas and Susie Tharu published by Telugu Akademi, Telangana Government, 2015.

COURSE OUTCOMES:
On completion of the course students will be able to

1. Students will have developed a better understanding of important issues related to gender in contemporary India.
2. Students will be sensitized to basic dimensions of the biological, sociological, psychological and legalaspects of gender. (This will be achieved through discussion of materials derived from research, facts, everyday life, literature and film).
3. Students will attain a finer grasp of how gender discrimination works in our society and acquire insight into the gendered division of labour and its relatuion to politics and economics.
4. Men and women students and professionals will be better equipped to work and live together as equals.
5. Students will develop a sense of appreciation of women in all walks of life by going through accounts of studies and movements as well as the new laws that provide protection and relief to women.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	-	-	-	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	2	-	-	-	-	-	-
CO4	-	-	-	2	-	-	-	-	-	-	-	-
CO5	-	-	3	-	-	--	-	-	-	-	-	-

(A400004) PROBABILITY, STATISTICS &COMPLEX VARIABLES

B. Tech (ME): IV Semester

L	T	P	C
3	1	0	4

UNIT-I:

Basic Probability: Probability spaces, conditional probability, independent events, and Baye's theorem, Random variables: Discrete and continuous random variables, Expectation of Random Variables, Variance of random variables

UNIT-II:

Probability distributions: Binomial, Poisson, evaluation of statistical parameters for these distributions, Poisson approximation to the binomial distribution, Continuous random variables and their properties, distribution functions and density functions, Normal and exponential, evaluation of statistical parameters for these distributions

UNIT-III:

Estimation & Tests of Hypotheses: Introduction, Statistical Inference, And Classical Methods of Estimation.: Estimating the Mean, Standard Error of a Point Estimate, Prediction Intervals, Estimating a Proportion for single sample, Difference between Two Means, difference between two proportions for two Samples, Statistical Hypotheses: General Concepts, Testing a Statistical Hypothesis, Tests Concerning a Single Mean, Tests on Two Means, Test on a Single Proportion, Two Samples: Tests on Two Proportions

UNIT-IV:

Complex Differentiation: Limit, Continuity and Differentiation of Complex functions, Analyticity, Cauchy-Riemann equations (without proof), finding harmonic conjugate, elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

UNIT-V:

Complex Integration: Line integral, Cauchy's theorem, Cauchy's Integral formula, Zeros of analytic functions, Singularities, Taylor's series, Laurent's series, Residues, Cauchy Residue theorem (All theorems without Proof).

TEXTBOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, (35th Edition), 2010.
2. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, keying Ye, Probability and statistics for engineers and scientists, (9thEdition), Pearson Publications.

REFERENCE BOOKS:

1. Fundamentals of Mathematical Statistics, Khanna Publications, S.C. Guptha and V.K. Kapoor.
2. Miller and Freund's, Probability and Statistics for Engineers, (8th Edition), Pearson Educations.
3. N.P. Baliand Manish Goyal, A text book of Engineering Mathematics, (10th Edition), Laxmi Publications, Reprint, 2010.
4. J.W. Brown and R.V. Churchill, Complex Variables and Applications, (7thEdition), Mc-GrawHill,2004.

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Apply the concepts of Probability and Random Variables to case studies.
2. Formulate and solve problems involving Random Variables and apply statistical methods for analyzing experimental data.
3. Apply concepts of estimation and testing of hypothesis to case studies.
4. Analyze the complex function with reference to the analyticity, integration using Cauchy's integral and residue theorems.
5. Taylor's and Laurent's series expansions of complex function.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	2	2	2		2					**2**
CO2	**3**	**3**	2	2	2		2					**2**
CO3	**3**	**3**	2	3	2		2					**2**
CO4	**3**	**3**	2	3	2							**2**
CO5	**3**	**3**	2	3	2							**2**

(A403302) MANUFACTURING PROCESSES

B. Tech (ME): IV Semester

L	T	P	C
2	0	0	2

Pre-requisites: None

UNIT – I:
Casting: Steps involved in making a casting – Advantage of casting and its applications; Patterns - Pattern making, Types, Materials used for patterns, pattern allowances; Properties of moulding methods. Methods of Melting - Crucible melting and cupola operation – Defects in castings; Principles of Gating – Requirements – Types of gates, Design of gating systems – Riser – Function, types of Riser and Riser design. Casting processes – Types – Sand moulding, Centrifugal casting, die casting, Investment casting, shell moulding

UNIT – II:
Welding: Classification – Types of welds and welded joints and their characteristics, Welding Positions - Gas welding - Types, oxy-fuel gas cutting – standard time and cost calculations. Arc welding, Shielded metal arc welding, submerged arc welding, Resistance welding, Thermit welding.

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

UNIT – IV:
Hot working, cold working, strain hardening, recovery, recrystallisation and grain growth, Sheet metal Operations: Stamping, Blanking and piercing, Coining, Strip layout, Hot and cold spinning – Bending and deep drawing, Rolling fundamentals – theory of rolling, types of Rolling mills and products, Forces in rolling and power requirements. Drawing and its types – wire drawing and Tube drawing – Types of presses and press tools, Forces and power requirement in the above operations

UNIT – V:
Extrusion of Metals: Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion, Hydrostatic extrusion, Forces in extrusion Drop Forging – Roll forging – Forging hammers: Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.
High Energy Rate Forming Processes: Principles of Explosive Forming, Electro-hydraulic Forming, Electro-magnetic forming and rubber pad Forming.

TEXT BOOKS:

1. Manufacturing Technology / P.N. Rao/ Vol.1 / Mc Graw Hill Education/ 5th Edition, 2018.
2. Manufacturing Engineering & Technology / Serope Kalpakjian / Steven R. Schmid / Pearson, 7th Edition,2014

REFERENCE BOOKS:

1. Production Technology Vol.: 1, WILEY, sreeramulu M, 2018
2. A Text book of Production Technology (Manufacturing Processes) / Dr.P.C. Sharma / S.Chand Publications /1st Edition, 2006.
3. Manufacturing processes H. S. Shan, Second Edition, Cambridge University Press, 2017.
4. Production Technology: Manufacturing Processes, Technology and Automation / R. K. Jain/Vol.1/Khanna Publishers /19th Edition, 2009.
5. Elements of Workshop Technology/ S.K. Hajra Choudhury, A.K. Hajra Choudhury, NirjharRoy/Vol.1/ Media Publishers & Promoters Pvt. Ltd./1st Edition,2008.

COURSE OUTCOMES:
Upon successful completion of the course, student will be able to:
1. Elaborate the fundamentals of various molding, casting techniques and furnaces.
2. Identify the importance of permanent joining and principles behind different welding processes.
3. Describe the concepts of various welding processes
4. Drscribe the concepts of hot working, cold working, rolling and sheet metal operations..
5. Elaborate the uniqueness of extrusion, forging and high energy rate forming processes in metal working.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	1	1		-	-	-	1	1
CO2	2	2	2	2			1	-	-	-	1	1
CO3	2	2	2	2			1	-	-	-	1	1
CO4	2	2	2	2			1	-	-	-	1	1
CO5	3	3	3	2	2	2		-	-	-	1	1

(A403306) IC ENGINES AND GAS TURBINES

B. Tech (ME): IV Semester

L	T	P	C
3	0	0	3

Note: 1. Steam Tables are permitted for examinations.

UNIT – I:
I.C. Engines: Classification - Working principles of Four & Two stroke engine, SI & CI engines, Valve and Port Timing Diagrams, Air – Standard, air-fuel and actual cycles - Engine systems – Carburetor and Fuel Injection Systems for SI engines, Fuel injection systems for CI engines, Ignition, Cooling and Lubrication system, Fuel properties and Combustion Stoichiometry

UNIT – II:
Normal Combustion and abnormal combustion in SI engines – Importance of flame speed and effect of engine variables – Abnormal combustion, pre-ignition and knocking in SI Engines – Fuel requirements and fuel rating, anti knock additives – combustion chamber – requirements, types of SI engines.
Four stages of combustion in CI engines: Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion. Induced turbulence in Diesel engine – open and divided combustion chambers and fuel injection– Diesel fuel requirements and fuel rating.

UNIT –III:
Testing and Performance: Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart, Classification of compressors – Fans, blowers and compressors – positive displacement and dynamic types – reciprocating and rotary types.
Reciprocating Compressors: Principle of operation, work required, Isothermal efficiency volumetric efficiency and effect of clearance volume, staged compression, under cooling, saving of work, minimum work condition for staged compression

UNIT – IV:
Rotary Compressor (Positive displacement type): Roots Blower, vane sealed compressor, mechanical details and principle of working – efficiency considerations.
Dynamic Compressors: Centrifugal compressors: Mechanical details and principle of operation –velocity and pressure variation. Energy transfer-impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient – velocity diagrams – power.
Axial Flow Compressors: Mechanical details and principle of operation – velocity triangles and energy transfer per stage degree of reaction, work done factor - isentropic efficiency- pressure rise calculations – Polytropic efficiency.

UNIT – V:
Gas Turbines: Simple Gas Turbine Plant – Ideal Cycle – Closed Cycle and Open Cycle for Gas Turbines, Constant Pressure Cycle, Constant Volume Cycle, Efficiency – Work Ratio and Optimum Pressure Ratio for Simple Gas Turbine Cycle, Parameters of Performance, Actual Cycle

TEXT BOOKS:
1. Ganesan, V. Internal combustion engines. McGraw Hill Education (India) Pvt Ltd, 2012.
2. Rajput, R. K. Thermal engineering, Laxmi Publications, 2010.

REFERENCE BOOKS:
1. Nag, P. K. Engineering thermodynamics, Tata McGraw-Hill Education, 2013
2. Mathur, M. L., and R. P. Sharma. Internal combustion engines, Dhanpat Rai Publ., 2005
3. Pulkrabek, Willard W. Engineering fundamentals of the internal combustion engine. Upper Saddle River: Pearson Prentice Hall, 2014.
4. Rudramoorthy, R. Thermal engineering. Tata McGraw-Hill, 2003
5. Heywood, John B. "Internal combustion engine fundamentals." (1988)
6. Khurmi, R. S., and J. K. Gupta, A Textbook of Thermal Engineering (Mechanical Technology). S. Chand, 2008

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Classify the working principles of internal combustion engines.
2. Compare combustion phenomena between SI Engines & CI engines.
3. Estimate the performance parameters of internal combustion engines.
4. Analyze the performance of compressors.
5. Evaluate the performance of gas turbines.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	-	-	-	-	-	-	1	1
CO2	2	2	1	1	1		1	-	-	-	1	1
CO3	1		2	3	2	1		-	-	-	1	1
CO4	3	2	1	1	1			-	-	-	1	1
CO5	3	2	1	1	1			-	-	-	1	1

(A403307) KINEMATICS OF MACHINERY

B. Tech. (ME): IV Semester

L	T	P	C
3	0	0	3

UNIT – I:

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

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

UNIT – II:

Kinematics: Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration – Graphical method – Application of relative velocity method. **Plane motion of body:** Instantaneous center of rotation-centrodes and axodes – Three centers in line theorem – Graphical determination of instantaneous center, determination of angular velocity of points and links by instantaneous center method. Klien's construction – Corioli's acceleration - determination of Corioli's component of acceleration

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

UNIT – III:

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

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

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

UNIT – IV:

Cams: Definitions of cam and followers – their uses – Types of followers and cams – Terminology – Types of follower motion - Uniform velocity, Simple harmonic motion and uniform acceleration and retardation, Maximum velocity and maximum acceleration during outward and return strokes in the above 3 cases, Analysis of Tangent cam with Roller follower.

UNIT – V

Higher pair: Friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion – velocity of sliding. Forms of teeth, cycloidal and involutes profiles – phenomena of interference – Methods of avoiding interference. Condition for minimum number of teeth to avoid interference – expressions for arc of contact and path of contact of Pinion & Gear and Pinion & Rack Arrangements– Introduction to Helical – Bevel and worm gearing

TEXT BOOKS:

1. Rattan, Sarjit S. Theory of machines. Tata McGraw-Hill Education, 2014
2. Uicker, John Joseph, Gordon R. Pennock, and Joseph Edward Shigley, Theory of machines and mechanisms. Vol. 1, New York, NY: Oxford University Press, 2011.

REFERENCE BOOKS:

1. Thomas, Bevan. Theory of Machines, 3/e. Pearson Education India, 1986
2. Khurmi R.S., Theory of Machines, S Chand Publishers
3. Rao, J. S., Dukkipati, R.V., Mechanism and Machine Theory, New age International Publishers, 1992.

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Analyze the mobility concepts of machines & mechanisms.
2. Analyze for velocity & acceleration on various mechanisms.
3. Analyze various motion mechanisms.
4. Design cam profiles and analyze for resulting follower motions on specified contours.
5. Design and analyze various power transmission drives.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1		1	-	-	-	-		-	1
CO2	2	3	2	3		-	-	-	-	1	-	1
CO3	3	2	1	1		-	-	-	-		-	1
CO4	1	2	1		2	-	-	-	-		-	1
CO5	2	3	3	1		-	-	-	-		-	2

(A403309) INSTRUMENTATION & CONTROL SYSTEMS

B. Tech. (ME): IV Semester

L	T	P	C
2	0	0	2

UNIT – I:
Definition – Basic principles of measurement – Measurement systems, generalized configuration and functional description of measuring instruments – examples. Static and Dynamic performance characteristics– sources of errors, Classification and elimination of errors, Measurement of Displacement: Theory and construction of various transducers to measure displacement – Using Piezo electric, Inductive, capacitance, resistance, ionization and Photo electric transducers; Calibration procedures.

UNIT – II:
Measurement of Temperature: Various Principles of measurement-Classification: Expansion Type: Bimetallic Strip-Liquid in glass Thermometer; Electrical Resistance Type: Thermistor, Thermocouple, RTD; Radiation Pyrometry: Optical Pyrometer; Changes in Chemical Phase: Fusible Indicators and Liquid crystals. Measurement of Pressure: Different principles used- Classification: Manometers, Dead weight pressure gauge Tester (Piston gauge), Bourdon pressure gauges, Bulk modulus pressure gauges, Bellows, Diaphragm gauges. Low pressure measurement – Thermal conductivity gauges, ionization pressure gauges, McLeod pressure gauge.

UNIT – III:
Measurement of Level: Direct methods – Indirect methods – Capacitive, Radioactive, Ultrasonic, Magnetic, Cryogenic Fuel level indicators –Bubbler level indicators.
Flow measurement: Rotameter, magnetic, Ultrasonic, Turbine flowmeter, Hot – wire anemometer, Laser Doppler Anemometer (LDA).
Measurement of Speed: Mechanical Tachometers, Electrical tachometers, Non-contact type Stroboscope; Measurement of Acceleration and Vibration: Different simple instruments – Principles of Seismic instruments – Vibrometer and accelerometer using this principle- Piezo electric accelerometer.

UNIT – IV:
Stress-Strain measurements: Various types of stress and strain measurements –Selection and installation of metallic strain gauges; electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending, compressive and tensile strains – Temperature compensation techniques, Use of strain gauges for measuring torque, Strain gauge Rosettes.
Measurement of Humidity: Moisture content of gases, Sling Psychrometer, Absorption Psychrometer, Dew point meter.
Measurement of Force, Torque and Power- Elastic force meters, load cells, Torsion meters, Dynamometers.

UNIT – V:
Elements of Control Systems: Introduction, Importance – Classification – Open and closed systems- Servomechanisms – Examples with block diagrams – Temperature, speed and position control systems- Transfer functions- First and Second order mechanical systems

TEXT BOOKS:
1. Principles of Industrial Instrumentation & Control Systems/Chennakesava R alaavala, Cengage Learning/1st Edition, 2009.
2. Basic Principles – Measurements (Instrumentation) & Control Systems /S. Bhaskar/ Anuradha Publications

REFERENCE BOOKS:
1. Measurement Systems: Applications & design, E. O. Doebelin, TMH, Tata Mcgraw Hill/6th Edition, 2017.
2. Instrumentation, Measurement & Analysis, B.C. Nakra & K.K. Choudhary, TMH, 4th Edition, 2016.
3. Experimental Methods for Engineers / Holman
4. Mechanical and Industrial Measurements / R. K. Jain/ Khanna Publishers.
5. Mechanical Measurements / Sirohi and Radhakrishna / New Age International, 3rd Edition, 2013.

COURSE OUTCOMES:
After completion of the course, the student will be able to:
1. Know the basic knowledge of the functional blocks of measurement systems.
2. Describe the working of various physical variable Temperature and pressure measuring instruments.
3. Explain the working of various physical variable Level, flow, Speed and Acceleration measuring instruments.
4. Describe the working of various physical and Electrical variables Stress, Humidity, Force, Torque and Power measuring instruments.

5. Describe the concept of control system and calculate transfer functions of mechanical and translational systems with different techniques.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	2	-	1	-	-	-	-	-	1
CO2	3	2	2	2	-	1	-	-	-	-	-	1
CO3	3	2	2	2	-	1	-	-	-	-	-	1
CO4	3	2	2	2	-	1	-	-	-	-	-	1
CO5	3	2	2	2	-	1	-	-	-	-	-	1

(A403506) MATERIAL SCIENCE & MECHANICS OF SOLIDS LABORATORY

B. Tech. (ME): IV Semester

L	T	P	C
0	0	2	1

MATERIAL SCIENCE LABORATORY

LIST OF EXPERIMENTS:

1. Preparation and study of crystal models for simple cubic, body centred cubic, face centred cubic and hexagonal close packed structures.
2. Preparation and study of the Microstructure of pure metals like Iron, Cu and Al.
3. Preparation and study of the Microstructure of Mild steels, low carbon steels, high Carbon steels.
4. Study of the Microstructures of Various Cast Irons.
5. Study of the Microstructures of Non-Ferrous alloys. (Al, Cu, Mg)
6. Hardenability of steels by Jominy End Quench Test.

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Characterize the microstructures of different ferrous and non ferrous metals.
2. Identify the effect of heat treatment on the properties of ferrousm aterials.
3. Perform metallographic methods for characterizing the micro structure of the various metals.
4. Plot the hardness variations of various heat treated and non-heat treated steels.
5. Identify the effect of heat treatment on the properties of nonferrous materials.

MECHANICS OF SOLIDS LAB

LIST OF EXPERIMENTS:

1. Direct tension test
2. Bending test on Simple supported beam
3. Bending test on Cantilever beam
4. Torsion test
5. Brinell hardness test/ Rockwell hardness test
6. Test on springs
7. Izod Impact test/ Charpy Impact test

COURSE OUTCOMES:

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

1. Calculate modulus of Elasticity for given material from the Tension test, bending test on simply supported and cantilever beams.
2. Calculate modulus of rigidity of given material from Torsion test on circular shafts.
3. Calculate hardness of materials from Brinell / Rockwell hardness tests.
4. Calculate modulus of rigidity of given material from spring test.
5. Calculate Impact strength and hardness of given material from Charpy/Izod impact tests

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1			2					1
CO2	3	3	2	1			2					1
CO3	3	3	2	2			2					1
CO4	3	3	2	1			2					1
CO5	3	3	3	1			2					1

(A403507) MANUFACTURING PROCESSES LABORATORY

B. Tech. (ME): IV Semester

L	T	P	C
0	0	2	1

Pre-requisites: Production Technology

Minimum of 12 Exercises need to be performed

I. Metal Casting Lab:
1. Pattern Design and making
2. Sand properties testing
3. Moulding Melting and Casting - 1 Exercise

II. Welding Lab:
1. Arc Welding Lap & Butt Joint - 2 Exercises
2. Spot Welding - 1 Exercise
3. TIG Welding - 1 Exercise
4. Brazing – 1 Excercise
4. Plasma welding - 1 Exercises

III. Mechanical Press Working:
1. Blanking & Piercing operation and study of simple, compound tool operations.
2. Hydraulic Press: Drawing operation and progressive press tool operation.
3. Bending and other operations

IV. Processing of Plastics
1. Injection Moulding
2. Blow Moulding

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

COURSE OUTCOMES:
After completion of the course, the student will be able to
1. Design and make Patterns, Test sand Properties.
2. Operate different types of welding machines
3. Prepare different types of joints in welding.
4. Perform operations on mechanical press.
5. Get familiarity with processing of Plastics.

CO-PO MAPPING:

/

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	3				1			1
CO2	3	2	1	1	3				1			1
CO3	3	2	1	1	3				1			1
CO4	3	2	1	1					1			1
CO5	3	2	1	1					1			1

(A403508) COMPUTER AIDED MACHINE DRAWING

B. Tech. (ME): IV Semester

L	T	P	C
0	0	2	1

Pre-requisites: Engineering graphics

Drawing of Machine Elements and simple parts:

1. Popular forms of Screw threads, bolts, nuts, stud bolts, tap bolts, set screws.
2. Keys, cottered joints and knuckle joint.
3. Rivetted joints
4. Shaft coupling, spigot and socket pipe joint.
5. Journal, pivot and collar and foot step bearings.

Drawing of Machine Elements: Using Computer aided drafting in addition to manual drawing

Assembly Drawings:

Drawing of assembled views for the part drawings of the following using conventions and easy drawing proportions

1. Steam engine parts – stuffing box, cross head, Eccentric.
2. Machine tool parts: Tail stock, Tool Post, Machine Vices.
3. Other machine parts - Screw jack, Connecting rod, Plumber block, Fuel Injector
4. Valves - Steam stop valve, spring loaded safety valve, feed check valve and air cock.

Assembly Drawings: Using Computer aided drafting in addition to manual drawing

NOTE: 1. First angle projection to be adopted.
2. All the drawing components/Assembly to be drawn using any Computer aided drafting package

TEXT BOOKS:

1. Machine Drawing / N.D. Bhatt / Charotar
2. Machine Drawing with Auto CAD / Goutham Pohit, Goutam Ghosh / Pearson

REFERENCE BOOKS:

1. Machine Drawing by / Bhattacharyya / Oxford
2. Machine Drawing / Ajeet Singh / Mc Graw Hill

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Draw conventional representation of materials and machine elements.
2. Draw different types of fasteners.
3. Draw different types of riveted joints.
4. Draw different types of couplings and bearings.
5. Draw assembly drawings of engine parts, machine parts and valves

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	-	1	-	-	-	1	2	-	1
CO2	2	-	2	-	2	-	-	-	1	2	-	1
CO3	2	-	2	-	2	-	-	-	1	2	-	1
CO4	2	1			2				1	3		1
CO5	2	1			2				1	3		1

(A403509) INSTRUMENTATION AND CONTROL SYSTEMS LABORATORY

B. Tech. (ME): IV Semester

L	T	P	C
0	0	2	1

Pre-requisites: Basic principles of Instrumentation and control systems

List of Experiments:

1. Calibration of Pressure Gauges.
2. Calibration of transducer for temperature measurement.
3. Study and calibration of LVDT transducer for displacement measurement.
4. Calibration of strain gauge for temperature measurement.
5. Calibration of thermocouple for temperature measurement.
6. Calibration of capacitive transducer for angular displacement.
7. Study and calibration of photo and magnetic speed pickups for the measurement of speed.
8. Calibration of resistance temperature detector for temperature measurement.
9. Study and calibration of a rotameter for flow 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.

COURSE OUTCOMES:

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

1. Characterize and calibrate measuring devices.
2. Identify and analyze errors in measurement.
3. Analyze measured data using regression analysis.
4. Calibrate Pressure Gauges, temperature,
5. Calibrate LVDT, capacitive transducer, rotameter.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	3	-	1	-	3	-	-	-
CO2	3	1	-	-	3	-	1	-	3	-	-	-
CO3	3	1	-	-	3	-	1	-	3	-	-	-
CO4	3	1	-	-	3	-	1	-	3	-	-	-
CO5	3	1	-	-	3	-	1	-	3	-	-	-

(A400701) ENVIRONMENTAL SCIENCES
(Common to All Branches)

B. Tech. (ME): IV Semester

L	T	P	C
2	0	0	0

UNIT-I:
Environmental Studies: Introduction, Definition, scope and importance, Ecosystems: Introduction, types, characteristic features, structure and functions of ecosystems, Bio-geo chemical cycle, Classification ofEco system.

UNIT-II:
Natural Resources: Classification of Resources, Land resources, Land as resource, Common property resources, Land degradation, Soil erosion and desertification, Effects of modern agriculture, fertilizer –pesticide problems, Forest resources, Use and over-exploitation.
Mining and dams – their effects on forest and tribal people, Water resources, Use and over- utilization of surface and groundwater, Floods, droughts, Water logging and salinity, Dams –benefits and costs, Conflicts over Water, Energy resources.

UNIT-III:
Bio-diversity and its conservation, Value of bio-diversity-consumptive and productive use, social, ethical, aesthetic and option values, Bio-geographical classification of India – India as a mega diversity habitat, Threats to bio-diversity –Hot-spots, habitat loss, poaching of wild life, loss of species, seeds, etc. Conservation of bio-diversity– In-situ and Ex-situ conservation

UNIT-IV:
Environmental Pollution–Local and Global Issues, Nature of thermal pollution and nuclear hazards, Global warming, Acid rain, Ozone depletion, Environmental case studies.

UNIT-V:
Environmental Problems in India, drinking water, sanitation and public health, Effects of the activities on the quality of environment, Water scarcity and groundwater depletion, Controversies on major dams – resettlement and rehabilitation of people: problems and concerns, Rain water harvesting, cloud seeding and watershed management. Economy and Environment, The economy and environment interaction, Economics of development, preservation and conservation, Sustainability: theory and practices, Limits to growth, Equitableuse of resources for sustainable life styles, Environmental Impact Assessment.

TEXT BOOKS:
1. Environmental Science (1st edition), Y. Anjaneyulu, B S Publications.
2. Environmental studies (1st edition), Deekshadave, Cengage learning India Pvt. Ltd.

REFERENCE BOOKS:
1. Environmental sciences and Engineering (1st edition), P. VenugopalRao, PHI learning Pvt. Ltd.,
2. Environmental Science and Technology (1st edition), M. Anji Reddy, B S Publications.
3. Environmental Encyclopedia (Cunningham, W.P., et al., Jaico Publishing House, Mumbai, 2003.

COURSE OUTCOMES:
On successful completion of this course, it is expected that students should be able to
1. Understand the basic concepts, scope, and importance of environmental studies
2. Acquire knowledge on natural resources and analyze the impacts of modern agriculture
3. Evaluate the value, threats, and conservation methods of biodiversity, understand India's as a mega diversity habitat.
4. Analyze global environmental pollution issues and understand the hazardous effects of environmental pollution
5. Examine environmental problems in India, and understand various environmental issues to focus on sustainable practices for Environmental Impact Assessment

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	-	2	3	1	-	1	-	2
CO2	3	3	2	2	-	2	3	1	-	-	-	2
CO3	2	2	3	1	-	2	3	1	-	-	-	2
CO4	2	3	2	2	-	2	3	1	-	-	-	2
CO5	2	2	3	3	-	3	3	1	-	-	-	2

(A403801) REAL TIME RESEARCH PROJECT/FIELD BASED PROJECT
(Common to All Branches)

B. Tech. (ME): IV Semester

L	T	P	C
0	0	4	2

(A403308) DYNAMICS OF MACHINERY

B. Tech. (ME): V Semester

L	T	P	C
3	0	0	3

Pre-requisite: Kinematics of Machinery

UNIT-I

Precession: Gyroscopes – effect of precession – motion on the stability of moving vehicles such as motorcycle – motorcar – aeroplanes and ships.

Static and Dynamic Force Analysis: Dynamic Force Analysis – D'Alembert's principle, Dynamic Analysis of 4-link mechanism, Slider Crank Mechanism, Engine Force Analysis – Piston Effort, Crank Effort, etc.

UNIT-II

Turning Moment Diagram and Flywheels: Turning moment diagram –fluctuation of energy – flywheels and their design - Inertia of connecting rod- inertia force in reciprocating engines – crank effort and torque diagrams.

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

UNIT-III

Clutches: Clutches – Types – Single plate, multi-plate and cone clutches.

Brakes and Dynamometers: Types of brakes- Simple block brake, band and block brake-internal expanding shoe brake-effect of braking of a vehicle. Dynamometers – absorption and transmission types, General description and methods of operation.

UNIT-IV

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

UNIT V:

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

TEXT BOOKS:

1. Theory of Machines, S.S. Rattan, Mc Grawhill, 2017.
2. Theory of Machines, Sadhu Singh, Pearson
3. Theory of Machines, R.S. Khurmi& J K Gupta, S Chand Publishers

REFERENCE BOOKS:

1. Theory of Machines, Joseph E Shiegley, Oxford University Press
2. Mechanism and Machine Theory, JS Rao and RV Duggipati, New Age
3. Theory of Machines, R.K. Bansal, JS Brar, Lakshmi publications

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Analyze the effect of precession on the stability of moving vehicles and Apply D'Alembert's principle to perform dynamic force analysis and predict the motion and stability of mechanical systems.
2. Analyze the function of flywheels and governors in mechanical systems and design turning moment diagrams to understand energy fluctuations.
3. Differentiate between types of clutches and brakes and evaluate their effects on vehicle and machinery performance.
4. Perform balancing of rotating and reciprocating masses using analytical and graphical methods, and assess the effectiveness of locomotive balancing techniques.

5. Analyze different types of vibrations in mechanical systems, including free vibrations, transverse vibrations of beams, and torsional vibrations in rotating shafts, using appropriate methods and techniques.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**3**	**2**	**1**							**2**
CO2	**3**	**2**	**1**	**2**	**1**							**2**
CO3	**3**	**2**	**2**	**2**	**1**		**2**					**2**
CO4	**3**	**3**	**2**	**3**	**2**				**1**			**2**
CO5	**3**	**3**	**3**	**3**	**2**		**2**	**1**	**2**			**2**

(A403312) DESIGN OF MACHINE ELEMENTS

B. Tech. (ME): V Semester

L	T	P	C
3	0	0	3

Note: Design Data books are not permitted in the Examinations. The design must not only satisfy strength criteria but also, rigidity criteria.

Pre-requisites: Engineering mechanics, mechanics of solids, manufacturing processes, metallurgy and material science

UNIT – I

Introduction: General considerations in the design of Engineering Materials and their properties –selection –Manufacturing consideration in design. BIS codes of steels.

Design for Static Strength: Simple stresses – Combined stresses – Torsional and Bending stresses – Impact stresses – Stress strain relation – Various theories of failure – Factor of safety – Design for strength and rigidity – preferred numbers. The concept of stiffness in tension, bending, torsion and combined situations.

UNIT – II

Design for Fatigue Strength: Stress concentration – Theoretical stress Concentration factor – Fatigue stress concentration factor- Notch Sensitivity – Design for fluctuating stresses – Endurance limit – Estimation of Endurance strength – Goodman's line – Soderberg's line – Modified goodman's line.

UNIT – III

Riveted, Welded and Bolted Joints: 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 fillet welds under bending, torsion. Welded joints under eccentric loading.

Bolted joints – Design of bolts with pre-stresses – Design of joints under eccentric loading – locking devices – bolts of uniform strength**.**

UNIT – IV

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

UNIT – V

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

Shaft Couplings: Rigid couplings – Muff, Split muff and Flange couplings. Flexible couplings – Bushed Pin Flange coupling

TEXT BOOKS:

1) Machine Design, V. B. Bandari, TMH publications
2) Machine Design, Pandya & Shah, Charotar Publications
3) Machine Design, T.V. Sundararaja Murthy & N. Shanmugam, Anuradha Publications

REFERENCE BOOKS:

1) Machine Design, RS Khurmi, S Chand publications
2) Design of Machine Elements, V.M. Faires
3) Mechanical Engineering Design, JE Shigley

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Apply knowledge of general considerations in the design of engineering materials, including their properties, selection criteria, and manufacturing considerations, to effectively analyze static strength in engineering applications.
2. Evaluate stress concentration and fatigue strength, including theoretical stress concentration factors, notch sensitivity, and design for fluctuating stresses
3. Analyze the design of riveted, welded, and bolted joints, including methods of failure, strength equations, efficiency, and design under eccentric loading.

4. Design keys, cotters, and knuckle joints, and analyze stresses in these components.
5. Design solid and hollow shafts for strength and rigidity, and shaft couplings including rigid and flexible types.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2		1		1		1		1		1
CO2	1	1				1		1		1		1
CO3	2	2	2	2		1		1		1		1
CO4	3	3	2	3	2							2
CO5	3	3	2	2	2							2

(A403310) METROLOGY AND MACHINE TOOLS

B. Tech. (ME): V Semester

L	T	P	C
3	0	0	3

Pre-requisites: None

UNIT – I Metal cutting: Introduction, elements of cutting process – Geometry of single point tools. Chip formation and types of chips, ool materials, tool life, tool wear, cutting fluids, Analysis of orthogonal cutting-
Merchant's force diagram, Machinability.
Engine lathe – Principle of working, types of lathes, specifications. Taper turning – Lathe attachments. Capstan and Turret lathe – Single spindle and multi-spindle automatic lathes – tool layouts.

UNIT – II Drilling and Boring Machines: Principles of working, specifications, types, operations performed; twist drill. Types of Boring machines and applications. Shaping, slotting and planing machines –Principles of working – machining time calculations.

UNIT – III Milling machines: Principles of working – Types of milling machines – Geometry of milling cutters methods of indexing. Grinding – theory of grinding – classification of grinding machines. Types of abrasives, bonds. Selection of a grinding wheel. Lapping, honing and broaching machines, comparison and Constructional features, machining time calculations.

UNIT – IV Limits, fits and tolerances: Types of Fits - Unilateral and bilateral tolerance system, hole and shaft basis system. Interchangeability and selective assembly. Limit Gauges: Taylor's principle, Design of GO and NO-GO gauges, Measurement of angles using Bevel protractor and Sine bar. Measurement of flatness using straight edges, surface plates, optical flat and auto collimator.

UNIT – V Surface Roughness Measurement: Roughness, Waviness. CLA, RMS, Rz Values. Methods of measurement of surface finish, Talysurf. Screw thread measurement, Gear measurement; Machine Tool Alignment Tests on lathe, milling and drilling machines. Coordinate Measuring Machines: Types and Applications of CMM.

TEXT BOOKS:

1. Machine Tool Practices/ Kibbe, Johne. Neely, T. White, Rolando O. Meyer/ Pearson
2. Engineering Metrology/ R.K. Jain/ Khanna Publishers.

REFERENCE BOOKS:

1. Principles of Machine Tools, Bhattacharyya A and Sen.G.C / New Central Book Agency.
2. Fundamentals of Dimensional Metrology / Connie Dotson / Thomson
3. Fundamentals of Metal Machining and Machine Tools / Geoffrey Boothroyd / McGraw Hill
4. Principles of Engineering Metrology/ Rega Rajendra/ Jaico Publishers.
5. Metrology and Measurement/ Bewoor & Kulkarni/ Tata Mc Graw Hill

COURSE OUTCOMES:

At the end of the course, the student would be able to

1. comprehend the principles of metal cutting and analyze cutting processes.
2. explain the principles of drilling, boring, shaping, slotting, and planing machines and perform various operations.
3. Explain milling and grinding concepts and compare various machining methods.
4. learn about tolerances, gauge design, and accurate measurement techniques.
5. measure surface roughness and explain screw threads and gears precisely and perform machine tool alignment tests.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	1	1						2	2
CO2	3	1	1	1	1						2	2
CO3	3	1	1	1	1						2	2
CO4	3	2	2	2			1					1
CO5	3	2	2	2			1					1

(A400102) - BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

B. Tech. (ME): V Semester

L	T	P	C
3	0	0	3

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

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

UNIT - V: Financial Ratios Analysis: Concept of Ratio Analysis, Importance and Types of Ratios, Liquidity Ratios, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Solvency, Leverage Ratios – Analysis and Interpretation (simple problems).

TEXTBOOKS:

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

REFERENCE BOOKS:

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

COURSE OUTCOMES:

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

1. Describe the various Principles and functions of Management and apply in real scenarios
2. Have the systematic knowledge of the synchronization of various departments of organization
3. Forecast demand, production, cost, capital, price under different market situations for various products of business enterprise in general.
4. Employ various factors of production to gain the maximum out of them and learn the cost concepts
5. Describe the financial aspects and sources of accumulation of funds and maintenance

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2										3
CO2										2	3	
CO3					2				3			
CO4				2			3					
CO5		2									3	

(A403311) STEAM POWER AND JET PROPULSION

B. Tech. (ME): V Semester

L	T	P	C
3	0	0	3

Note: Steam Table book Permitted.
Pre-requisite: Thermodynamics

UNIT-I
Rankine Cycle: BasicRankine Cycle, Cycle with Reheating, Regeneration and Binary Vapour Cycle.
Boilers – Classification – Working principles with sketches including H.P. Boilers – Mountings and Accessories – Working principles- Boiler horse power, Equivalent Evaporation, Efficiency and Heat balance – Draught- Classification – Height of chimney for given draught and discharge- Condition for maximum discharge- Efficiency of chimney.

UNIT-II
Steam Nozzles: Stagnation Properties- Function of nozzle – Applications and Types- Flow through nozzles- Thermodynamic analysis – Assumptions -Velocity of nozzle at exit-Ideal and actual expansion in nozzle- Velocity coefficient- Condition for maximum discharge- Critical pressure ratio- Criteria to decide nozzle shape- Super saturated flow, its effects, Degree of super saturation and Degree of under cooling - Wilson line.
Steam Condensers: Requirements of steam condensing plant – Classification of condensers – Working principle of different types – Vacuum efficiency and Condenser efficiency – Air leakage, sources and its affects, Air pump- Cooling water requirement.

UNIT-III
Steam Turbines: Classification of steam turbines.
Impulse turbine: Mechanical details – Velocity diagram – Effect of friction – Power developed, Axial thrust, and Blade or diagram efficiency – Condition for maximum efficiency. 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.

UNIT-IV
Reaction Turbine: Mechanical details – Principle of operation, Thermodynamic analysis of a stage, Degree of reaction –Velocity diagram – Parson's reaction turbine – Condition for maximum efficiency
Jet Propulsion: Principle of Operation, Classification of jet propulsive engines, Working Principles with schematic diagrams and representation on T-S diagram, Thrust, Thrust Power and Propulsion Efficiency

UNIT V:
Turbo jet engines: Needs and Demands met by Turbo jet – Schematic Diagram, Thermodynamic Cycle, and Performance Evaluation Thrust Augmentation – Methods.
Rockets: Application – Working Principle – Classification – Propellant Type – Thrust, Propulsive Efficiency – Specific Impulse – Solid and Liquid propellant Rocket Engines.

TEXT BOOKS:
1. Rathore, Mahesh.M, Thermal Engineering, Tata Mc-Graw Hill.
2. Rajput R.K., Thermal Engineering, Lakshmi Publications, 4th edition.

REFERENCE BOOKS:
1. P. Khajuria & S.P. Dubey, Gas Turbines and Propulsive Systems, Dhanpatrai Publications, 5th revision
2. P.L. Ballaney, Thermal Engineering in S.I. units, Khanna Publications, 24th edition.
3. Ramalingam. K.K, Thermal Engineering, Scitech, 2nd edition
4. R.S. Khurmi & J.K. Gupta, Thermal Engineering, S. Chand Publications, 1st edition.
5. R. Yadav, Thermodynamics and Heat Engines, Central Publishing House, 6th revision.

COURSE OUTCOMES:
Upon successful completion of the course, student will be able to:

1. Explain simple models of heat exchange devices like super heater, economizer, reheater, boiler tubes and chimneys.
2. Test and improve the performance of steam nozzles and stem condensers in a vapor power cycle.
3. Distinguish, analyze and examine the efficiencies of steam turbines.

4. Analyze reaction turbines and jet propulsion devices.
5. Distinguish and apply the principles of propulsion systems for aeronautics and astronautics.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**2**	**1**	**1**	**1**							**1**
CO2	**3**	**3**	**3**	**2**	**2**							**1**
CO3	**3**	**3**	**3**	**2**	**2**							**1**
CO4	**3**	**3**	**3**	**2**	**2**							**1**
CO5	**3**	**3**	**3**	**2**	**2**							**1**

(A403314) CAD/CAM

B. Tech. (ME): V Semester

L	T	P	C
2	0	0	2

Pre-requisites: To learn the importance and use of computer in design and manufacture

UNIT – I: Fundamentals of CAD/ CAM: Application of computers for Design and Manufacturing, Benefits of CAD/ CAM - Computer peripherals for CAD/ CAM, Design workstation, Graphic terminal, CAD/ CAM software- definition of system software and application software, CAD/ CAM database and structure. Geometric Modeling: Wire frame modeling, wire frame entities, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.

UNIT – II: Surface modeling: Algebraic and geometric form, Parametric space of surface, Blending functions, parametrization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface. B-spline surface, Regenerative surface and pathological conditions. Solid Modelling: Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

UNIT – III: NC Control Production Systems: Numerical control, Elements of NC system, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.

UNIT – IV: Group Technology: Part families, Parts classification and coding. Production flow analysis, Machine cell design. Computer aided process planning: Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems. Computer aided manufacturing resource planning: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning

UNIT – V: Flexible manufacturing system: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS. Computer aided quality control: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision. Computer Integrated Manufacturing: CIM system, Benefits of CIM

TEXT BOOKS:

1. CAD/CAM Concepts and Applications / Alavala / PHI
2. CAD/CAM Principles and Applications / P. N. Rao / Mc Graw Hill

REFERENCE BOOKS:

1. CAD/CAM/ Groover M.P/ Pearson
2. CAD/CAM/CIM/ Radhakrishnan and Subramanian / New Age

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Describe the fundamental concepts and applications of CAD/CAM, including the benefits, computer peripherals, and basic geometric modeling techniques.
2. Apply surface and solid modeling techniques to create and manipulate complex geometric shapes using various parametric and algebraic methods.
3. Develop and implement numerical control (NC) part programs, utilizing both manual and computer-assisted methods, to enhance manufacturing efficiency.
4. Implement group technology principles and computer-aided process planning (CAPP) to optimize production processes and resource planning in manufacturing.
5. Analyze and design flexible manufacturing systems (FMS) and understand the integration of computer-aided quality control and computer-integrated manufacturing (CIM) systems for improved manufacturing operations.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	2	3	1	-	-	-	-	-	1
CO2	3	2	1	2	3	1	-	-	-	-	-	1
CO3	2	2	1	2	3	1	-	-	-	-	-	1
CO4	2	2	1	2	3	2	-	-	-	-	-	1
CO5	2	2	1	2	3	2	-	-	-	-	-	1

(A403510) THERMAL ENGINEERING LAB

B. Tech. (ME): V Semester

L	T	P	C
0	0	2	1

Pre-Requisite: Thermodynamics & Thermal Engineering - I

List of Experiments

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

Note: Perform a minimum of any 10 out of the 12 Exercises

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Distinguish the different I.C. Engines.
2. Draw valve/Port Timing diagrams
3. Evaluate the performance of an I.C. engine system for a given set of conditions and inspect the ways to improve the efficiency of engines.
4. Analyze the Volumetric efficiency of air compressor.
5. Demonstrate the working principles of boilers.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			1		1	2		3			2
CO2	3					1	2		3			2
CO3	3	3	2	2		1	2		3			2
CO4	3	3	2	2		1	2		3			2
CO5	3					1	2		3			2

(A403511) METROLOGY AND MACHINE TOOLS LAB

B. Tech. (ME): V Semester

L	T	P	C
0	0	2	1

Prerequisites: Theoretical exposure to Metrology and machine tools.

List of Experiments:

1. Step turning on lathe machine
2. Taper turning on lathe machine
3. Thread cutting and knurling on lathe machine
4. Machining of holes using drilling machine (Practice on reaming, use of drill jigs)
5. Gear cutting on the Milling machine
6. Grinding of Tool angles using tool & cutter grinding machine
7. Alignment Testing of lathe/Drilling/Milling
8. Measurement of lengths, heights, diameters by vernier calipers, micrometers.
9. Measurement of Diameter of bores by internal micrometers and dial bore indicators.
10. Use of gear teeth vernier calipers for checking the chordal addendum and chordal height of the spur gear.
11. Angle and taper measurements by bevel protractor and sine bars.
12. Thread measurement by 2-wire and 3-wire methods.
13. Surface roughness measurement by Tally Surf.
14. Use of mechanical comparator

COURSE OUTCOMES:

After completion of the course, the student will be able to

1. Identify parts of Lathe and perform different operations on Lathe
2. Identify parts of drilling machine and perform operations on drilling machine
3. Identify parts of Milling and perform operations on Milling,
4. Identify various measuring instruments and use them appropriately.
5. Measure surface finish of machined components.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	3	-	1	-	3	-	-	-
CO2	3	1	-	-	3	-	1	-	3	-	-	-
CO3	3	1	-	-	3	-	1	-	3	-	-	-
CO4	3	1	-	-	3	-	1	-	3	-	-	-
CO5	3	1	-	-	3	-	1	-	3	-	-	-

(A403512) THEORY OF MACHINES LAB

B. Tech. (ME): V Semester

L	T	P	C
0	0	2	1

Note: Student will perform any ten experiments out of the twelve Experiments:

List of Experiments: (A Minimum of 10 experiments are to be conducted)

1. To determine the frequency of torsional vibration of a given rod
2. Determine the effect of varying mass on the centre of sleeve in porter and proell governor
3. To find the motion of the follower if the given profile of the cam
4. To balance masses statically and dynamically for single rotating mass systems
5. Determine the critical speed of a given shaft for different n-conditions
6. Study of velocity ratio in simple, compound, reverted and epicyclic gear trains
7. Study on holding torque determination in epicyclic gear train apparatus.
8. Determine the effect of gyroscope for different motions
9. Coriolis component of acceleration apparatus
10. Determination of natural frequency of given structure using FFT analyzer
11. Determine time period, amplitude and frequency of undamped free longitudinal vibration of single degree spring mass systems.
12. Determine time period, amplitude and frequency of damped free longitudinal vibration of single degree spring mass systems

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Determine effect of varying mass in governors.
2. Draw cam profiles.
3. Measure gyroscopic torque.
4. Explain free, forced, damped vibrations.
5. Determine natural frequency using FFT analyzer.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1					3			1
CO2	3	2	2	1					3			1
CO3	3	2	2	1					3			1
CO4	3	2	2	2					3			1
CO5	3	2	2	2	3				3			1

(A403313) MACHINE DESIGN

B. Tech. (ME): VI Semester

L	T	P	C
3	0	0	3

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

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

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

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

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

UNIT – IV Mechanical Springs: Stresses and deflections of helical springs – Extension and compression springs – Design of springs for fatigue loading – natural frequency of helical springs – Energy storage capacity – helical torsion springs – Design of co-axial springs, Design of leaf springs.
Belts & Pulleys: Transmission of power by Belt and Rope Drives, Transmission efficiencies, Belts – Flat and V types – Ropes - pulleys for belt and rope drives.

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

TEXT BOOKS:
1. Design of Machine Elements / Spotts/ Pearson
2. Machine Design / Pandya & Shah / Charothar

REFERENCE BOOKS:
Design of Machine Elements-II / Kannaiah / New Age

COURSE OUTCOMES:
By undergoing this course, student will be able to
- Select suitable sliding contact bearing based on load conditions.
- Select suitable rolling contact bearing based on load conditions.
- Design Internal Combustion engine parts.
- Select and design spring, power transmission systems for given application.
- Select suitable gear and design gear for power transmission.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	1	-	1	-	1	-	1		1
CO2	1	1	-		-	1	-	1	-	1	-	1
CO3	2	2	2	2		1	-	1	-	1	-	1
CO4	3	3	2	3	2	-	-	-	-	-	-	2
CO5	3	3	2	2	2	-	-	-	-	-	-	2

(A403315) HEAT TRANSFER

B. Tech. (ME): VI Semester

L	T	P	C
3	0	0	3

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 surfaces and 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 , Theorem and method, application for developing semi empirical non- dimensional correlation for convection heat transfer – Significance of non-dimensional numbers – Concepts of Continuity, Momentum and Energy Equations – Integral Method as approximate method -Application of Von Karman Integral Momentum Equation for flat plate with different velocity profiles.

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

Unit – IV

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

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

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

UNIT V

Heat Transfer with Phase Change:

Boiling: – Pool boiling – Regimes – Calculations on Nucleate boiling, Critical Heat flux and Film boiling

Condensation: Film wise and drop wise condensation –Nusselt's Theory of Condensation on a vertical plate - Film condensation on vertical and horizontal cylinders using empirical correlations

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

TEXT BOOKS:

1. Fundamentals of Heat Transfer –Incropera& Dewitt/John wiley
2. Heat Transfer – A basic approach/ Ozisik/ Mc Graw- Hill
3. Fundamentals of Engineering Heat & Mass Transfer-R.C. Sachdeva/NewAge.
4. Heat& Mass Transfer-D.S.Kumar/S.K.Kataria& sons

REFERENCE BOOKS:

1. Heat Transfer – A Practical Approach – Yunus Cengel, Boles / TMH
2. Heat Transfer / Holman/TMH

3. Engineering Heat and Mass Transfer – Sarit K. Das / Dhanpat Rai Pub
4. Heat and Mass Transfer – R. Yadav /CPH
5. Essential Heat Transfer - Christopher A Long / Pearson Education
6. Heat Transfer-P.K. Nag /TMH
7. Heat Transfer –P. S. Ghoshdastidar/Oxford University press.

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Describe the fundamental principles and equations governing conduction heat transfer, including steady, unsteady, and periodic heat transfer in various geometries.
2. Analyze one-dimensional steady-state and transient conduction heat transfer with variable thermal conductivity and heat generation, including the use of extended surfaces and fins.
3. Apply dimensional analysis and empirical correlations to solve problems in convective heat transfer for both external and forced convection flows.
4. Evaluate heat transfer in internal flows and design heat exchangers using concepts such as hydrodynamic and thermal entry lengths, LMTD, and NTU methods.
5. Analyze heat transfer involving phase change processes such as boiling and condensation, as well as radiation heat transfer using black body and grey body concepts, including the application of relevant laws and empirical correlations.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**2**	**2**	**2**	**1**						**1**
CO2	**3**	**2**	**2**	**2**	**1**	**1**						**1**
CO3	**2**	**3**	**2**	**2**	**1**	**1**	**1**					**1**
CO4	**3**	**2**	**2**	**1**	**1**	**1**	**1**					**1**
CO5	**3**	**2**	**2**	**2**	**1**	**1**						**1**

(A403316) FINITE ELEMENT METHODS

B. Tech. (ME): VI Semester

L	T	P	C
3	0	0	3

Pre-requisites: Mechanics of Solids

UNIT – I

Introduction to Finite Element Methods: General Procedure – Engineering Applications – Stress and Equilibrium, Strain – Displacement relations. Stress – strain relations, Finite Elements: 1- Dimensional, 2 – Dimensional, 3-Dimensional & Interpolation Elements

One Dimensional Problems: 1-D Linear and 1-D Quadratic Elements - Finite element modeling, Coordinates and shape functions. Assembly of Global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions

UNIT – II

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

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

UNIT – III

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

Finite element modeling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements.

Two dimensional four noded isoparametric elements and numerical integration.

UNIT – IV

Steady state heat transfer analysis: one dimensional analysis of Slab, fin and two dimensional analysis of thin plate.

UNIT – V

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

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Apply finite element method to solve problems in one dimensional problem
2. Formulate and solve problems in one dimensional structure including trusses, beams.
3. Apply finite element method to solve problems in two dimensional problems.
4. Apply finite element method to solve problems in heat transfer.
5. Evaluate the natural frequencies of bar, beam structures.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	3				1	1		1
CO2	2	2	3	3	3				1	1		1
CO3	3	3	3	3	3				1	1		1
CO4	3	3	3	3	3				1	1		1
CO5	3	3	3	3	3				1	1		1

(A403317) REFRIGERATION AND AIR CONDITIONING

B. Tech. (ME): VI Semester

L	T	P	C
3	0	0	3

Unit – I

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

Air Refrigeration: Bell Coleman cycle and Brayton Cycle, Open and Dense air systems, Actual air refrigeration system, Refrigeration needs of Air crafts, Air systems, Applications, Problems.

Unit – II

Vapour compression refrigeration: working principle and essential components of the plant – Simple Vapour compression refrigeration cycle – COP – Representation of cycle on T-S and p-h charts – effect of sub cooling and super heating – cycle analysis – Actual cycle Influence of various parameters on system performance – Use of p-h charts – Problems.

Unit -III

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

Unit -IV

Vapour Absorption System: Calculation of max COP – description and working of NH_3 – water system – Li – Br system. Principle of operation Three Fluid absorption system, salient features.

Steam Jet Refrigeration System: Working Principle and Basic Components, Principle and operation of (i) Thermoelectric refrigerator (ii) Vortex tube or Hilsch tube.

Unit – V

Introduction to Air Conditioning: Psychometric Properties & Processes – Sensible and latent heat loads – Characterization – Need for Ventilation, Consideration of Infiltration – Load concepts of RSHF, ASHF, ESHF and ADP, Concept of human comfort and effective temperature – Comfort Air conditioning – Industrial air conditioning and Requirements – Air conditioning Load Calculations.

Air Conditioning systems: Classification of equipment, cooling, heating humidification and dehumidification, filters, grills and registers deodorants, fans and blowers. Heat Pump – Heat sources – different heat pump circuits – Applications.

TEXT BOOKS:

1. CP Arora, Refrigeration and Air Conditioning, Tata Mc-Graw Hill, 2nd edition.
2. Manohar Prasad, Refrigeration and Air Conditioning, New Age Publishers, 2nd edition.

REFERENCE BOOKS:

1. SC Arora & Domkundwar, A Course in Refrigeration and Air conditioning, Dhanpatrai Publications.
2. Dossat Roy.J, Principles of Refrigeration, Pearson Education Asia, 4th edition
3. Ananthanarayanan. P.N, Basic Refrigeration and Air-Conditioning, Tata Mc-Graw Hill, 3rd edition
4. R.S. Khurmi, A Text book of Refrigeration & Air Conditioning, Chand Publications.
5. Ballaney. P.L, Refrigeration & Air Conditioning, Khanna Publications, 15th edition.

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Demonstrate the basic concepts of refrigeration and related performance parameters.
2. Design and develop the refrigerators using the vapour compression refrigeration system.
3. Analyze performance of vapour absorption refrigeration systems and differentiate with steam jet refrigeration systems.
4. Demonstrate of psychometric properties and processes used in Air Conditioning.
5. Design and develop the Air-conditioning systems for thermal comfort conditions.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**3**	**1**	**1**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**2**
CO2	**2**	**3**	**1**	**1**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**2**
CO3	**2**	**3**	**1**	**1**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**2**
CO4	**2**	**3**		**1**	**2**	**-**	**-**	**-**	**2**	**-**	**-**	**2**
CO5		**2**	**1**	**1**	**2**	**1**	**-**	**1**	**1**	**-**	**-**	**1**

(A403401) UNCONVENTIONAL MACHINING PROCESSES
(Professional Elective-I)

B. Tech. (ME): VI Semester

L	T	P	C
3	0	0	3

UNIT – I

Introduction: Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection. Materials. Applications. Ultrasonic machining – Elements of the process, mechanics of metal removal process, parameters, economic considerations, applications and limitations, recent development.

UNIT - II

Abrasive Jet Machining, Water Jet Machining And Abrasive Water Jet Machining: Basic principles, equipment, process variable, and mechanics of metal removal, MRR, application and limitations.

Electro – Chemical Processes: Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring processes, metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM – Simple problems for estimation of metal removal rate.

UNIT – III

Thermal Metal Removal Processes: General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection. Wire EDM, principle, applications.

UNIT – IV

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes –General Principle and application of laser beam machining – thermal features, cutting speed and accuracy of cut.

UNIT - V

Application of plasma for machining, metal removing mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries. Chemical machining – principle - maskants - applications. Magnetic abrasive finishing, Abrasive flow finishing, Electro stream drilling, shaped tube electrolyte machining.

TEXT BOOKS:

1. Advanced Machining Processes / VK Jain / Allied publishers
2. Modern Machining Processes - P. C. Pandey, H. S. Shan/ Mc Graw Hill

REFERENCE BOOKS:

1. Unconventional Manufacturing Processes/ Singh M.K/ New Age Publishers
2. Advanced Methods of Machining/ J.A. McGeough/ Springer International
3. Non-Traditional Manufacturing Processes/ Benedict G.F./ CRC Press

COURSE OUTCOMES:

After completion of the course, the student will be able to

1. Study the need for unconventional machining processes and explain ultrasonic machining process.
2. Describe Abrasive jet, Water jet, and Abrasive water jet machining and electrochemical machining process.
3. Describe working principle and process variables of EDM process.
4. Explain the process capabilities and process parameters of Electron Beam machining and Laser Beam machining.
5. Describe the working of Plasma Arc machining, chemical machining and Abrasive Finishing processes.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	3	2	-	-	-	-	-	1	1
CO2	3	1	1	1	1	-	-	-	-	-	2	2
CO3	3	1	1	1	1	-	-	-	-	-	2	2
CO4	3	1	1	1	1	-	-	-	-	-	2	2
CO5	3	3	1	1	1	-	-	-	-	-	2	2

(A403402) PRODUCTION PLANNING AND CONTROL
(Professional Elective-I)

B. Tech. (ME): VI Semester

L	T	P	C
3	0	0	3

UNIT – I

Introduction: Definition – Objectives of Production Planning and Control – Functions of production planning and control - Types of production systems - Organization of production planning and control department.

Forecasting: Definition- uses of forecast- factors affecting the forecast- types of forecasting- their uses - general principle of forecasting. Forecasting techniques- quantitative and qualitative techniques. Measures of forecasting errors.

UNIT – II

Inventory management – Functions of inventories – relevant inventory costs – ABC analysis – VED analysis – Basic EOQ model- Inventory control systems –continuous review systems and periodic review systems, MRP I, MRP II, ERP, JIT Systems - Basic Treatment only.

Aggregate planning: Definition – aggregate-planning strategies – aggregate planning methods – transportation model.

UNIT – III

Line Balancing: Terminology, Methods of Line Balancing, RPW method, Largest Candidate method and Heuristic method. Routing – Definition – Routing procedure – Factors affecting routing procedure, Route Sheet.

UNIT – IV

Scheduling –Definition – Scheduling Policies – types of scheduling methods – differences with loading – flow shop scheduling – job shop scheduling, line of balance (LOB) – objectives - steps involved.

UNIT – V

Dispatching: Definition – activities of dispatcher – dispatching procedures – various forms used in dispatching.

Follow up: definition – types of follow up – expediting – definition – expediting procedures-Applications of computers in planning and control.

TEXT BOOKS:

1. Operations management – Heizer- Pearson.
2. Production and Operations Management / Ajay K Garg / Mc Graw Hill.

REFERENCE BOOKS:

1. Production Planning and Control- Text & cases/ SK Mukhopadhyaya /PHI.
2. Production Planning and Control- Jain & Jain – Khanna publications

COURSE OUTCOMES:

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

1. Describe the objectives, functions, and organization of production planning and control, as well as the principles and techniques of forecasting in production systems.
2. Analyze and implement inventory management techniques and aggregate planning strategies to optimize inventory costs and meet production demands.
3. Apply line balancing methods and develop routing procedures to enhance production efficiency and workflow in manufacturing processes.
4. Develop and implement scheduling policies and methods for flow shop and job shop environments to optimize production schedules and resource utilization.
5. Describe and execute dispatching procedures and follow-up activities, including expediting and the application of computers in production planning and control.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2			1						1
CO2	2	2	2			1						1
CO3	2	2	2			1						1
CO4	2	2	2			1						1
CO5	2	2	2			1						1

(A403403) OPERATIONS RESEARCH
(Professional Elective-I)

B. Tech. (ME): VI Semester

L	T	P	C
3	0	0	3

Unit – I

Development – Definition– Characteristics and Phases – Types of models – Operations Research models – applications.
Allocation: Linear Programming Problem - Formulation – Graphical solution – Simplex method – Artificial variables techniques: Two–phase method, Big-M method; Duality Principle.

Unit – II

Transportation Problem: Formulation – Optimal solution, unbalanced transportation problem – Degeneracy.
Assignment problem: Formulation – Optimal solution - Variants of Assignment Problem; Traveling Salesman problem.

Unit – III

Sequencing: Introduction – Flow –Shop sequencing – n jobs through two machines 'n' jobs through three machines – Job shop sequencing – two jobs through 'm' machines.
Replacement: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely- Group Replacement.

Unit – IV

Game Theory: Introduction –Terminology– Solution of games with saddle points and without saddle points- 2 x 2 games –m x 2 & 2 x n games - graphical method – m x n games - dominance principle.
Inventory: Introduction – Single item, Deterministic models – Types - Purchase inventory models with one price break and multiple price breaks –Stochastic models – demand discrete variable or continuous variable – Single Period model with no setup cost.

Unit – V

Waiting Lines: Introduction – Terminology-Single Channel – Poisson arrivals and Exponential Service times – with infinite population and finite population models– Multichannel – Poisson arrivals and exponential service times with infinite population.
Dynamic Programming:
Introduction – Terminology- Bellman's Principle of Optimality – Applications of dynamic programming- shortest path problem – linear programming problem.

TEXT BOOKS:

1. Operations Research Theory and Applications / J. K. Sharma sixth Edition, Trinity
2. Introduction to Operations Research/ Hillier & Lieberman/MGH

REFERENCE BOOKS:

Operations Research: An Introduction, Hamdy A. Taha/PHI

1. Operations Research/NVS Raju/SMS Education/3rd Revised Edition
2. Operations Research /A. M. Natarajan, P. Balasubramaniam, A. Tamilarasi/Pearson Education.
3. Operations Research/ Wagner/ PHI Publications.
4. Operations Research/M.V. Durga Prasad, K.Vijaya Kumar Reddy, J. Suresh Kumar/Cengage

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Convert the problem into a mathematical model and understand the theoretical workings of the simplex method for linear programming and perform iterations of it by hand decision making approaches and tools to be used in each type.
2. Understand variety of problems such as assignment, transportation, travelling salesman etc.
3. Solve simple problems of sequencing and replacement.
4. Understand the usage of game theory and inventory problems.
5. Solve dynamic programming problems.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	1				1		3	3
CO2	3	3	3	3	1				1		3	3
CO3	3	3	3	3	1				1		3	3
CO4	3	3	3	3	1				1		3	3
CO5	3	3	3	3	1				1		3	3

(A403404) MICROPROCESSORS IN AUTOMATION
(Professional Elective-I)

B. Tech. (ME): VI Semester

L	T	P	C
3	0	0	3

UNIT - I: Basic Concepts of Digital Circuits
Number Systems, Logic Gates, Combinational Circuits, Flip-flops, Sequential Logic Circuits: Counters, Shift Registers. Basic components and computer architecture- CPU, Memory and Peripherals.

UNIT - II: Architecture of Microprocessor
Introduction, Origin, Historical Developments, Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus Systems, Timing and Control Signals, PIN diagram, Machine Cycles, Instruction Cycle and Timing States, Instruction Timing Diagrams, Addressing Modes. Concept of Interrupt, Needfor Interrupts, Interrupt structure, Multiple Interrupt requests and their handling, Programmable interrupt controller.

UNIT - III: Assembly Language Programming
Instruction Set, Simple programs in 8085 mainly on Addition, Subtraction, Multiplication, Rotation, Ascending and Descending of the given data

UNIT - IV: Memory and I/O Device Interfacing
Memory Interfacing - Memory structure and its requirements, Basic Concept in Memory Interfacing, Address Decoding, Interfacing Circuits, Address Decoding and Memory Addresses, Typical Examples on Memory interfacing: Interface (2k x 8) ROM, (8k x 8) EPROM, and (1k x 8) RAM with 8085. IO Interfacing – Basic Interfacing Concepts-Peripheral I/O instructions, I/O Execution, Device Selection and data transfer, absolute vs. Partial Decoding, Input Interfacing, Interfacing I/Os using Decoders.

UNIT - V: Architecture of Microcontroller
Introduction to Microcontrollers and how they differ from microprocessors, Block diagram of Microcontrollers, Architecture of 8051 microcontroller, Pin Diagram, Instruction set, simple 8051 programming, introduction to ARM microcontroller and its applications.

TEXTBOOKS:
1. Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh Gaonkar, PENRAM International Publishers.
2. The 8051 Microcontroller and Embedded Systems: Using Assembly and C, Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D, Mckinlay, 2nd Edition, Pearson publication, 2007.

REFERENCE BOOKS:
1. Microprocessors and Interfacing: Programming and Hardware, Douglas V. Hall
2. Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal, Prentice Hall
3. Introduction to Microprocessors, Aditya P Mathur, Tata McGraw-Hill, Europe; 3rd Edition, 1990.
4. Digital Electronics: An Introduction to Theory and Practice, William H. Gothmann, PHI Learning Private Limited.
5. Digital and microprocessor technology, Patrick J O'Connor, Prentice-Hall, 1983.
6. Digital and Microprocessor Engineering, S.J.Cahill, Wllis Horwood Limited (John Wiley & Sons).
7. Digital Control Systems, Benjamin C. Kuo, Oxford University Press (2/e, Indian Edition, 2007).
8. Digital Computer Electronics: An Introduction to Microcomputers, Albert Pual Malvino, Tata McGraw-Hill Publishing Company Ltd.

COURSE OUTCOMES:
On completion of the course students will be able to

1. Understand the basic concepts of digital circuits.
2. Explain architecture of microprocessor.
3. Write assembly language program.
4. Explain Memory and I/O interfacing.
5. Explain Architecture of microcontroller.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		2	2	3	1		1	2	2		2
CO2	2		2	2	3	1		1	2	2		2
CO3	2		2	2	3	1		1	2	2		2
CO4	2		2	2	3	1		1	2	2		2
CO5	2		2	2	3	1		1	2	2		2

(A400504) ADVANCED ENGLISH COMMUNICATION SKILLS LABORATORY
(Common to all branches)

B. Tech. (ME): VI Semester

L	T	P	C
0	0	2	1

INTRODUCTION
The introduction of the English Language Lab is considered essential at 3rd year level. At this stage the students need to prepare themselves for their careers which may require them to listen to, read, speak and write in English both for their professional and interpersonal communication in the globalised context.

UNIT-I:
Functional English: Starting a conversation, responding appropriately and relevantly, using the right body language, Role play in Different Situations.

UNIT-II:
Vocabulary Building: Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, analogy, idioms and phrasal verbs.

UNIT-III:
Group Discussion: Dynamics of group discussion, intervention, summarizing, modulation of voice, body languagea, relevance, fluency and coherence.

UNIT-IV:
Interview Skills: Concept and process, pre-interview planning, opening strategies, answering strategies, Interview through tale and video- conferencing.

UNIT-V:
Resume` and Technical Report Writing: Structure and presentation, planning, defining the career objective, projecting one's strengths and skill-sets, summary, formats and styles, Letter-writing.
Reading Comprehension: Reading for facts, guessing meanings from context, scanning, skimming, inferring meaning and critical reading.

REFERENCES

1. The Basics of Communication: A Relational Prespective, Stev Duck & DavidT. Mc Mahan. Sage South Asia Edition. Sage Publications (2012)
2. English Vocabulary in Use series, Cambridge University Press 2008
3. Barron's – The leader in test preparation 2nd Edition
4. Philip Geer, Barron's – Essential words for the GRE – 3rd Edition
5. P.S. Bright-Manual for Group Discussion
6. R Guptas, Anand Ganguly, Group and Interviews

COURSE OUTCOMES:
On completion of the course students will be able to

1. Explain the rules of formal and informal situational dialogues and develop verbal & nonverbal communication skills.
2. Build academic vocabulary, use a variety of accurate sentence structure and utilize digital literacy tools to develop writing and grammar skills.
3. Express clarity of thoughts, capability to hold the discussion with everyone and develop analytical thinking.
4. Develop the skills needed for approaching different types of interviews Illustrate the report writing and summarize the main ideas of report; apply key elements of structure and style in drafting loner documents.
5. Read an increasing range of different types of texts by combining contextual, semantic, grammatical and phonic knowledge and summarize the personal details, Customize the objectives statement for each position they are applying for job.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	2	-	-	-	-	-	-
CO2	-	-	2	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	2	-	-	-
CO4	-	-	-	-	-	-	-	2	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	2

(A403513) HEAT TRANSFER LAB

B. Tech. (ME): VI Semester

L	T	P	C
0	0	2	1

List of Experiments:

1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of given metal rod.
5. Heat transfer in pin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.
11. Stefan Boltzman Apparatus.
12. Critical Heat flux apparatus.
13. Study of heat pipe and its demonstration.
14. Heat transfer in drop and film wise condensation

(A Student will perform any 12 experiments out of the above)

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Analyze the modes of heat transfer in the practical perspective.
2. Develop knowledge in making calculations for thermal conductivity of insulating materials and solids of various heat transfer equipment.
3. Acquires the real time knowledge in steady state and transient heat conduction.
4. Apply the concepts of heat transfer in the design of fins with different geometries.
5. Design and develop the simple heat exchanger systems.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2				3		3	3
CO2	3	3	2	2	2				3		3	3
CO3	3	3	2	2	2				3		3	3
CO4	3	3	2	2	2				3		3	3
CO5	3	3	2	2	2				3		3	3

(A403514) COMPUTER AIDED ENGINEERING LAB

B. Tech. (ME): VI Semester

L	T	P	C
0	0	2	1

I. Modeling

1. **Drafting:** Development of part drawings for various components in the form of orthographic and isometric views - Representation of dimensioning and tolerances.
2. **Part Modeling:** Generation of various 3D Models through Protrusion, revolve, sweep. Creation of various features, Study of parent child relation.
3. **Assembly:** Feature based and Boolean based modeling and Assembly Modeling, Study of various standard Translators. Design of simple components.

II. Analysis

1. Determination of deflection and stresses in 2D and 3D trusses and beams.
2. Determination of deflections, principal and Von-Mises stresses in plane stress, plane strain and Axi-symmetric components.
3. Determination of stresses in 3D and shell structures (at least one example in each case)
4. Estimation of natural frequencies and mode shapes Harmonic response of 2D beam.
5. Steady state heat transfer analysis of plane and axi-symmetric components.

III. Manufacturing

1. Programming CNC turning centre for machining of cylindrical objects.
2. Programming CNC mill for machining flat surfaces.
3. Machining of simple components on CNC lathe and Mill by transferring NC Code / from CAM software.

(**Student will perform at least 3 from each of the above 3 categories and a total of 10 exercises among the above**)

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Explain the basic fundamentals that are used to create and manipulate geometric models in computer program**.**
2. Model the 3D geometric information of machine components including assemblies, and automatically generate 2D production drawings.
3. Analyze deflections, stresses, natural frequencies, mode shapes and harmonic response of 2D Structures.
4. Analyze deflections, stresses, natural frequencies, mode shapes and harmonic response of 3D Structures.
5. Write CNC programs for turning and milling machining operations.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	3			3	3	3	3
CO2	3	3	3	3	3	3			3	3	3	3
CO3	3	3	3	3	3	3			3	3	3	3
CO4	3	3	3	3	3	3			3	3	3	3
CO5	3	3	3	3	3	3			3	3	3	3

(A400705) - INTELLECTUAL PROPERTY RIGHTS

B. Tech. (ME): VI Semester

L	T	P	C
2	0	0	0

The Objective of the course is to have the basic concepts of Intellectual Property Rights through which a firm/individual can protect its existence through its uniqueness.

UNIT-I:

INTRODUCTION TO INTELLECTUAL PROPERTY: Introduction, types of intellectual property, international Organizations, agencies and treaties, importance of intellectual property rights.

UNIT-II: TRADEMARKS:

Purpose and function of trademarks, acquisition of trademark rights, protectable matter, Selecting and evaluating trade mark, trade mark registration processes.

UNIT-III: LAW OF COPY RIGHTS:

Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right owner ship issues, copy right registration, notice of copy right, international copy right law.

Law of Patents: Foundation of patent law, patent searching process, owner rights and transfer.

UNIT-IV: TRADE SECRETS:

Trade secret law, determination of trade secretes status' liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

UNFAIR COMPETITION: Misappropriation right of publicity, false advertising

UNIT-V: NEW DEVELOPMENT OF INTELLECTUAL PROPERTY:

new developments in trademark law; copy right law, patent law, intellectual property audits. International overview on intellectual property, international-trade mark law, copy right law, international patent law, and international development in trade secrets law.

TEXT BOOKS & REFERENCES

- Intellectual property right, Deborah, E. Bouchoux, cengage learning.
- Intellectual property right - Unleashing the knowledge economy, PrabuddhaGanguli, Tata Mc Graw Hill Publishing Company Ltd.

COURSE OUTCOMES:

On completion of the course students will be able to:

1. Have Skill to understand the concept of intellectual property rights.
2. Develop procedural knowledge to Legal System and solving the problem relating Patents.
3. Gain knowledge on development and owning of Trade Marks, Copy Rights, and Patents.
4. Develop conceptual exposure on legal aspects related to IPR
5. Have Knowledge on different types of competition and ethical and unethical practices of advertising

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						3		3				3
CO2		3	3			3		3				3
CO3		3	3			3		3				3
CO4						3		3				3
CO5						3	3	3		3		3

(A403802) – INDUSTRY ORIENTED MINI PROJECT/INTERNSHIP

B. Tech. (ME): VI Semester

L	T	P	C
0	0	4	2

(A403318) INDUSTRIAL MANAGEMENT

B. Tech. (ME): VII Semester

L	T	P	C
2	0	0	2

Prerequisites: None

UNIT – I: Introduction to Management: Entrepreneurship and organization – Nature and Importance of Management, Functions of Management, Taylor's Scientific Management Theory, Fayol's Principles of Management, Maslow's Theory of Human Needs, Douglas McGregor's Theory X and Theory Y, Herzberg's Two-Factor Theory of Motivation, Systems Approach to Management, Leadership Styles, Social responsibilities of Management

UNIT – II: Designing Organizational Structures: Departmentalization and Decentralization, Types of Organization structures – Line organization, Line and staff organization, functional organization, Committee organization, matrix organization, Virtual Organization, Cellular Organization, team structure, boundary less organization, inverted pyramid structure, lean and flat organization structure and their merits, demerits and suitability.

UNIT – III: Operations Management: Objectives- product design process- Process selection-Types of production system (Job, batch and Mass Production), Plant location-factors- Urban-Rural sites comparison-Types of Plant Layouts- Design of product layout- Line balancing (RPW method) Value analysis-Definition-types of values- Objectives- Phases of value analysis- Fast diagram

UNIT - IV: Work Study: Introduction — definition — objectives — steps in work study — Method study — definition, objectives — steps of method study. Work Measurement — purpose — types of study — stop watch methods — steps — key rating — allowances — standard time calculations — work sampling. Statistical Quality Control: variables-attributes, Shewart control charts for variables- chart, R chart, – Attributes- Defective-Defect- Charts for attributes-p-chart -c chart (simple Problems), Acceptance Sampling-Single sampling- Double sampling plans-OC curves.

UNIT – V: Job Evaluation: Methods of job evaluation — simple routing objective systems — classification method factor comparison method, point method, benefits of job evaluation and limitations. Project Management (PERT/CPM): Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), Identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing. (simple problems)

TEXT BOOKS:

1. Industrial Engineering and Management/O.P. Khanna/Khanna Publishers.
2. Industrial Engineering and Management Science/T.R. Banga and S.C. Sarma/Khanna Publishers.

REFERENCE BOOKS

1. Motion and Time Study by Ralph M Barnes! John Willey & Sons Work Study by lLO.
2. Human factors in Engineering & Design/Ernest J McCormick /TMH.
3. Production & Operation Management /Paneer Selvam/PHI.
4. Industrial Engineering Management/NVS Raju/Cengage Learning.
5. Industrial Engineering Hand Book/Maynard.
6. Industrial Engineering Management I Ravi Shankar/Galgotia

COURSE OUTCOMES:

1. Able to apply principles of management
2. Able to design the organization structure
3. Able to apply techniques for plant location, design plant layout and value analysis
4. Able to carry out work study to find the best method for doing the work and establish standard time for a given method
5. Able to do job evaluation and network analysis.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	1				1		3	3
CO2	3	3	3	3	1				1		3	3
CO3	3	3	3	3	1				1		3	3
CO4	3	3	3	3	1				1		3	3
CO5	3	3	3	3	1				1		3	3

(A403405) ADDITIVE MANUFACTURING
(Professional Elective-II)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

Pre-requisites: Manufacturing Processes, Engineering Materials

UNIT - I Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes.

UNIT - II Liquid-based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies Solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT - III Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three-dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification; Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP

UNIT - IV Rapid Prototyping Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Rapid Prototyping Software's: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.

UNIT - V RP Applications: Application - Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules.

TEXT BOOKS:

1. Rapid prototyping; Principles and Applications /Chua C.K., Leong K.F. and LIM C.S/World Scientific Publications
2. Rapid Manufacturing /D.T. Pham and S.S. Dimov/Springer

REFERENCE BOOKS:

1. Terry Wohlers, Wholers Report 2000, Wohlers Associates
2. Rapid Prototyping and Manufacturing /PaulF.Jacobs/ASME

COURSE OUTCOMES: At the end of the course students will be able to:

1. Describe various CAD issues for 3D printing and rapid prototyping and related operations for STL model manipulation.
2. Formulate and solve typical problems on reverse engineering for surface reconstruction from physical prototype models through digitizing and spline-based surface fitting.
3. Formulate and solve typical problems on reverse engineering for surface reconstruction from digitized mesh models through topological modelling and subdivision surface fitting.
4. Explain and summarize the principles and key characteristics of additive manufacturing technologies and commonly used 3D printing and additive manufacturing systems.
5. Explain and summarize typical rapid tooling processes for quick batch production of plastic and metal parts.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2		3	2		1	2	2		2
CO2	2	2	2		3	2		1	2	2		2
CO3	2	2	2		3	2		1	2	2		2
CO4	2	2	2		3	2		1	2	2		2
CO5	2	2	2		3	2		1	2	2		2

(A403406) AUTOMATION IN MANUFACTURING
(Professional Elective-II)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT - I Introduction: Types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools. Mechanical feeding and too changing and machine tool control transfer the automaton.

UNIT - II Automated flow lines: Methods or work part transport transfer Mechanical buffer storage control function, design and fabrication consideration. Analysis of Automated flow lines: General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

UNIT - III Assembly system and line balancing: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT - IV Automated material handling: Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems. Automated storage systems, Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT -V Fundamentals of Industrial controls: Review of control theory, logic controls, sensors and actuators, Data communication and LAN in Manufacturing. Business process Re-engineering: Introduction to BPE logistics, ERP, Software configuration of BPE.

TEXT BOOK:

1. Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover 3e./PE/PHI, 2009.
2. Computer Control of Manufacturing Systems/ Yoram koren/ Mc Graw Hill/ 1st Edition, 1983.

REFERENCE BOOKS:

1. Computer Aided Manufacturing/Tien-Chien Chang, Richard A. Wyskand Hsu-Pin Wang/Pearson/ 3rd Edition, 2005.
2. Automation /W. Buekinsham/PHI Publications/ 1st Edition, 2011

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Describe the importance of Automation implementation in Manufacturing.
2. Analyze the various Automated flow lines.
3. Perform Line balancing of assembly system.
4. Describe automated Material Handling and automated storage
5. Explain Industrial Process controls and automatic inspection

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		2	2	3	1		1	2	2		2
CO2	2		2	2	3	1		1	2	2		2
CO3	2		2	2	3	1		1	2	2		2
CO4	2		2	2	3	1		1	2	2		2
CO5	2		2	2	3	1		1	2	2		2

(A403407) ARTIFICIAL INTELLIGENCE IN MECHANICAL ENGINEERING
(Professional Elective-II)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT - I: Introduction to Artificial Intelligence
Definition, History, Present state of Artificial Intelligence (AI), Phases of AI, Approaches to AI - Hard or Strong AI, Soft or Weak AI, Applied AI, Cognitive AI, and Applications domains focused on mechanical engineering,

UNIT - II: Problem Solving Methods
Problem solving methods-1. Uninformed search includes Depth First Search (DFS), Breadth First Search (BFS), Uniform Cost Search (UCS), Depth Limited Search, Iterative Deepening Depth First Search (IDDFS) and bidirectional search. 2. Informed Search (heuristic search) includes greedy best first search, A* search, memory bounded heuristic search, learning to search better, Simple problems

UNIT - III: Neural Networks
Introduction to Perceptron and Neural Networks, Activation and Loss functions, Single Neuron of Human and Human Brain Modelling, ANN architecture-Input layer, Hidden layer and output layer, Types of Neural Networks- Single layer feed-forward network, Multilayer feed-forward network, Multi-Layer Perceptron (MLP), Recurrent networks or feedback ANN, Characteristics of Neural Networks, Simple problems on Back Propagation Algorithms to minimize the error

UNIT - IV: Machine Learning
Unsupervised learning- Definition, basic concepts, applications, K-means Clustering, hierarchical Clustering, Dimension Reduction-PCA, Simple Examples
Supervised Learning - Definition, basic concepts, applications, Linear Regression, Multiple Variable Linear Regression, Logistic Regression, Naive Bayes Classifiers, k-NN Classification, Support Vector Machine, Simple Examples.
Reinforcement Learning (RL) - Framework, Component of RL Framework, Types of RL Systems. Q- learning, Examples of RL Systems, Simple Examples

UNIT - V: Ensemble Learning Techniques
Introduction on ensemble methods, Decision Trees, Bagging, Random Forests, Boostin, Simple Examples

TEXT BOOK:
1. Artificial Intelligence: A Modern Approach, Stuart Russell & Peter Norvig, Prentice-Hall, Third Edition (2009).

REFERENCE BOOKS:
1. Artificial Intelligence, Ela Kumar, Wiley, 2021
2. Artificial Intelligence: Concepts and Applications, Lavika Goel, Kindle Edition, Wiley, 2021.
3. Nature-Inspired Optimization in Advanced Manufacturing Processes and Systems, Edited by
4. Ganesh M. Kakandikar and Dinesh G. Thakur, CRC press, First edition, 2021.

COURSE OUTCOMES:
Upon successful completion of the course, student will be able to:
1. Describe the fundamental concepts and applications of Artificial Intelligence (AI).
2. Apply various problem-solving methods to AI-related problems.
3. Describe the architecture and applications of neural networks and implement simple neural network models.
4. Apply machine learning techniques, including supervised, unsupervised, and reinforcement learning, to real-world problems.
5. Describe and implement ensemble learning techniques for improving model performance.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		2	2	3	1		1	2	2		2
CO2	2		2	2	3	1		1	2	2		2
CO3	2		2	2	3	1		1	2	2		2
CO4	2		2	2	3	1		1	2	2		2
CO5	2		2	2	3	1		1	2	2		2

(A403408) MECHATRONICS
(Professional Elective-II)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT - I:

Introduction: Overview, History of mechatronics, Scope and significance of Mechatronics systems, elements of Mechatronic systems, Needs and benefits of Mechatronics in manufacturing.

Sensors: Classification of sensors basic working principles, displacement sensor – linear and rotary potentiometers, LVDT and RVDT, incremental and absolute encoders, Proximity and range sensors – Eddy current sensor, ultrasonic sensor, laser interferometer transducer, hall Effect sensor, inductive Proximity switch, Light sensors– Photodiodes,Phototransistors,FlowSensors–ultrasonicsensor,
Laser Doppler Anemometer, Tactile Sensors – PVDF tactile sensor, micro-switch and reed switch, Piezoelectric sensors, Vision Sensor.

UNIT - II:

Actuators: Electrical Actuators: Solenoids, relays, diodes, thyristors, triacs, BJT, FET, DC motor, Servo Motor, BLDC Motor, AC Motor, Stepper Motor, Hydraulic & pneumatic devices – Power supplies, valves, Cylinder sequencing, Design of hydraulic & pneumatic circuits. Piezo Electric Actuators, Shape memory alloys.

UNIT - III:

Basic System models & Analysis: Modeling of one & two degrees of freedom Mechanical, Electrical, fluid and thermal systems, block diagram representations of these systems. Dynamic Responses of System: Transfer function, modeling dynamic systems, first order systems, second order systems.

UNIT - IV:

Digital Electronics: Number systems, BCD codes and arithmetic, Gray codes, self-complimenting codes, Error detection and correction principles. Boolean functions using Karnaugh Map, Design of combinational circuits, design of arithmetic circuits, Design of code converters, encoders and decoders.
Signal Conditioning: Operational amplifiers, inverting amplifier, differential amplifier, Protection, comparator, filters, multiplexer, Pulse width modulation counters, decoders. Data acquisition – Quantizing theory, Analog to digital conversion, digital to analog conversion. Controllers: Classification of Control systems, Feedback, Closed loop and open loop systems PLC

UNIT - V:

Programming: PLC Principles of operation, PLC sizes, PLC hardware components, I/O section Analog I/O section, Analog I/O modules, digital I/O modules, CPU processor memory, module programming, Ladder Programming, ladder diagrams, Timers, Internal relays and counters, data handling, analogue input and output. Application on real time industrial automation systems.

Advanced Applications in Mechatronics: Sensors for condition monitoring, mechatronic control in automated manufacturing, Artificial intelligence in Mechatronics, micro sensors in mechatronics, Application of Washing machine as mechatronic device.

TEXT BOOKS:

1. W. Boton, “Mechatronics”, 5th edition, Adison Wesley Longman ltd, 2010.
2. Mechatronics system design by Devdas Shetty and Richard A. Kolk, P.W.S. Publishing company, 2001.
3. Alciatore David G & Histand Michael B, “Introduction to Mechatronics and Measurement systems”, 4th edition, Tata McGraw Hill, 2006

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Describe the fundamentals and significance of Mechatronics systems and the working principles of various sensors.
2. Comprehend the functionality and application of different types of actuators in Mechatronics systems.
3. Model and analyze mechanical, electrical, fluid, and thermal systems and their dynamic responses.
4. Design and analyze digital electronic circuits and understand signal conditioning and data acquisition processes.
5. Develop and implement PLC programming and apply advanced Mechatronics concepts to real-time industrial automation systems.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		2	2	3	1		1	2	2		2
CO2	2		2	2	3	1		1	2	2		2
CO3	2		2	2	3	1		1	2	2		2
CO4	2		2	2	3	1		1	2	2		2
CO5	2		2	2	3	1		1	2	2		2

(A403409) POWER PLANT ENGINEERING
(Professional Elective-III)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

Pre-Requisites: None

UNIT – I

Introduction to the Sources of Energy – Resources and Development of Power in India.
Steam Power Plant: Plant Layout, Working of different Circuits, Fuel and handling equipments, types of coals, coal handling, choice of handling equipment, coal storage, Ash handling systems.
Combustion Process: Properties of coal – overfeed and underfeed fuel beds, traveling grate stokers, spreader stokers, retort stokers, pulverized fuel burning system and its components, combustion needs and draught system, cyclone furnace, design and construction, Dust collectors, cooling towers and heat rejection. Corrosion and feed water treatment.

UNIT – II

Internal Combustion Engine Plant: Diesel Power Plant: Introduction – IC Engines, types, construction– Plant layout with auxiliaries – fuel supply system, air starting equipment, lubrication and cooling system – super charging.
Gas Turbine Plant: Introduction – classification - construction – Layout with auxiliaries – Principles of working of closed and open cycle gas turbines. Combined Cycle Power Plants and comparison.

UNIT – III

Hydro Electric Power Plant: Water power – Hydrological cycle / flow measurement – drainage area characteristics – Hydrographs – storage and Pondage – classification of dams and spill ways.
Hydro Projects and Plant: Classification – Typical layouts – plant auxiliaries – plant operation pumped storage plants.

UNIT – IV

Nuclear Power Station: Nuclear fuel – breeding and fertile materials – Nuclear reactor – reactor operation.
Types of Reactors: Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Homogeneous Reactor, Gas cooled Reactor, Radiation hazards and shielding – radioactive waste disposal.

UNIT – V

Power Plant Economics and Environmental Considerations: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, Load curves, load duration curve. Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor – related exercises. Effluents from power plants and Impact on environment – pollutants and pollution standards – Methods of Pollution control.

TEXT BOOKS:

1. Power Plant Engineering/ P. K. Nag / Mc Graw Hill
2. Power Plant Engineering / Hegde / Pearson.

REFERENCES BOOKS:

1. Power Plant Engineering / Gupta / PHI
2. Power Plant Engineering / A K Raja / New age

COURSE OUTCOMES:

At the end of the course students are able to:

1. Understand the various sources of energy and the fundamental concepts and layout of steam power plants.
2. Comprehend the construction and working principles of internal combustion engine plants and gas turbine plants.
3. Analyze the operation, layout, and components of hydroelectric power plants.
4. Understand the principles, types, and operation of nuclear power plants, along with safety and waste disposal issues.
5. Evaluate the economic and environmental considerations in power plant operation, including cost analysis and pollution control methods.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3	1	1	2	1	-	-	2	-	-	2
CO2	3	3		1	2		-	-	2	-	-	2
CO3	3	3		1	2		-	-	2	-	-	2
CO4	3	3		1	2		-	-	2	-	-	2
CO5	3	3		1	2		-	-	2	-	-	2

(A403410) AUTOMOBILE ENGINEERING
(Professional Elective-III)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT - I

Introduction: Layout of automobile – introduction chassis and body components. Types of Automobile engines. – Power unit – Introduction to engine lubrication – engine servicing

Fuel System:

S.I. Engines: Fuel supply systems, Mechanical and electrical fuel pump – filters – carburetor – types – air filters – petrol injection. Introduction to MPFI and GDI Systems.

C.I. Engines: Requirements of diesel injection systems, types of injection systems, DI Systems IDI systems. Fuel pump, nozzle, spray formation, injection timing, testing of fuel pumps. Introduction to CRDI and TDI Systems.

UNIT - II

Cooling System: Cooling Requirements, Air Cooling, Liquid Cooling, Thermo, water and Forced Circulation System – Radiators – Types – Cooling Fan - water pump, thermostat, evaporative cooling – pressure sealed cooling – antifreeze solutions.

Ignition System: Function of an ignition system, battery ignition system, constructional features of storage, battery, auto transformer, contact breaker points, condenser, and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

Electrical System: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc.

UNIT - III

Transmission System: Clutches, principle, types, cone clutch, single plate clutch, multi plate clutch, magnetic and centrifugal clutches, fluid fly wheel – gear boxes, types, sliding mesh, constant mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter. Propeller shaft – Hotch – Kiss drive, Torque tube drive, universal joint, differential rear axles – types – wheels and tyres.

Suspension System: Objects of suspension systems – rigid axle suspension system, torsion bar, shock absorber, Independent suspension system.

UNIT - IV

Braking System: Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes.

Steering System: Steering geometry – camber, castor, king pin rake, combined angle toein, center point steering. Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism, steering gears – types, steering linkages.

UNIT - V

Emissions from Automobiles: Pollution standards National and international – Pollution Control – Techniques – Multipoint fuel injection for SI Engines. Common rail diesel injection Energy alternatives – Solar, Photo-voltaic, hydrogen, Biomass, alcohols, LPG, CNG, liquid Fuels, and gaseous fuels, Hydrogen as a fuel for IC Engines. - Their merits and demerits. Standard Vehicle maintenance practice.

TEXT BOOKS:

1. Automobile Engineering / William H Crouse
2. A Text Book Automobile Engineering–Manzoor, Nawazish Mehdi & Yosuf Ali, Frontline Publications.

REFERENCE BOOKS:

1. A Text Book of Automobile Engineering by R K Rajput. Laxmi Publications.
2. Automotive Mechanics / Heitner
3. Automotive Engineering / Newton Steeds & Garrett
4. Automotive Engines / Srinivasan
5. A Text Book of Automobile Engineering By Khalil U Siddiqui New Age International

COURSE OUTCOMES:

At the end of the course students will be able to:

1. Illustrate the function of each and every system of an automobiles including fuel system and injection approaches
2. Explain the Cooling, ignition and electrical system of the Automobile
3. Describe each component of transmission system of an automobile viz clutch, gear box, propeller shaft and differential and suspension system and the effect of the same on tyre performance and other components of an automobile
4. Analyze the geometry of the steering mechanism and braking system
5. Demonstrate about emission standards, emission control techniques and electrical systems.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**		**1**	**1**	**1**	**3**	**3**					**3**
CO2	**3**		**1**	**1**	**1**	**3**	**3**					**3**
CO3	**3**		**3**	**2**	**1**	**3**	**3**					**3**
CO4	**3**		**3**	**2**	**1**	**3**	**3**					**3**
CO5	**3**		**1**	**1**	**1**	**3**	**3**					**3**

(A403411) NON-CONVENTIONAL ENERGY SOURCES
(Professional Elective-III)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT – I: Principles of Solar Radiation: Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT-II: Solar Energy Collection: Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors. Direct Energy Conversion: Need for DEC, Carnot cycle, limitations, principles of DEC. Thermoelectric generators, seebeck, peltier and joul Thomson effects, Figure of merit, materials, applications, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, MHD Engine, power generation systems, electron gas dynamic conversion, economic aspects. Fuel cells, principles, faraday's law's, thermodynamic aspects, selection of fuels and operating conditions.

UNIT-III: Solar Energy Storage and Applications: Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion. Ocean Energy: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics.

UNIT-IV: Wind Energy: Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria.

UNIT-V: Bio-Mass: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation and economic aspects. Geothermal Energy: Resources, types of wells, methods of harnessing the energy, potential in India.

TEXT BOOKS:
1. Non-Conventional Energy Sources /G.D. Rai
2. Renewable Energy Technologies /Ramesh & Kumar/Narosa

REFERENCE BOOKS:
1. Renewable energy resources/ Tiwari and Ghosal/Narosa.
2. Non-Conventional Energy / Ashok V Desai /Wiley Eastern.
3. Non-Conventional Energy Systems / K Mittal/Wheeler
4. Solar Energy/Sukhatme

COURSE OUTCOMES:
Upon successful completion of the course, student will be able to:

1. Describe the principles of solar radiation and its measurement, including the environmental impact and potential of solar energy.
2. Analyze different solar energy collection methods and technologies, including flat plate and concentrating collectors, and direct energy conversion techniques.
3. Evaluate solar energy storage methods such as sensible and latent heat storage, and their applications in solar heating/cooling, distillation, and photovoltaic energy conversion.
4. Examine alternative renewable energy sources including ocean energy (OTEC, tidal, wave), wind energy (windmills), biomass (bio-conversion, bio-gas), and geothermal energy.
5. Assess the economic and environmental aspects of various renewable energy technologies and their integration into energy systems.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3		1	2				2			2
CO2	3	3		1	2				2			2
CO3	3	3		1	2				2			2
CO4	3	3		1	2				2			2
CO5	3	3		1	2				2			2

(A403412) SOLAR ENERGY TECHNOLOGY
(Professional Elective-III)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT- I:
Introduction – Solar energy option, specialty and potential – Sun – Earth – Solar radiation, beam and diffuse – measurement – estimation of average solar radiation on horizontal and tilted surfaces – problems – applications. Capturing solar radiation – physical principles of collection – types – liquid flat plate collectors – construction details – performance analysis – concentrating collection – flat plate collectors with plane reflectors – cylindrical parabolic collectors – Orientation and tracking – Performance Analysis.

UNIT- II:
Design of Solar Water Heating System and Layout: Power generation – solar central receiver system – Heliostats and Receiver – Heat transport system – solar distributed receiver system – Power cycles, working fluids and prime movers, concentration ratio.

UNIT- III:
Thermal Energy Storage: Introduction – Need for – Methods of sensible heat storage using solids and liquids – Packed bed storage – Latent heat storage – working principle – construction – application and limitations. Other solar devices – stills, air heaters, dryers, Solar Ponds & Solar Refrigeration, active and passive heating systems.

UNIT- IV:
Direct Energy Conversion: solid-state principles – semiconductors – solar cells – performance – modular construction – applications. conversion efficiencies calculations.

UNIT- V:
Economics: Principles of Economic Analysis – Discounted cash flow – Solar system – life cycle costs – cost benefit analysis and optimization – cost-based analysis of water heating and photo voltaic applications.

TEXT BOOKS:
1. Principles of solar engineering/ Kreith and Kerider/Taylor and Franscis/2nd Edition.
2. Solar energy thermal processes/ Duffie and Beckman/John Wiley & Sons

REFERENCE BOOKS:
1. Solar energy: Principles of Thermal Collection and Storage/ Sukhatme/TMH/2nd edition
2. Solar energy/ Garg/TMH 5. Solar energy/ Magal/Mc Graw Hill
3. Solar Thermal Engineering Systems / Tiwari and Suneja/Narosa
4. Power plant Technology/ El Wakil/TMH.

COURSE OUTCOMES:
Upon successful completion of the course, student will be able to:

1. Understand the principles of solar radiation and its measurement, estimation, and application in solar energy systems and Analyze different types of solar collectors and their construction details, including flat plate and concentrating collectors.
2. Design solar water heating systems, including layout considerations and performance analysis.
3. Evaluate thermal energy storage methods such as sensible and latent heat storage, and their applications in solar devices.
4. Examine the principles and applications of direct energy conversion using solar cells, including performance metrics and efficiency calculations.
5. Apply economic analysis principles to assess the life cycle costs and cost-benefit of solar energy systems.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	3		1	2				2			2
CO2	3	3		1	2				2			2
CO3	3	3		1	2				2			2
CO4	3	3		1	2				2			2
CO5	3	3		1	2				2			2

(A403413) RE ENGINEERING
(Professional Elective-IV)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT - I

Introduction to Reverse Engineering: Reverse Engineering –The Generic Process
Reverse Engineering in Automotive, Aerospace, Medical sectors: Legal Aspects of Reverse Engineering: Copyright Law, Reverse Engineering, Recent Case Law, Barriers to Adopting Reverse Engineering.A discussion on a few benchmarks case studies

UNIT - II

Methodologies and Techniques for Reverse Engineering: The Potential for Automation with 3-D Laser Scanners, What Is Not Reverse Engineering, What is Computer-aided (Forward) Engineering, What Is Computer-aided Reverse Engineering, Computer Vision and Reverse Engineering, Structured- light Range Imaging, Scanner Pipeline

UNIT - III

Reverse Engineering–Hardware and Software: Contact Methods Noncontact Methods, Destructive Method. Reverse Engineering Software Classification, Fundamental Reverse Engineering Operations, Reverse Engineering Phases

UNIT - IV

Selecting a Reverse Engineering System: The Selection Process, Some Additional Complexities, Point Capture Devices, Triangulation Approaches, "Time-of-flight" or Ranging Systems, Structured-light and Stereoscopic Imaging Systems, issues with Light-based Approaches, Tracking Systems, Internal Measurement Systems, X-ray Tomography, Destructive Systems, Some Comments on Accuracy, Positioning the Probe, Post processing the Captured Data, Handling Data Points, Curve and Surface Creation, Inspection Applications, Manufacturing Approaches.

UNIT - V:

Integration between Reverse Engineering and Rapid Prototyping: Modeling Cloud Data in Reverse Engineering, Data Processing for Rapid Prototyping, Integration of RE and RP for Layer-based Model Generation, Adaptive Slicing Approach for Cloud Data Modeling, Planar Polygon Curve Construction for a Layer, Determination of Adaptive Layer Thickness.

TEXT BOOK:

1. Reverse Engineering: An Industrial Perspective by Vinesh Raja and Kiran J. Fernandes, Springer-Verlag London Limited 2008

REFERENCE BOOKS:

1. K. Otto and K. Wood, Product Design: Techniques in Reverse Engineering and New Product Development, Prentice Hall, 2001.
2. Anupam Saxena, Birendra Sahay, Computer Aided Engineering Design, Springer, 2005.
3. Ali K. Kamrani and Emad Abouel Nasr, Engineering Design and Rapid Prototyping, Springer, 2010.

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

1. Understand the concept and applications of reverse engineering across various sectors.
2. Analyze the methodologies and techniques used in reverse engineering, including 3-D laser scanners and computer vision.
3. Explain the hardware and software aspects involved in reverse engineering, including contact and non-contact methods.
4. Evaluate the process of selecting appropriate reverse engineering systems and technologies.
5. Integrate reverse engineering with rapid prototyping techniques for efficient product development

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CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3		2	1	1		2	2	2		1
CO2	2	3		2	1	1		2	2	2		1
CO3	2	3		2	1	1		2	2	2		1
CO4	2	3		2	1	1		2	2	2		1
CO5	2	3		2	1	1		2	2	2		1

(A403414) TURBO MACHINERY
(Professional Elective-IV)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

Pre-requisites: Thermal Engineering, Heat Transfer

UNIT - I Introduction to Turbomachinery: Classification of turbo-machines, second law of thermodynamics applied to turbine and compressors work, nozzle, diffuser work, fluid equation, continuity, Euler's, Bernoulli's, equation and its applications, expansion and compression process, reheat factor, preheat factor

UNIT - II Fundamental Concepts of Axial and Radial Machines: Euler's equation of energy transfer, vane congruent flow, influence of relative circulation, thickness of vanes, number of vanes on velocity triangles, slip factor, Stodola, Stanitz and Balje's slip factor, suction pressure and net positive suction head, phenomena of cavitation in pumps, concept of specific speed, shape number, axial, radial and mixed flow machines, similarity laws.

UNIT - III Gas Dynamics: Fundamental thermodynamic concepts, isentropic conditions, mach numbers, and area, Velocity relations, Dynamic Pressure, Normal shock relation for perfect gas. Supersonic flow, oblique shock waves. Normal shock recoveries, detached shocks, Aerofoil theory. Centrifugal compressor: Types, Velocity triangles and efficiencies, Blade passage design, Diffuser and pressure recovery. Slip factor, Stanitz and Stodolas formula's, Effect of inlet mach numbers, Pre whirl, Performance

UNIT - IV Axial Flow Compressors: Flow Analysis, Work, and velocity triangles, Efficiencies, Thermodynamic analysis. Stage pressure rise, Degree of reaction, Stage Loading, General design, Effect of velocity, Incidence, Performance Cascade Analysis: Geometrical and terminology. Blade force, Efficiencies, Losses, Free end force, Vortex Blades.

UNIT - V Axial Flow Gas Turbines: Work done. Velocity triangle and efficiencies, Thermodynamic flow analysis, Degree of reaction, Zweifels relation, Design cascade analysis, Soderberg, Hawthrone, Ainley, Correlations, Secondary flow, Free vortex blade, Blade angles for variable degree of reaction. Actuator disc, Theory, Stress in blades, Blade assembling, Material and cooling of blades, Performances, Matching of compressors and turbines, off design performance.

TEXT BOOKS:
1. Principles of Turbo Machines/DG Shepherd / Macmillan
2. Turbines, Pumps, Compressors/Yahya/ Mc Graw Hill

REFERENCE BOOKS:
1. A Treatise on Turbo machines / G. Gopal Krishnan and D. Prithviraj/ SciTech
2. Gas Turbine Theory/ Saravanamuttoo/ Pearson
3. Turbo Machines/ A Valan Arasu/ Vikas Publishing House Pvt. Ltd.

COURSE OUTCOMES:
Upon successful completion of the course, student will be able to:
1. Describe and apply thermodynamic principles to turbines and compressors, including nozzle and diffuser characteristics, and fluid dynamics equations.
2. Analyze axial and radial machines, calculate velocity triangles, and address cavitation in pumps
3. Apply gas dynamics principles to analyze shock waves, isentropic conditions, and centrifugal compressors.
4. Analyze axial flow compressors, calculate efficiencies, and apply cascade analysis techniques.
5. Analyze axial flow gas turbines, calculate efficiencies, and describe turbine design principles

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**2**	**2**	**1**	**1**	**1**							**1**
CO2	**3**	**3**	**3**	**2**	**2**							**1**
CO3	**3**	**3**	**3**	**2**	**2**							**1**
CO4	**3**	**3**	**3**	**2**	**2**							**1**
CO5	**3**	**3**	**3**	**2**	**2**							**1**

(A403415) FLUID POWER SYSTEMS
(Professional Elective-IV)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

Pre-requisites: Fluid Mechanics and Hydraulics Machinery

UNIT- I

Introduction to oil hydraulics and pneumatics: Structure, advantages and limitations. ISO symbols, energy losses in hydraulic systems. Applications, Basic types and constructions of Hydraulic pumps and motors. Pump and motor analysis. Performan curves and parameters.

UNIT- II

Hydraulic actuators, types and constructional details, lever systems, control elements – direction, pressure and flow control valves. Valve configurations, General valve analysis, valve lap, flow forces and lateral forces on spool valves. Series and parallel pressure compensation flow control valves. Flapper valve Analysis and Design.

UNIT- III

Proportional control valves and servo valves. Nonlinearities in control systems (backlash, hysteresis, dead band and friction nonlinearities). Design and analysis of typical hydraulic circuits. Regenerative circuits, high low circuits, Synchronization circuits, and accumulator sizing.

UNIT- IV

Intensifier circuits Meter-in, Meter-out and Bleed-off circuits; Fail Safe and Counter balancing circuits, accessories used in fluid power system, Filtration systems and maintenance of system. Components of pneumatic systems; Direction, flow and pressure control valves in pneumatic systems. Development of single and multiple actuator circuits. Valves for logic functions; Time delay valve; Exhaust and supply air throttling;

UNIT- V

Examples of typical circuits using Displacement – Time and Travel-Step diagrams. Will-dependent control, Travel-dependent control and Time dependent control, combined control, Program Control, Electropneumatic control and air-hydraulic control, Ladder diagrams. Applications in Assembly, Feeding, Metal working, materials handling and plastics working.

TEXT BOOKS:

1. Fluid Power Control systems/ Pippenger, J.J., and R. M. Koff/ New York: McGraw Hill.
2. Fluid Power Systems: modeling, simulation and microcomputer control/ John Watton/ Prentice Hall International.

REFERENCE BOOKS:

1. Fundamentals of Fluid Power Control. / John Watton/ 1 st Ed. Cambridge University Press, 2009
2. Fluid Power with applications/ Anthony Esposito / Pearson Education.

COURSE OUTCOMES: Upon successful completion of the course, student will be able to:

1. Describe the structure, advantages, and limitations of oil hydraulics and pneumatics systems.
2. Identify and analyze hydraulic actuators, control elements, and valve configurations in fluid power systems.
3. Design and analyze hydraulic circuits incorporating proportional control valves and understand nonlinearities in control systems.
4. Implement intensifier circuits, maintain hydraulic systems through filtration, and comprehend pneumatic components.
5. Apply control techniques like electropneumatic and air-hydraulic controls in industrial processes using hydraulic and pneumatic systems.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2								2
CO2	3	3	2	2								2
CO3	2	1	3	2	2							1
CO4	2	1	3	2	2							1
CO5	2	1	3	1	2							1

(A403416) COMPUTATIONAL FLUID DYNAMICS
(Professional Elective-IV)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT - I:

Basic Aspects of the Governing Equations – Physical Boundary Conditions – Methods of solutions of Physical Problems – Need for Computational Fluid Dynamics – Different numerical/CFD techniques – FDM, FEM, FVM etc., - Main working principle - CFD as a research and design tool – Applications in various branches of Engineering.

Mathematical behavior of Partial Differential Equations (Governing Equations): Classification of linear/ quasi linear PDE – Examples - Physical Processes: Wave Equations and Equations of Heat Transfer and Fluid Flow – Mathematical Behavior - General characteristics – Its significance in understanding

the physical and numerical aspects of the PDE – One way and Two Way variables – Well posed problems – Initial and Boundary Conditions

Solution of Simultaneous Algebraic Equations: Direct Method – Gauss Elimination – LU Decomposition – Pivoting – Treatment of Banded Matrices – Thomas Algorithm

Iterative Method: Gauss Seidel and Jordan Methods - Stability Criterion

UNIT - II:

Finite Difference Method: Basic aspects of Discretization – Finite Difference formulae for first order and second order terms – Solution of physical problems with Elliptic type of Governing Equations for different boundary conditions - Numerical treatment of 1D and 2D problems in heat conduction, beams etc., - Solutions –Treatment of Curvelinear coordinates – Singularities – Finite Difference Discretization – Solution of 1D heat conduction problems in Heat conduction in curve linear coordinates

UNIT - III:

FDM: Solution of physical problems with Parabolic type of Governing Equations – Initial Condition – Explicit, implicit and semi-implicit methods – Types of errors – Stability and Consistency – Von Neumann Stability criterion– Solution of simple physical problems in 1D and 2D – Transient Heat conduction problems- ADI scheme - Simple Hyperbolic type PDE - First order and Second order wave equations – Discretization using Explicit method - Stability criterion – Courant Number – CFL Condition - Its significance - Treatment of simple problems

UNIT - IV:

Finite Difference Solution of Unsteady Inviscid Flows: Lax – Wendroff Technique – Disadvantages – Maccormack's Technique

Fluid Flow Equations – Finite Difference Solutions of 2D Viscous Incompressible flow problems – Vorticity and Stream Function Formulation – Finite Difference treatment of Lid Driven Cavity Problem -Application to Cylindrical Coordinates with example of flow over infinitely long cylinder and sphere –

Obtaining Elliptic Equations

UNIT - V:

Finite Difference Applications in Fluid flow problems: Fundamentals of fluid Flow modeling using Burger's Equation – Discretization using FTCS method with respect to Upwind Scheme and Transport Property – Upwind Scheme and Artificial Viscosity

Solutions of Navier Stokes Equations for Incompressible Fluid Flows: Staggered Grid – Marker and Cell (MAC) Formulation – Numerical Stability Considerations – Pressure correction method - SIMPLE Algorithm

TEXT BOOKS:

1. Computational Fluid Dynamics: The basics with applications/ John D Anderson/McGraw Hill Publications
2. Numerical Heat Transfer and Fluid Flow/ S.V. Patankar/ Mc Graw Hill

REFERENCE BOOKS:

1. Computational Fluid Flow and Heat Transfer / K Muralidharan and T Sudarajan/ Narosa Publishers.
2. Computational Methods for Fluid Dynamics / Firziger & Peric/ Springer

COURSE OUTCOMES: Upon successful completion of the course, student will be able to:

1. Differentiate between different types of Partial Differential Equations
2. understand appropriate numerical techniques.
3. Solve the simple heat transfer and fluid flow problems using different numerical techniques,viz., FDM.
4. Understand Finite Difference Solution of Unsteady Inviscid Flows
5. Analyze Finite Difference Applications in Fluid flow problems

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	3	3	3				1	1		1
CO2	2	2	3	3	3				1	1		1
CO3	3	3	3	3	3				1	1		1
CO4	3	3	3	3	3				1	1		1
CO5	3	3	3	3	3				1	1		1

(A403417) INDUSTRIAL ROBOTICS

(Professional Elective-V)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

Pre-requisites: Basic principles of Kinematics and mechanics

UNIT – I

Introduction: Automation and Robotics – An over view of Robotics – present and future applications.

Components of the Industrial Robotics: common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, Design of end effectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

UNIT – II

Motion Analysis: Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems.

Manipulator Kinematics: H notation-H method of Assignment of frames-H Transformation Matrix, joint coordinates and world coordinates, Forward and inverse kinematics – problems on Industrial Robotic Manipulators.

UNIT – III

Differential transformation of manipulators: Jacobians – problems. Dynamics: Lagrange – Euler and Newton – Euler formations – Problems.

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolated motion – straight line motion.

UNIT - IV

Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors – End Effectors and Tools

UNIT V

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloadingProcessing - spot and continuous arc welding & spray painting - Assembly and Inspection. Robotic Programming Methods – Languages: Lead Through Programming, Textual Robotic Languages such as APT, MCL

TEXT BOOKS:

1. Industrial Robotics / Groover M P /Mc Graw Hill
2. Introduction to Industrial Robotics / Ramachandran Nagarajan / Pearson

REFERENCE BOOKS:

1. Robot Dynamics and Controls / Spony and Vidyasagar / John Wiley
2. Robot Analysis and control / Asada, Slotine / Wiley Inter-Science
3. Robotics – Fu et al / TMH Publications.

COURSE OUTCOMES:

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

1. Gain an overview of robotics, including present and future applications, and understand the components and architecture of industrial robotics systems.
2. Demonstrate proficiency in analyzing motion using basic rotation matrices, equivalent axis-angle representations, and homogeneous transformations applicable to both rotation and translation in robotic systems.
3. Apply Jacobian matrices to analyze differential transformations of manipulators, and solve dynamics problems using Lagrange-Euler and Newton-Euler formulations in robotics.
4. Compare and evaluate different types of actuators including pneumatic, hydraulic, and electric motors, and analyze the role of feedback components such as position sensors (e.g., potentiometers, encoders) and force/torque sensors in robotic applications.
5. Implement robotic systems for various manufacturing tasks including material handling, processing (e.g., welding, painting), assembly, and inspection, utilizing different programming methods like lead-through programming and textual robotic languages.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**2**
CO2	**2**	**2**	**2**	**1**	**1**				**1**	**1**		**1**
CO3	**3**	**3**	**1**	**2**	**2**				**2**	**1**		**1**
CO4	**3**	**1**	**2**	**2**	**3**					**2**		**2**
CO5	**3**	**3**	**3**	**2**	**3**	2	1	**1**	**2**	**2**		**2**

(A403418) COMPOSITE MATERIALS

(Professional Elective-V)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT - I

Introduction: Definition, Classification of Composite materials based on structure, based on matrix, Advantages of composites, Applications of composites, Functional requirements of reinforcement and matrix.

UNIT - II

Types of reinforcements and their properties: Fibers: Carbon, Boron, Glass, Aramid, Al2O3, SiC, Nature and manufacture of glass, carbon and aramid fibres, Comparison of fibres. Role of interfaces: Wettability and Bonding, the interface in Composites, Interactions and Types of bonding at the Interface, Tests for measuring Interfacial strength.

UNIT - III

Fabrication of Polymeric Matrix Composites: Structure and properties of Polymeric Matrix Composites, Interface in Polymeric Matrix Composites, Applications; Fabrication of Ceramic Matrix Composites, Properties of Ceramic Matrix Composites, Interface in Ceramic Matrix Composites, Toughness of Ceramic Matrix Composites Applications of Ceramic Matrix Composites.

UNIT - IV

Fabrication of Metal Matrix Composites: Solid state fabrication, Liquid state fabrication and In-situ fabrication techniques; Interface in Metal Matrix Composites: Mechanical bonding, Chemical bonding and Interfaces in In-situ Composites; Discontinuously reinforced Metal Matrix Composites, Properties and Applications. Fabrication of Carbon fiber composites, properties, interface and applications.

UNIT - V

Micromechanics of Composites: Density, Mechanical Properties: Prediction of Elastic constants, Micro mechanical approach, Halpin-Tsai equations, Transverse stresses; Thermal properties: Hydrothermal stresses and Mechanics of Load transfer from matrix to fiber.

TEXT BOOKS:

1. Composite Materials – Science & Engineering, K.K. Chawla, Springer-Verlag, New York, 1987.
2. An Introduction to Composite Materials, Hull, Cambridge, 2nd Edt. 1997.

REFERENCE BOOKS:

1. Composites, Engineered Materials Handbook, Vol. 1, ASM International, Ohio, 1988.
2. Structure and Properties of Composites, Materials Science and Technology, Vol. 13, VCH, Weinheim, Germany, 1993
3. Composite Materials: Engineering and Science, F.L. Matthews and R.D. Rawlings, Chapman & Hall, London, 1994

COURSE OUTCOMES:

1) Understand the classification & advantages of composite materials and Identify key applications and the essential roles of reinforcement and matrix in composites.

2) Describe various types of reinforcement fibers (e.g., carbon, glass, aramid) and Explain the role of interfaces in composites and methods for testing interfacial strength.

3) Learn fabrication techniques for polymeric and ceramic matrix composites and Discuss the properties, interfaces, and applications of these materials in industry.

4) Explore fabrication methods for metal matrix composites and properties of carbon fiber composites and Understand the significance of interfaces in these materials and their diverse applications.

5) Apply micromechanical principles to predict mechanical and thermal properties of composites and Analyze load transfer mechanisms and performance characteristics in composite materials

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	1	1					1	1
CO2	2	2	2	2			1				1	1
CO3	2	2	2	2			1				1	1
CO4	2	2	2	2			1				1	1
CO5	3	3	3	2	2	2					1	1

(A403419) ENERGY CONSERVATION AND MANAGEMENT

(Professional Elective-V)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT-I:

Energy Conservation: Rules for efficient energy conservation – technologies for energy conservation – outline of waste heat and material reclamation, load management, alternate energy sources, and energy storage.

UNIT-II:

Thermal Insulation & Refractors: Heat loss through un-insulated surfaces, effects of insulation on current carrying wires – economic thickness of insulation – critical radius of insulation – properties of thermal insulators – classification of insulation materials – classification of refractors – properties of refractors – criteria for good refractory material – applications of insulating & refractory materials.

UNIT-III:

Waste Heat Recovery Systems: Guideline to identify waste heat – feasibility study of waste heat – shell and tube heat exchanger – thermal wheel – heat pipe heat exchanger – heat pump – waste heat boilers – incinerators.
Heat Recovery Systems & Heat Exchanger Networks: Liquid to liquid heat exchangers – gas to liquid heat recovery systems, regenerators, recuperators, rotating regenerators – miscellaneous heat recovery methods – selection of materials for heat exchangers – combined radiation and convective heat exchanger, U tube heat exchanger, tube heat exchanger, fluidized bed heat exchanger – economizer.

UNIT-IV:

Engineering Economics: Managerial objectives, steps in planning – efficiency of organization- capital budgeting – classification of costs – interest – types – nominal and effective interest rates – discrete and continuous compounding – discounting - time value of money – cash flow diagrams – present worth factor, capital recovery factor, equal annual payments – equivalent between cash flows.
Energy auditing: A definition – objectives – level of responsibility – control of energy – uses of energy – check lists – energy conservation schemes – energy index – cost index – pie charts – sankey diagrams – load profiles – types of energy audits – questionnaire – energy audit of industries – general energy audit – detailed energy audit – energy saving potential.

UNIT-V:

Project Management

Method of investment appraisal – rate of return method, pay back method, net present value method(NPV) – adoption of the methods in energy conservation campaign – types of projects — propose ofproject management – classification – role and qualities of project manager – types of budgets – budget committee – budgeting.
Energy Management Programs: Necessary steps of energy management programme – concepts of energy management – general principles of energy management – energy management in manufacturing and process industries – qualities and functions of energy managers – duties of energy manager - language of energy manager – checklist for top management.

TEXT BOOKS:

1. Waste heat recovery systems -D.A. Reay/Pergmon Press.
2. Energy Management -W.R. Murphy & G. Mickay, Butterworths

REFERENCE BOOKS:

1. Energy Conservation -P.W.O' Callaghan, Pargamon Press 1981.
2. Engineering Heat Audits -C.P. Gupta & Rajendra Prakash, Nechand & Bros.
3. Hand book of energy audits -Albert Thumann, The F.Airmont Press Inc., Atlanta Georgia, 1979.
4. Energy Management Principles -Craig B. Smithm, Pergarmon Press

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

1. Describe rules and technologies for efficient energy conservation, including waste heat and material reclamation, load management, alternate energy sources, and energy storage.
2. Analyze the impact of thermal insulation on heat loss, determine economic thickness of

insulation, and evaluate properties and applications of thermal insulators and refractory materials.

3. Evaluate feasibility and implementation of waste heat recovery systems, including shell and tube heat exchangers, thermal wheels, heat pipe heat exchangers, and waste heat boilers.
4. Apply principles of engineering economics to evaluate energy projects, including capital budgeting, cost classification, time value of money, and financial analysis methods.
5. Demonstrate proficiency in project management methods for energy conservation projects, including investment appraisal techniques, budgeting, and the role of energy managers in implementing energy management programs.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		2			2	3		2		2	2
CO2	2		2			2	3		2		2	2
CO3	2		2			2	3		2		2	2
CO4	2		2			2	3		2		2	2
CO5	2		2		3	2	3		2		2	2

(A403420) MECHANICAL VIBRATIONS
(Professional Elective-V)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT – I:
Single degree of Freedom systems - I: Undamped and damped free vibrations; forced vibrations coulomb damping; Response to excitation; rotating unbalance and support excitation; vibration isolation and transmissibility.

UNIT – II:
Single degree of Freedom systems - II: Response to Non-Periodic Excitations: unit impulse, unit step and unit Ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

UNIT – III:
Two-degree freedom systems: Principal modes- undamped and damped free and forced vibrations; undamped vibration absorbers;
Multi degree freedom systems: Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi- rotor systems and geared systems; Discrete- Time systems.

UNIT – IV:
Continuous system: Free vibration of strings – longitudinal oscillations of bars- traverse vibrations of beams- Torsional vibrations of shafts.
Critical speeds of shafts: Critical speeds without and with damping, secondary critical speed.
Numerical Methods: Rayleigh's stodola's, Matrix iteration, Rayleigh- Ritz Method and Holzer's methods.
Vibration measuring instruments: Vibrometers, velocity meters & accelerometers

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

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

REFERENCE BOOKS:
1. Mechanical Vibrations / SS Rao / Pearson
2. Mechanical Vibration /Rao V. Dukkipati, J Srinivas/ PHI.
3. Mechanical Vibrations/ G.K. Grover/ Nemchand & Brothers.

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

1. Analyze undamped and damped free vibrations, forced vibrations, and vibration isolation techniques.
2. Apply convolution integral and Laplace transformation methods to analyze system responses to unit impulse, step, ramp functions, and arbitrary excitations.
3. Utilize matrix formulation to understand stiffness and flexibility influence coefficients, eigenvalue problems, and normal modes in multi-degree freedom systems.
4. Apply numerical methods like Rayleigh's method and matrix iteration to analyze free vibrations in continuous systems and calculate critical speeds of shafts.
5. Interpret subjective human responses to sound, understand the decibel scale, and calculate sound power, intensity, and pressure levels.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	2	2	2			2	1			2
CO2	2	3	2	2	2			2	1			2
CO3	2	3	2	2	2			2	1			2
CO4	2	3	2	2	2			2	1			2
CO5	2	3	2	2	2			2	1			2

(A404601) FUNDAMENTALS OF INTERNET OF THINGS
(Open Elective-I Offered by ECE)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT– I:
Introduction to Arduino: Introduction to Arduino Uno, Features, Pin functionality, Basic Arduino Programming: Interfacing LEDs, Switches using Digital I/O Read/Write, Acquiring and generating signals using Analog I/ORead/Write, Serial functions.

UNIT–II:
Introduction to Raspberry Pi: Introduction to Raspberry Pi, Pin functionality, Revision of Python Programming; Raspberry Pi commands, GPIO programming.
Other Open Source Devices: Features and pin functions of Node MCU, ESP8266, ESP32.

UNIT-III:
Introduction to IOT: Terms and definitions, Logical design of IoT, IOT Reference Model;
IOT and M2M: Introduction to M2M, Difference between IoT and M2M and other types;
IOT Servers and Cloud Offerings: IoT enabling technologies–Cloud Computing; Introduction to Cloud Storage/Services–Google, Microsoft Azure, IBM, Amazon Web services for IOT, setting up to read and write using Thing speak;

UNIT–IV:
IOT & Communication Protocols: Serial –RS 485, IEEE1394 Firewire, I2C, SPI, USB, CAN; Wireless sensor networks and its technologies, IOT Protocols.

UNIT– V:
Domain Specific IOT Applications & Case Studies:
IOT Application & case studies for Agriculture, Smart Cities & Transport, Home Automation, Environment, Retail, Logistics, Health, Life style, Industry–Energy;

TEXT BOOKS:
1. Srinivasa KG, Siddesh GM, Hanumantha Raju R, Internet of Things, Cengage, 2019.

REFERENCE BOOKS:
1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: AHands-on-Approach", VPT,1st Edition,2014
2. Jeremy Blum, Exploring Arduino: Tools and Techniques for EngineeringWizardry, Wiley, 2013
3. Simon Monk, Raspberry Pi Cook book, O'Reilly 3rd Edition,2019
4. Michael Margolis, Arduino Cook book, 2nd Edition, December 2011, O'Reilly Media, Inc.
5. Rahul Dubey, An Introduction to Internet of Things – Connecting Devices, Edge Gate way, and Cloud with Applications, Cengage, 2019.

COURSE OUTCOMES:
Students will be able to
1. Have knowledge of programming open-source Edge devices like Arduino, Raspberry Pi.
2. Apply the knowledge of arduino and raspberry pi with clouds for IOT applications.
3. Analyze the different communication and IOT protocols.
4. Aware of various cloud services and providers.
5. Understand various IOT implementations in different domains.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1		2	1							1
CO2		2										1
CO3				3	1	1						1
CO4		3										1
CO5			2	3	1							1

(A404602) PRINCIPLES OF DIGITAL SIGNAL PROCESSING
(OpenElective-I Offered by ECE)

B. Tech (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT-I:

Introduction to Signal and Systems: Basic Signals and Systems – properties and basic operations-1-D Signals and Filters – Random Signals -Multi-dimensional Signals – Analog and Digital signals and their conversion techniques Convolution process, Filtering process, Z-transform concepts.

UNIT-II:

Time domain analysis and Characteristics: Correlation and Discrete sequences: notation, signal characteristics, and operations discrete linear time in variant systems-Properties and analysis of discrete linear time invariant systems, Periodic sampling: aliasing and low pass filtering.

UNIT-III:

Frequency domain Analysis: Discrete Fourier transforms (DFT) DFT properties: symmetry, linearity, magnitudes, frequency axis, and shifting Inverse DFT-Fast Fourier transform (FFT): relationship to DFT, implementation considerations, radix-2 algorithm, and input/output indexing FFT: butterfly algorithm structures.

UNIT-IV:

FIR filter design: FIR filters–Introduction-Basic properties-Design using Hamming, Hanning Windows-Realization of FIR filters.

UNIT-V:

IIR filter design: Review of design of analogue Butterworth Filters, - Design of IIR digital filters using impulse invariance technique-Realization using direct, cascade and parallel forms.

TEXT BOOKS:

1. Richard G. Lyons, Understanding Digital Signal Processing, Third edition, Prentice-Hall, 2011
2. Introduction to Digital Signal Processing, J. Proakis & E. Manolakis, Mac Millan, 2007 (4th Edition)

REFERENCES:

1. 1. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, Digital Signal Processing, TMH/Mc Graw Hill International, 2007
2. E.C.I feachorand B.W.Jervis,"Digital signal processing-A practical approach", Second edition, Pearson, 2002

COURSE OUTCOMES:

Students will be able to

1. Characterize discrete time signals and LTI signal processing systems mathematically.
2. Analyze the functions performed by simple discrete-time systems.
3. Develop the discrete Fourier transform (DFT) overtime domain signals, its applications, and its implementation by FFT techniques.
4. Apply the design techniques for FIR type digital filters known as the―windowing method.
5. Design IIR type digital filters over the given specifications

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										1
CO2	3	3										1
CO3	3	3	2									1
CO4	3	3	2	2								1
CO5	3	3	2	2								1

(A402601) RENEWABLE ENERGY SOURCES
(OPEN ELECTIVE-I OFFERED BY EEE)

B. Tech (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT I:

GLOBAL AND NATIONAL ENERGY SCENARIO: Overview of conventional & renewable energy sources, need & development of renewable energy sources, types of renewable energy systems, Future of Energy Use, Global and Indian Energy scenario, Renewable and Non-renewable Energy sources, Energy for sustainable development, Potential of renewable energy sources, renewable electricity and key elements, Global climate change, CO2 reduction potential of renewable energy-concept of Hybrid systems.

UNIT II:

SOLAR ENERGY: Solar energy system, Solar Radiation, Availability, Measurement and Estimation, Solar Thermal Conversion Devices and Storage, Applications Solar Photovoltaic Conversion solar photovoltaic, solar thermal, applications of solar energy systems.

UNIT III:

WINDENERGY: Wind Energy Conversion, Potential, Wind energy potential measurement, Site selection, Types of wind turbines, Wind farms, wind Generation and Control.Nature of the wind, power in the wind, factors influencing wind, wind data and energy estimation, wind speed monitoring, classification of wind, characteristics, applications of wind turbines, offshore wind energy – Hybrid systems, wind resource assessment, Betz limit, site selection, windenergy conversion devices. Windmill component design, economics and demand side management, energy wheeling, and energy banking concepts. Safety and environmental aspects,wind energy potential and installation in India.

UNIT IV:

BIOGAS: Properties of biogas (Calorific value and composition), biogas plant technology and status, Bio energy system, design and constructional features. Biomass resources and their classification, Biomass conversion processes, Thermo chemical conversion, direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion, types of biogas Plants, applications, alcohol production from biomass, biodiesel production, Urban waste to energy conversion, Biomass energy programme in India.

UNIT V:

OCEAN ENERGY: Ocean wave energy conversion, principle of Ocean Thermal Energy Conversion (OTEC), ocean thermal powerplants, tidal energy conversion, Tidal and wave energy its scope and development, Scheme of development oftidal energy.

Small hydro Power Plant: Importance of small hydro power plants and their Elements, types of turbines forsmallhydro, estimation of primary and secondarypower.

GeothermalEnergy: Geothermal power plants, various types, hot springs and steam ejection.

TEXT BOOKS

1. RenewableEnergy Sources/Twidell, J.W. and Weir, A./EFNSponLtd.,1986.
2. Non-ConventionalEnergySources/G.D. Rai/KhannaPublishers

COURSE OUTCOMES:

After successful completion of this course, the students can be able to:

1. Understand the importance of renewable energy sources
2. Explain the operation of solar energy system
3. Illustrate various wind energy conversion systems
4. Explain the operation of Bio gas conversion
5. Explain the principle and operation of Ocean wave energy conversion.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	1			1			2		
CO2	2	1	1	1			1			2		
CO3	2	1	1	1			1			2		
CO4	2	1	1	1			1			2		
CO5	2	1	1	1			1			2		

(A402602) BASICS OF POWER ELECTRONICS & DRIVES
(OPENELECTIVE-1 Offered by EEE)

B. Tech (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT-I:
POWER SEMI CONDUCTOR DEVICES: Power Semiconductor Devices Construction and Characteristics of Power diodes, Power Transistors, Power MOSFET, Insulated Gate Bipolar transistors (IGBTs) Introduction to Thyristor family:SCR, DIACs, TRIACs

UNIT-II:
PHASE CONTROLLED (ACTODC) CONVERTERS: Principle of phase-controlled converter operation;Operation of 1-phase half wave converter with R, RL and RLEload; 1- phase full wave converter, Bridge Configuration; Operation with R, RL, RLE load; Operation of 1-phaseSemi-converter/Half controlled converter:

UNIT-III:
THREE-PHASE CONVERTERS: Operation of half wave converter: Full wave fully controlled converters: Semi-controlled converter; Dual Converter: Principle and operation; Applications of AC-DC converters

UNIT-IV:
DC TO DCCONVERTERS: The chopper, Basic principle of DC chopper, Classification of DC choppers, Control strategies Basic DC-DCconverter (switch regulator) topologies: Principle, operation Step-down (Buck), Step-up (Boost), Step up/down (Buck-Boost), Continuous conduction and Discontinuous conduction operation, two zone operation, Four quadrant operation (Operating modes),

UNIT-V:
POWER CONVERTERS FED DRIVES: Single phase separately excited drives: Half wave converter, Semi converter and Fully Controlled converter baseddrives; Braking operation of separately excited drive Semi-converter and Fully Controlled converter-based drives 3-phase separately excited drives: Half Wave converter, Semi-converter and Fully Controlled converter-based drives; Principle of power control (motoring control) of separately excited and series motor with DC-DC Converter;

TEXT BOOKS:
1. MD Singhand KB Khanchandani, “Power electronics”, TMH, NewDelhi, 2nd edition., 2007
2. P.S. Bimbhra, “PowerElectronics”, Khanna Publishers, NewDelhi, 2012
3. Muhammad H. Rashid, “Power Electronics-Circuits, Devices and Applications”, Prentice Hall of India, 3rd edition, 2003

REFERENCE BOOKS:
1. Vedam Subramanyam, “Power Electronics–Devices, Converters and Applications”, New Age International Publishers Pvt. Ltd., Bangalore,2nd edition, 2006.
2. NedMohan, Undel and and Robbins, “Power Electronics–Converters, Applications and Design”, John Willey & sons, Inc., 3rd edition, 2003.
3. V.R. Moorthi, “Power Electronics”, Oxford University press, 2005.
4. G.K. Dubey, S.R. Doradla, A. Joshi, and R.M.K. Sinha, “Thyristorised Power Controllers”, New Age International Ltd. Publishers, 1986 (Reprint2008).
5. P.T. Krein, “Elements of Power Electronics”, Oxford University Press, 1998
6. G.K. Dubey, “Fundamentals of Electrical Drives”, Narosa Publishing House, New Delhi, 2nd edition, 2001

COURSE OUTCOME:
After successful completion of this course, the students can be able to:
1. Explain the construction and characteristics of Power semiconductor devices.
2. Analyze the operation of single phase and three phase ac-to-dc converters.
3. Analyze various three phase converters.
4. Compare the various types of dc-to-dc converters.
5. Apply the knowledge of power electronic converter for various applications.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1							2		
CO2	3	3	3	1						2		
CO3	3	3	3	1						2		
CO4	3	3	1	1						2		
CO5	3	3	1	2						2		

(A405604) JAVA PROGRAMMING
(OPEN ELECTIVE-I Offered by CSE Department)

B. Tech (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT–I:
Conversion, Casting, Conditional Statements, Loops, Branching Mechanism, Classes, Objects, Class Declaration, Creating Objects, Method Declaration and Invocation, Method Over loading, Constructors–Parameterized Constructors, Constructor Over loading, Cleaning-up unused Objects, Class Variables & Methods-static Keyword, this Keyword.

UNIT–II:
Arrays: One-DimensionalArrays, Two-Dimensional Arrays, Command-Line Arguments, Inner Class.
Inheritance: Introduction, Types of Inheritance, extends Keyword, Examples, Method Overriding, super, final Keywords, Abstract classes, Interfaces, Abstract Classes Verses Interfaces.

UNIT–III:
Packages–Creating and Using Packages, Access Protection, Wrapper Classes, String Class, String Buffer Class.
Exception: Introduction, Types, Exception Handling Techniques, User-Defined Exception.

UNIT-IV:
Multi threading: Introduction, Main Thread, Creation of New Threads–By Inheriting the Thread Class or Implementing the Runnable Interface, Thread Life cycle, Thread Priority, Synchronization.

UNIT–V:
java.io Package, File Class, FileInputStream Class, File Output Stream Class, Scanner Class, Buffered Input Stream Class, Buffered Output Stream Class, Random Access File Class.

TEXT BOOKS:
1. Sachin Malhotra, Saurabh Choudhary, Programming in Java (2e), Oxford publications.

REFERENCEBOOKS:
1. Herbert Schildt, Java: The Complete Reference (9e), McGraw Hill Education;
2. C. Thomas Wu, An introduction to object-oriented programming with Java (5e), McGraw-Hill Education;

COURSE OUTCOMES:
The student shall be able to:
1. Explain the OOPs concepts.
2. Describe various types of Inheritance in Java.
3. Develop robust Java applications using Packages,Exceptions.
4. Implement Java applications using Java Threads.
5. Design Java applications with various modes of Input and output

CO-POMAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2		2							1
CO2	1	2	2		2							1
CO3	1	2	2	2	2							2
CO4	1	2	2	2	2					2		2
CO5	1	2	2	2	2					2		2

(A405602) FUNDAMENTALS OF OPERATING SYSTEMS
(OPEN ELECTEIVE-I Offered by CSE Department)

B. Tech (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT-I:
Operating System- Introduction, Structures- Simple Batch,Multi programmed,Time-shared, Personal Computer, Parallel, Distributed Systems, Real-Time Systems, System components, Operating System services, System Calls Process- Process concepts and scheduling,Operations on processes,Cooperating Processes,Threads

UNIT-II:
CPU Scheduling- Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling.System call interface for process management-fork, exit, wait, waitpid, exec Deadlocks-System Model, Dead locks Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, and Recovery from Deadlock

UNIT-III:
Process Management and Synchronization –The Critical Section Problem, Synchronization Hardware, Semaphores, and Classical Problems of Synchronization, CriticalRegions, Monitors

UNIT–IV:
Inter process Communication Mechanisms: IPC between processes on a single computer system, IPC between processes on different systems, using pipes, FIFOs, message queues, shared memory.

UNIT– V:
Memory Management and Virtual Memory-Logical versus Physical Address Space, Swapping, Contiguous Allocation, Paging, Segmentation, Segmentation with Paging, Demand Paging, Page Replacement, Page Replacement Algorithms

TEXT BOOKS:

1. Operating System Principles-Abraham Silberchatz, PeterB.Galvin, Greg Gagne, 7thEdition, JohnWiley.
2. Advanced programming in the UNIX environment, W.R.Stevens, Pearson education.

REFERENCE BOOKS:

1. Operating Systems- Internals and Design Principles, William Stallings, Fifth Edition–2005, Pearson Education / PHI
2. Operating System a Design Approach-Crowley, TMH.
3. Modern Operating Systems, Andrew S. Tanenbaum 2nd edition, Pearson/PHI
4. UNIX programming environment, Kernighan and Pike, PHI/ Pearson Education
5. UNIXInternals-TheNew Frontiers, U. Vahalia, PearsonEducation.

COURSEOUTCOMES:

1. Demonstrate the knowledge of the components of computers and their respective roles in computing.
2. Explain CPU Scheduling Algorithms and explain the methods for handling Deadlocks.
3. Explain Process Management and Synchronization and Demonstrate Inter process Communication.
4. Analyze various Memory Management and Allocation Methods.
5. Discuss File System Interface and Operations

CO-POMAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1											
CO2	1	2	2	2								
CO3	1	2	2	2								
CO4	1	2	2	2								
CO5	1	2	2	2								

(A403601) FUNDAMENTALS OF ENGINEERING MATERIALS
(Open Elective-I Offered by Mechanical Department)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT–I:

Structure of Metals: Crystallography, Miller's indices, Packing Efficiency, Density calculations, Grains and Grain Boundaries, Effect of grain size on the properties, Determination of grain size by different methods. Constitution ofAlloys: Necessity of alloying, Types of solid solutions, Hume – Rothery rules, Intermediate alloy phases.

UNIT–II:

Phase Diagrams: Construction and interpretation of phase diagrams, Phase rule, and Lever rule, Binary phase Diagrams, Isomorphous, Eutectic and Eutectoid transformations with examples.

UNIT–III:

Steels: Iron-Carbon Phase Diagram and Heat Treatment: Study of Fe-Fe3C phase diagram. Construction of TTT diagrams. Annealing, Normalizing, Hardening and Tempering of steels, Hardenability. Alloy steels.

UNIT–IV:

Cast Irons: Structure and properties of White Cast iron, Malleable Cast iron, Grey cast iron. EngineeringMaterials-III: Non-ferrous Metals and Alloys: Structure and properties of copper and its alloys, Aluminium and its alloys, Al-Cu phase diagram, Titanium and its alloys.

UNIT–V:

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

TEXT BOOKS:

1. Material Science and Metallurgy / Kodgire
2. Essentials of Materials Science and engineering / Donald R.Askeland / Thomson.

REFERENCE BOOKS:

1. Introduction to Physical Metallurgy / Sidney H.Avner.
2. Materials Science and engineering / William and callister.
3. Elements of Material science / V.Rahghavan

COURSE OUTCOMES:

At the end of the course the students are able to:

1. Identify the crystalline structure of steel.
2. Understand the theory of time temperature and transformation
3. Determine of different uses of heat treatment in steel.
4. Distinguish between the various forms of steel.
5. Understand the properties of non-ferrous alloys and uses of composite materials.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2				1						1
CO2	3	2				1						1
CO3	3	2				1						1
CO4	3	2				1						1
CO5	3	2				1						1

(A403602) BASICS OF THERMODYNAMICS
(Open Elective-I Offered by Mechanical Department)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT–I:

Introduction: Basic Concepts: System, Control Volume, Surrounding, Boundaries, universe, Types of Systems, Macroscopic and Microscopic view points, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & In exact Differentials, Cycle, Reversibility – Quasi – static Process, Irreversible Process, Causes of Irreversibility.

UNIT-II:

Types, Displacement & Other forms of Work, Heat, Point and Path functions, Zeroth Law of Thermodynamics – Concept of Temperature – Principles of Thermometry – Reference Points –Const. Volume gas Thermometer – Scales of Temperature, Ideal Gas Scale.

UNIT–III:

First and Second Laws of Thermodynamics: First Law: Cycle and Process, Specific Heats (cp and cv), Heat interactions in a Closed System for various processes, Limitations of First Law, Concept of Heat Engine (H.E.) and Reversed H.E. (Heat Pump and Refrigerator), Efficiency/COP, Second Law: Kelvin-Planck and Clausius Statements, Carnot Cycle, Carnot Efficiency, Statement of Clausius Inequality, Property of Entropy, T-Sand P-V Diagrams

UNIT-IV:

Mixtures of perfect Gases – Mole Fraction, Mass friction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Laws of additive volumes – Mole fraction, Volume fraction and partial pressure, Equivalent Gas const. Atmospheric air – Psychrometric Properties–Dry bulbTemperature, Wet Bulb Temperature, Dew point Temperature, Specific Humidity, Relative Humidity, saturated Air, Vapour pressure, Degree of saturation – Adiabatic Saturation, Psychrometric chart

UNIT-V:

Power Cycles: Otto, Diesel cycles - Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis

RefrigerationCycles: Bell-Coleman cycle, Vapour compression cycle – performance Evaluation.

TEXT BOOKS:

1. Basic Engineering Thermodynamics / PK Nag / McGraw Hill
2. Engineering Thermodynamics / chattopadhyay / Oxford

REFERENCE BOOKS:

1. Thermodynamics for Engineers / Kenneth A.Kroos, Merle C.Potter / Cengage
2. Thermodynamics / G.C.Gupta / Pearson

COURSE OUTCOMES:

After completing this course, the students will be able to

1. Apply energy balance to systems and control volumes, insituations involving heat and work interactions.
2. Evaluate changes in thermometric properties of substances.
3. Apply the laws of thermodynamics to different systems.
4. Understand the psychrometric properties of air
5. Compare different air standard cycles.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	2	1	2	-	2	-	-	2
CO2	3	3	2	3	3	1	2	-	2	-	-	2
CO3	3	3	1	3	1	1	2	-	2	-	-	2
CO4	3	3	1	3	1	1	2	-	2	-	-	2
CO5	3	3	1	3	2	1	2	-	1	-	-	2

(A400601) BASICS OF LOGISTICS AND SUPPLY CHAIN MANAGEMENT
(Open Elective-I Offered by MBA)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT–I:

Understanding Supply Chain: Objectives of a Supply Chain, Importance, Stages ofSupply Chain, Value Chain Process, Cycle View of Supply Chain Process, Key Issues in SCM, Logistics & SCM, Supply Chain Drivers and Obstacles, Supply Chain Strategies, Strategic Fit, Best Practices in SCM, Obstacles of Streamlined SCM, Green Supply Chain Management, Supply Chain Sustainability.

UNIT–II:

Logistics: Evolution, Objectives, Components and Functions of Logistics Management, Difference between Logistics and Supply Chain, Distribution related Issues and Challenges, Gaining Competitive Advantage through Logistics Management, Transportation: Functions, Costs, and Mode of Transportation Network and Decision, Models, Containerization, Cross Docking, Reverse Logistics. Outsourcing: Nature and Concept, Strategic Decision to out sourcing, Third-party Logistics (3PL), Fourth-party Logistics (4PL).

UNIT–III:

Designing the Supply Chain Network: Designing the Distribution Network, Role of Distribution, Factors Influencing Distribution, Design Options, e-Business and its Impact, Distribution Networks in Practice, Network Design in the Supply Chain, Role of Network, Factors Affecting the Network Design Decisions, Modeling for Supply Chain

UNIT–IV:

Supply Chain Performance: Bullwhip Effect and Reduction, Performance Measurement: Dimension, Tools of Performance Measurement, SCOR Model. Demand Chain Management, Global Supply Chain, Challenges in Establishing Global Supply Chain, Factors that influence Designing Global Supply Chain Network.

UNIT–V:

Coordination in a Supply Chain: Importance of Coordination, Lack of Supply Chain Coordination and the Bullwhip Effect, Obstacles to Coordination, Managerial Levels, Building Partnerships and Trust, Continuous Replenishment and Vendor Managed Inventories, Collaborative Planning, Forecasting and Replenishment. Role of Information Technology in Supply Chain, Supply Chain 4.0

TEXT BOOKS:

1. IMT Ghaziabad Advanced Supply Chain Management, Sage Publications, 2021.
2. Rajat K. Basiya, Integrated Supply Chain Management, Sage Publications, 2020.

REFERENCE BOOKS:

1. K Sridhara Bhat, Logistics & Supply Chain Management, HPH, 1e, 2017.
2. Chopra, Sunil, Meindl, Peter and Kalra, D. V, Supply Chain Management: Strategy, Planning and Operation; Pearson Education, 6e, 2016.
3. Donald J. Bowersox and David J. Closs, Logistical Management" The Integrated Supply Chain Process, TMH, 2017
4. Sunil Chopra and Peter Meindl, Supply chain Management: Strategy, Planning and Operation, Pearson Education, New Delhi 2013

COURSE OUTCOMES:

Students will be able to:

1. Understand the cyclical perspective of logistics and supply chain process.
2. Learn about the distribution, transportation, warehousing related issues and challenges in supply chain.
3. Appreciate the significance of network design in the supply chain.
4. Gain knowledge of various models/tools of measuring the Supply Chain Performance.
5. Appreciate the role of coordination and technology in supply chain management

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	2	2	2	2	-	-	-
CO2	3	2	3	-	-	2	2	-	-	3	-	2
CO3	-	3	3	2	3	3	2	-	3	-	-	-
CO4	-	-	-	2	3	3	-	-	-	-	3	-
CO5	-	-	-	-	3	-	2	2	3	-	3	2

(A400602) INDUSTRIAL RELATIONS
(Open Elective-I Offered by MBA)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT-I:
Overview of Industrial Relations: Meaning & Objectives, Scope, Importance, Approaches to Industrial Relations – Role of Three Actors to Industrial Relations – State, Employer & Employees, Causes for poor IR, Developing sound IR. Ethical approach to IR: Idea of trustee ship Principles & features, Code of conduct, the industrial policy resolution 1991, ILO in IR. Collective Bargaining (Perspective, Bargaining Structure, Procedure and Machinery for Collective Bargaining) – The Bargaining Process – Strengths and Skills

UNIT-II:
Lawson Industrial Relations: The Trade Union Act 1926: Role & function of Trade union, Registration, Rights and privileges, Duties, Dissolution of Trade Unions. Industrial Disputes Act 1947: Strike, Lockout, Layoff, Retrenchment, Grievance and disciplinary procedures, Penalties, Causes, Tripartite & Bipartite Bodies, Grievance Procedure. Industrial Employment Act, 1946: Information in standing orders, Procedure for submission

UNIT-III:
Lawson Wages, Welfare and Social Security: Minimum Wages Act, 1948, Payment of Wages Act, 1936, Payment of Bonus Act, 1965 Lawson Labour Welfare: The Workmen's Compensation Act, 1923, The Employees' State Insurance Act, 1948, The Maternity Benefit Act, 1961. Lawson Social Security: The Employee's Provident Fund Act, 1952, The Payment of Gratuity Act, 1972.

UNIT-IV:
Laws on Working Conditions: Factories Act, 1948: Health, Welfare, Safety, Working Hours, Annual Leave with wages, Registers and Records. Contract Labour (Regulation and Abolition) Act, 1986 – Child Labour (Prohibition and Regulation Act, 1986)

UNIT-V:
Quality of Work Life and Quality Circles: Meaning of quality of work life – Quality Circles-Objectives- Process, Structure and problems- workers participation in management and qualitycircles– Concept of empowerment.

TEXT BOOKS:

1. Arun Monappa (2020). Industrial Relations, NewDelhi: Tata McGraw-Hill Publishing Company Ltd.
2. Mamoria C.B, Mamoria G. (2021). Dynamics of Industrial Relations. NewDelhi: Himalayan Publications,

REFERENCE BOOKS:

1. Padhi P.K. (2012), Labour & Industrial Laws, New Delhi: PHI Learning P.Ltd.
2. Kapoor N.D (2014), Elements of Mercantile Law, New Delhi: S.Chand & Co.
3. Subramani PN & Rajendran. G (2001), Human Resources Management and Industrial Relations, New Delhi: Himalaya Publishing House.
4. Pylee PV & A Simon George (2007), Industrial relations and personnel Management, New Delhi: Vikas Publishing House Pvt. Ltd., New Delhi.

COURSE OUTCOMES:
1. Access the concept and Scope of Industrial Relations and its resolution.
2. Outline the knowledge towards Trade unions, Industrial disputes and Grievance Procedure.
3. Identify various Laws on Wages, Welfare and Social Security.
4. Illustrate rules and regulations of working conditions.
5. Enlighten on quality standards in industry

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	2	2	3		-	-	-
CO2	-	-	-	-	-	2	2	3	2	2	-	-
CO3	1	-	-	-	-	-	-	-	2	2	-	3
CO4	-	-	-	-	-	2	2	2	2	-	-	-
CO5	-	-	-	-	-	2	-	-	3	-	-	-

(A401601) DISASTER PREPAREDNESS & PLANNING MANAGEMENT
(Open Elective–I offered by Civil Department)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT-I:
Introduction- Concepts and definitions: disaster, hazard, vulnerability, resilience, risksseverity, frequency and details, capacity, impact, prevention, mitigation.

UNIT-II:
Disasters - Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); man made disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

UNIT-III:
Disaster Impacts - Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT-IV:
Disaster Risk Reduction (DRR) - Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); Roles and responsibilities of government, community, local institutions, NGOs and other stake holders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

UNIT-V:
Disasters, Environment and Development – Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

TEXT BOOKS:
1. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
2. Singh B.K., 2008, Handbook of Disaster Management: Techniques &Guidelines, Rajat Publication.
3. Ghosh G.K, 2006, Disaster Management, APH Publishing Corporation

REFERENCE BOOKS:
1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
3. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June2003
4. Inter-Agency Standing Committee (IASC) (Feb.2007) IASC Guide lines on Mental Health and Psychosocial Support in Emergency Settings, Geneva:IASC

COURSE OUTCOMES:
At the end of the course the students are able to:
1. Analyze impact of disasters
2. Identify the natural and manmade disasters and its vulnerability
3. Relate the disaster impacts at national and global context
4. Develop strategies to cope up with disasters.
5. Build disaster management plan

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	1	2	2	-	3	2	1	3
CO2	3	3	2	2	1	2	2	-	3	2	1	3
CO3	3	3	2	2	1	2	2	-	3	2	1	3
CO4	3	3	2	2	1	2	2	-	3	2	1	3
CO5	3	3	2	2	1	2	2	-	3	2	1	3

(A401602) ENVIRONMENTAL IMPACT ASSESSMENT
(Open Elective–I Offered by Civil Department)

B. Tech. (ME): VII Semester

L	T	P	C
3	0	0	3

UNIT-I:
Introduction: The Need for EIA, Indian Policies Requiring EIA, The EIA Cycle and Procedures, Screening, Scoping, Base line Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Public Hearing, Decision Making, Monitoring the Clearance Conditions, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements.

UNIT-II:
EIA Methodologies: Environmental attributes - Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation & Evaluation, impact communication, Methods – Adhoc methods, Check lists methods, Matrices methods, Networks methods, Over lays methods. EIA review - Baseline Conditions – Construction Stage Impacts, post project timpacts.

UNIT-III:
Environmental Management Plan: EMP preparation, Monitoring Environmental Management Plan, Identification of Significant or Unacceptable Impacts Requiring Mitigation, Mitigation Plans and Relief & Rehabilitation, Stipulating the Conditions, Monitoring Methods, Pre-Appraisal and Appraisal.

UNIT-IV:
Environmental Legislation and Life cycle Assessment: Environmental laws and protection acts, Constitutional provisions-powers and functions of Central and State government, The Environment (Protection) Act 1986, The Water Act 1974, The Airact 1981, Wild Life act 1972, Guide lines for control of noise, loss of biodiversity, solid and Hazardous waste management rules. Life cycle assessment: Life cycle analysis, Methodology, Management, Flow of materials – cost criteria case studies.

UNIT-V:
Case Studies: Preparation of EIA for developmental projects - Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Nuclear fuel complex, High way project, Sewage treatment plant, Municipal Solid waste processing plant, Airports.

TEXT BOOKS:

1. Anjaneyulu.Y and Manickam.V., Environmental Impact Assessment Methodologies, B.S.Publications, Hyderabad, 2007
2. Barthwal R.R, Environmental Impact Assessment, New Age International Publishers, 2002

REFERENCE BOOKS:

1. Jain R.K, Urban L.V, Stracy G.S, Environmental Impact Analysis, Van Nostrand Reinhold Co., New York, 1991.
2. Rau J.G and Wooten D.C., Environmental Impact Assessment, McGraw Hill Pub. Co., New York,1996

COURSE OUTCOMES:
On completion of the course students will be able to

1. Identify the attributes to be considered for EIA
2. Assess impact of deforestation
3. Interpret impact prediction, significance of soil quality and mitigation
4. Conduct environmental audit and prepare reports
5. Illustrate environmental policies and provisions

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	2	-	-	2	-	3	2	-	3
CO2	3	1	-	2	-	-	2	-	3	2	-	3
CO3	3	1	-	2	-	-	2	-	3	2	-	3
CO4	3	1	-	2	-	-	2	-	3	2	-	3
CO5	3	1	-	2	-	-	2	-	3	2	-	3

(A403803) MAJOR PROJECT PHASE - I

B. Tech. (ME): VII Semester

L	T	P	C
0	0	6	3

(A403421) INDUSTRY 4.0
(Professional Elective-VI)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT – I:

Industry 4.0 Basics: Industrial revolution: Phases, Evolution of Industry4.0, Environmental impacts of industrial revolution, Applications, Design requirements, Drivers of Industry4.0, Sustainability Assessment of industries, Smart Business Perspective, Cyber security, Impacts of Industry 4.0.

UNIT – II:

Industrial Internet of Things- Basics: IIoT and Industry 4.0, IIC, Industrial Internet Systems, Design of industrial internet systems, Impact of industrial internet, Benefits of industrial internet, Industrial sensing, Industrial Processes, Features of IIoT for industrial processes, Industrial plant–The future architecture, Digital Enterprise

Business Models and Reference Architecture of IIoT: Definition of a business model, Business models of IIoT, Industrial Internet Reference Architecture

UNIT –III:

Key Technologies: Off-site Technologies, Cloud Computing, Fog Computing Key Technologies: On-site Technologies, Augmented Reality, Virtual Reality, Smart factories, Lean manufacturing system, Big Data and Advanced Analytics

UNIT –IV:

Sensors: Various sensor types and their underlying working principles, Characteristics of Sensors – Resolution, calibration, accuracy and others, Sensor Categories – Thermal, Mechanical, Electrical, Optical and Acoustic sensors.

Actuators: Thermal, Hydraulic, Pneumatic, Electro mechanical Actuator

UNIT – V:

Industrial Data Transmission and Acquisition: Architecture of various data transmission technologies like Foundation Fieldbus, Profibus, Highway Addressable Remote Transducer (HART), Interbus, Bitbus, Digital STROM, Controller Area Network, and other recent and upcoming Technologies. Distributed Control System, SCADA and PLC System.

IIOT Applications: IoT Applications on Industrial automation, Factories and Assembly line, Plant Security and Safety, Transportation, Agriculture, Healthcare, Home Automation, Oil, Chemical and Pharmaceutical Industry and others.

TEXT BOOKS:

1. Introduction to Industrial Internet of Things and Industry 4.0 by Sudip Misra, Chandana Roy, Anandarup Mukherjee, CRC Press
2. Vijay Madisetti, Arshdeep Bahga, Internet of Things, “A Hands-on Approach”, University Press.

REFERENCE BOOKS:

1. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs
2. Pethuru Raj and Anupama C. Raman, “The Internet of Things: Enabling Technologies, Platforms, and Use Cases”, CRC Press
3. Adrian McEwen, “Designing the Internet of Things”, Wiley.
4. Raj Kamal, “Internet of Things: Architecture and Design”, McGraw Hill.
5. Cuno Pfister, “Getting Started with the Internet of Things”, O Reilly Media

COURSE OUTCOMES: After completion of the course the student will be able to

1. Explain Smart Business Perspective, Cyber security, Impacts of Industry 4.0.
2. Understand the basics of the Industrial Internet of Things.
3. Understand various key technologies.
4. Implement various sensors and actuators.
5. Understand different industrial transmission technologies and IIOT applications in real life

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	3			2	2	2		3
CO2	2	2	2	3	3			2	2	2		3
CO3	2	2	2	3	3			2	2	2		3
CO4	2	2	2	3	3			2	2	2		3
CO5	2	2	2	3	3			2	2	2		3

(A403422) ELECTRIC AND HYBRID VEHICLES

(Professional Elective-VI)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT- I:

Introduction To Electric Vehicle: History of Electric Vehicles, Development towards 21st Century, Types of Electric Vehicles in use today – Battery Electric Vehicle, Hybrid (ICE & others), Fuel Cell EV, Solar Powered Vehicles. Motion and Dynamic Equations of the Electric Vehicles: various forces acting on the Vehicle in static and dynamic conditions.

UNIT- II:

Introduction To Hybrid and Electric Vehicles: Social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid Drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis

UNIT- III:

Electric Drive Trains: Basic concept of electric traction, introduction to various electric drivetrain topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency

UNIT- IV:

Types of Storage Systems: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Calculation for the rating.

UNIT- V:

Modelling of Hybrid Electric Vehicle Range: Driving Cycles, Types of Driving Cycles, Range modelling for Battery Electric Vehicle, Hybrid (ICE & others), Fuel Cell EV, Solar Powered Vehicles. Case study of 2 wheeler, 3 wheeler and 4 wheeler vehicles.

TEXT BOOKS

1. James Larminie, J. Lowry, “Electric Vehicle Technology Explained”, John Wiley & Sons Ltd. 2003.
2. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell
3. Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.

REFERENCE BOOKS

1. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2016.
2. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2010

COURSE OUTCOMES: At the end of the course student will be able to

1. Choose the appropriate source of energy for the hybrid electric vehicle based on driving cycle.
2. Analyze the power and energy need of the various hybrid electric vehicle and Measure and Estimate the energy consumption of the Hybrid Vehicles
3. Evaluate energy efficiency of the vehicle for its drive trains
4. Elaborate the types of storage systems such as battery based, fuel cell based etc.
5. Explain the types of Driving Cycles, Fuel Cell EV, Solar Powered Vehicles

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2		1	2	2				1	2
CO2	2	1	2		1	2	2				1	2
CO3	2	1	2		1	2	2				1	2
CO4	2	1	2		1	2	2				1	2
CO5	2	1	2		1	2	2				1	2

(A403423) TOTAL QUALITY MANAGEMENT
(Professional Elective-VI)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT - I Introduction: The concept of TQM, Quality and Business performance, attitude, and involvement of top management, communication, culture and management systems. Management of Process Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs. Process Control, Statistical Quality Control, Control Charts and Acceptance Sampling.

UNIT - II Customer Focus and Satisfaction: Process vs. Customer, internal customer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships. Bench Marking: Evolution of Bench Marking, meaning of bench marking, benefits of bench marketing, the bench marking procedure, pitfalls of bench marketing.

UNIT - III Organizing for TQM: The systems approach, organizing for quality implementation, making the transition from a traditional to a TQM organization, Quality Circles, seven Tools of TQM: Stratification, check sheet, Scatter diagram, lshikawa diagram, paneto diagram, Kepner &Tregoe Methodology.

UNIT - IV The Cost of Quality: Definition of the Cost of Quality, Quality Costs, Measuring Quality Costs, use of Quality Cost information, Accounting Systems and Quality Management.

UNIT - V ISO 9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQC Q- 90. Series Standards, benefits of ISO 9000 certification, the third party audit, Documentation ISO9000 and services, the cost of certification implementing the system.

TEXT BOOKS:

1. Total Quality Management / Joel E. Ross/Taylor and Francis Limited
2. Total Quality Management/P. N. Mukherjee/PHI

REFERENCE BOOKS:

1. Beyond TQM / Robert L. Flood.
2. Statistical Quality Control / E. L. Grant.
3. Total Quality Management: A Practical Approach/H. Lal.
4. Quality Management/Kanishka Bedi/Oxford University Press/2011.
5. Total Engineering Quality Management/Sunil Sharma/Macmillan.

COURSE OUTCOMES:

Upon successful completion of the course, student will be able to:

1. Attain the basic techniques of quality improvement, quality standards.
2. Acquire basic knowledge on customer focus and satiosfaction.
3. Organize TQM
4. Describe cost of quality
5. Describe the concepts of ISO 9000

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2		2				1	1	2		2
CO2	1	2		2				1	1	2		2
CO3	1	2		2				1	1	2		2
CO4	1	2		2				1	1	2		2
CO5	1	2		2				1	1	2		2

(A403424) Fuzzy Logic and ANN
(Professional Elective-VI)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:

Evolution of neural networks: Artificial Neural Network: Basic model, Classification, Feed forward and Recurrent topologies, Activation functions; Learning algorithms: Supervised, Un-supervised and Reinforcement; Fundamentals of connectionist modeling: McCulloch – Pits model, Perceptron, Adaline, Madaline.

UNIT–II:

Topology of Multilayer perceptron, Back propagation learning algorithm, limitations of Multilayer perceptron. Radial Basis Function networks: Topology, learning algorithm; Kohenen's self-organising network: Topology, learning algorithm; Bidirectional associative memory Topology, learning algorithm, Applications.

UNIT–III:

Recurrent neural networks: Basic concepts, Dynamics, Architecture and training algorithms, Applications; Hopfield network: Topology, learning algorithm, Applications; Industrial and commercial applications of Neural networks: Semiconductor manufacturing processes, Communication, Process monitoring and optimal control, Robotics, Decision fusion and pattern recognition.

UNIT–IV:

Classical and fuzzy sets: Introduction, Operations and Properties, Fuzzy Relations: Cardinality, Operations and Properties, Equivalence and tolerance relation, Value assignment: cosine amplitude and max-min method; Fuzzification: Membership value assignment- Inference, rank ordering, angular fuzzy sets. Defuzzification methods, Fuzzy measures, Fuzzy integrals, Fuzziness and fuzzy resolution; possibility theory and Fuzzy
arithmetic; composition and inference; Considerations of fuzzy decision-making.

UNIT-V:

Basic structure and operation of Fuzzy logic control systems: Design methodology and stability analysis of fuzzy control systems; Applications of Fuzzy controllers. Applications of fuzzy theory.

TEXT BOOKS:

1. Neural Networks in Computer Intelligence by Limin Fu, McGraw Hill, 2003.
2. Soft Computing and Intelligent Systems Design, Theory, Tools and Applications by Fakhreddine O. Karray and Clarence De Silva., Pearson Education, India, 2009.

REFERENCE BOOKS:

1. Fuzzy Logic with Engineering Applications by Timothy J. Ross, McGraw Hill, 1995.
2. Artificial Neural Networks by B. Yegnanarayana, PHI, India, 2006.

COURSE OUTCOMES: After completion of this course, the student will be able to

1. Describe the concepts of neural networks and fuzzy logics
2. Describe the topology of multi-layer perceptron, recurrent neural networks and
3. Describe the topology of recurrent neural networks
4. Describe the topology of Fuzzification & Defuzzification.
5. Describe the basic structure and operation of Fuzzy logic control systems

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		2	1	2				2	1		2
CO2	2		2	1	2				2	1		2
CO3	2		2	1	2				2	1		2
CO4	2		2	1	2				2	1		2
CO5	2		2	1	2				2	1		2

(A404603) SENSORS & TRANSDUCERS
(Open Elective-II Offered by ECE Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT–I:
Introduction: Definition, principle of sensing & transduction, classification.
Mechanical and Electro mechanical sensor: Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity. Strain gauge: Theory, type, materials, design consideration, sensitivity, gauge factor, variation with temperature, adhesive, rosettes. Inductive sensor: common types - Reluctance change type, Mutual inductance change type, Magneto strictive type, material, construction and input output variable, Ferromagnetic plunger type, short analysis.

UNIT–II:
Capacitive sensors: variable distance – parallel plate type, variable area – parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type, calculation of sensitivity, Proximity sensor and Stretched diaphragm type: microphone, response characteristics. Piezo electric element: piezo electric effect, charge and voltage co-efficient, crystal model, materials, natural & synthetic type, their comparison, force & stress sensing, ultrasonic sensors.

UNIT–III:
Thermal sensors: Resistance change type: RTD materials, tip sensitive & stem sensitive type, Thermistor material, shape, ranges and accuracy specification. Thermo emf sensor: types, thermoelectric power, general consideration, Junction semiconductor type IC and PTA Ttype. Radiation sensors: types, characteristics and comparison, Pyroelectric type.

UNIT–IV:
Magnetic sensors: Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics. Radiation sensors: LDR, Photovoltaic cells, photo diodes, photo emissive cell types, materials, construction, response, Geigercounters, Scintillation detectors.

UNIT–V:
FilmSensors: Thick film and thin film types, Electro analytic sensors – Electro chemical cell, Polarization types, and membrane electrode types. Biosensors, Smart/Intelligent sensors, Nano-sensors, Nano-tube sensors, molecular and quantum sensors

TEXT BOOKS:
1. Sensor & transducers, D. Patranabis, 2nd edition, PHI
2. Instrument transducers, H.K.P. Neubert, Oxford University press.
3. Measurement systems: application & design, E.A. Doebelin, McGraw Hill.

REFERENCE BOOKS:
1. Sensor andTransducers, Third Edition, Ian Sinclair, Newnes.
2. Sensor Technology, Hand Book, JONS Wilson, Newnes ELSEVIER.
3. Sensorand Transducers, Characteristics, Applications, Instrumentation, Interfacing, Second Edition, M.J. Usher and D.A. Keating, MACMILLAN Press Ltd.

COURSE OUT COMES:
At the end of the course the student will be able to:
1. Explain the basic concepts of mechanical and electro mechanical sensors, their electrical characteristics.
2. Analyze various capacitor sensors, ultrasonic sensors their electrical characteristics.
3. Compare and elaborate various thermal sensors, principle of operation.
4. Distinguish various magnetic sensors based on their operations, radiation sensors and their operation.
5. Analyze various film sensors and operation of different nano sensors and their applications.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										1
CO2	3	2										1
CO3	3	2										1
CO4	3	2										1
CO5	3	2										1

(A404604) IMAGE PROCESSING
(Open Elective-II Offered by ECE Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:
Digital Image fundamentals: Digital Image fundamentals, Components of Digital Image Processing, Sampling and Quantization, Relationship between pixels. ImageTransforms: 2-DFFT, Properties, Walsh transform, Hadamard Transform, Discrete Cosine Transform, Haar Transform.

UNIT-II:
Image Enhancement (Spatial Domain): Introduction, Image Enhancement in Spatial domain, Enhancement through point operation, Types of point operation, Histogram manipulation, Linear and nonlinear gray level Transformation, Local or neighborhood operation, Median filter, image Smoothing & Sharpening
Image Enhancement (FrequencyDomain): Filtering in Frequency domain, obtaining frequency domain filters from spatial filters, generating filters directly in the frequency domain, image Smoothing & Sharpening.

UNIT-III:
Image Restoration: Degradation model, Algebraic approach to restoration, Inverse filtering, least mean square filters, Constrained Least Squares Restoration.

UNIT-IV:
ImageSegmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region oriented segmentation. Morphological Image Processing: Dilation and Erosion, Structuring Element Decomposition, Opening and Closing, the Hitor MissTransformation.

UNIT-V:
Image Compression: Redundancies and their removal methods, Fidelity criteria, Image compression models, Huffman and Arithmetic Coding, Error free compression, Lossy compression, Lossy and Lossless Predictive Coding, Transform based Compression, JPEG 2000 Standards.

TEXT BOOKS:
1. Digital Image Processing – Rafael C.Gonzalez, Rechard E.Woods, 3rd edition. Pearson, 2008
2. Digital Image Processing – S.Jayaraman, S Esakkirajan, T Veerakumar - TMH, 2010

REFERENCE BOOKS:
1. Digital Image Processing using MATLAB – Rafael C.Gonzalez, Richard Ewoods and Steven L.Eddings,2nd Edition, TMH, 2010.
2. Fundamentals of Digital Image Processing – A.K.Jain, PHI, 1989.
3. Digital Image processing and Computer vision – Somka, Hlavac, Boyle Cengage learning (Indianedition) 2008.
4. Introductory Computer vision Imaging Techniques and Solutions – Adrianlow, 2008, 2nd Edition.
5. Introduction to Image Processing & Analysis – John C.Russ, J.Christian Russ, CRC press, 2010.

COURSE OUTCOMES:
At the end of the course the student will be able to:
1. Describe the fundamentals of digital image processing.
2. Distinguish between spatial domain enhancement and frequency domain enhancement.
3. Explain various image degradation models for image restoration.
4. Analyze the image restoration and segmentation methods.
5. Discriminate between lossless and lossy compression techniques.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										1
CO2	3	3										1
CO3	3	3	2									1
CO4	3	3	2									1
CO5	3	3	2									1

(A402603) ELECTRIC VEHICLE TECHNOLOGY
(Open Elective–II offered by EEE Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

Prerequisites: Basics of Electrical Engineering (or equivalent subject)

UNIT-I:
Introduction to Hybrid Electric Vehicle: Review of Conventional Vehicle: Introduction to Hybrid Electric Vehicles: Types of EVs, Hybrid Electric Drive-train, Tractive effort in normal driving

UNIT-II:
Electric Drives: Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains, Electric Propulsion unit, Configurationand control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, switched reluctancemotor

UNIT-III:
Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles:-Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices, Sizing the drive system, Design of Hybrid Electric Vehicle and Plug-in Electric Vehicle.

UNIT-IV:
Energy Management System: Energy Management Strategies, Automotive networking and communication, EV charging standards, V2G, G2V, V2B, V2H. Business: E-mobility business, electrification challenges, Business -E-mobility business, electrification challenges.

UNIT-V:
Mobility and Connectors: Connected Mobility and Autonomous Mobility - case study Emobility Indian Road map Perspective. Policy: EVs in infrastructure system, integration of Evs in smart grid, social dimensions of Evs. Connectors - Types of EV charging connector, North American EV Plug Standards, DC Fast Charge EV Plug Standards in North America, CCS (Combined Charging System), CHA deMO, Tesla, European EV Plug Standards.

TEXT BOOKS:
1. Emadi A. (Ed.), Miller J., Ehsani M., “Vehicular Electric Power Systems” Boca Raton, CRC Press, 2003
2. Husain I. “Electric and Hybrid Vehicles” Boca Raton, CRC Press, 2010.

REFERENCE BOOKS:
1. Larminie James and John Lowry, “Electric Vehicle Technology Explained” John Wiley and Sons, 2012
2. Tariq Muneer and Irene Illescas García, “The automobile, In Electric Vehicles: Prospects and Challenges”, Elsevier, 2017
3. Sheldon S.Williamson, “Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles”, Springer, 2013

COURSE OUTCOMES:
On completion of the course, students will be able to
1. Explain Hybrid Electric Vehicle technology
2. Understand the operation of various Electric Drives used in Hybrid Electric Vehicle
3. Illustrate various energy storage techniques in Hybrid Electric Vehicle
4. Gain Knowledge on Energy Management Strategies in Hybrid Electric Vehicle
5. Understand the different types of Mobility and Connectors in Hybrid Electric Vehicle

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3								2		
CO2	3	3								2		
CO3	3	3								2		
CO4	3	3								2		
CO5	3	3								2		

(A402604) BASICS OF POWER PLANT ENGINEERING
(Open Elective–II offered by EEE Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:
Coal Based Thermal Power Plants: Basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems.

UNIT-II:
Gas Turbine and Combined Cycle Power Plants: Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

UNIT-III:
Basics of Nuclear Energy Conversion: Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclearpowerplants.

UNIT-IV:
Hydro electric Power Plants: Classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems

UNIT-V:
Energy, Economic and Environmental Issues: Power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

TEXT BOOKS:
1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.

REFERENCE BOOK:
1. Elliot T.C, Chen Kand Swanekamp R.C, Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

COURSE OUTCOMES:
On completion of the course, students will be able to
1. Understand the layout and various components of Coal Based Thermal Power Plants
2. Understand the operation of Gas Turbine and Combined Cycle Power Plants
3. Illustrate the Nuclear Energy Conversion system
4. Explain the operation and Classification, typical layout and components of Hydro electric Power Plants
5. Understand the different parameter sassociated with Energy, Economic and Environmental Issues

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1					2			
CO2	2	2	2	1					2			
CO3	3	3	3	1					2			
CO4	3	3	3	1					2			
CO5	2	2	2	1					2			

(A405601) FUNDAMENTALS OF DATA BASE MANAGEMENT SYSTEMS
(Open Elective-II Offered by CSE Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:

Introduction to Databases: Introduction, Traditional File-Based Systems, Database Approach, Roles in the Database Environment, Advantages and Disadvantages of DBMS, The Three-Level ANSI-SPARC Architecture, Database Languages, Data Models, Functions of a DBMS, Components of DBMS. Relational Model: Introduction, Terminology, Integrity Constraints, Views. The Relational Algebra: Unary Operations, Set Operations, Join Operations, Division Operation, Aggregation and Grouping Operations.

UNIT–II:

SQL: The ISO SQL Data Types, Integrity Enhancement Feature–Domain Constraints, Entity Integrity, Referential Integrity, General Constraints, Data Definition–Creating a Database, creating a Table, changing a Table Definition, removing a Table, Creating an Index, Removing an Index, Views–Creating a View, Removing a View, View Resolution, Restrictions on Views, View Updatability 'WITH CHECK OPTION', Advantages and Disadvantages of Views, View Materialization.

UNIT–III:

SQL: Introduction, Data Manipulation–Simple Queries, Sorting Results, Using the SQL Aggregate Functions, Grouping Results, Sub-queries, ANY and ALL, Multi-table Queries, EXISTS and NOT EXIST, Combining Result Tables, Database Updates.

UNIT-IV:

Advanced SQL: The SQL Programming Language–Declarations, Assignments, Control Statements, Exceptions, Cursors, Subprograms, Stored Procedures, Functions, and Packages, Triggers, Recursion

UNIT–V:

Normalization: The Purpose of Normalization, How Normalization Supports Database Design, Data Redundancy and Update Anomalies, Functional Dependencies in brief, The Process of Normalization, 1NF, 2NF, 3NF, BCNF.

TEXT BOOKS:

1. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-Hill Education, 2003
2. Abraham Silberschatz, Henry F.Korth, S.Sudarshan, Database System Concepts, McGraw-Hill Education

REFERENCE BOOKS:

1. Thomas M. Connolly, Calyn E. Begg, Database Systems–A Practical Approach to Design, Implementation, and Management (6e), Pearson publisher
2. Ramez Elmasri, Shamkant B.Navathe, Fundamentals of Database Systems, Pearson publisher

COURSE OUTCOMES:

Students shall be able to

1. Describe Database Management System Architecture.
2. Create, update, and modify Relational Database Objects.
3. Manipulate data in Relational Database
4. Develop PL/SQL programs using Cursors, Subprograms, Stored Procedures, Functions, and Packages, Triggers.
5. Explain the purpose of normalization and types Normal forms.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**1**	**1**										
CO2	**2**	**2**	2	2	2							
CO3	**2**	**2**	2	2	2							
CO4	**2**	**2**	2	2	2							
CO5	**2**	**2**	2	2	2							

(A405605) WEB PROGRAMMING
(Open Electeive-II Offered by CSE Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:
Structuring Documents for the Web: Introducing HTML and XHTML, Basic Text Formatting, Presentational Elements, Phrase Elements, Lists, Editing Text, Core Elements and Attributes, Attribute Groups Links and Navigation: Basic Links, Creating Links with the **<a>** Element, Advanced E-mail Links. Images, Audio, and Video: Adding Images Using the **<img>** Element, Using Images as Links Image Maps, Choosing the Right Image Format, Adding Flash, Video and Audio to your web pages. Tables: Introducing Tables, Grouping Section of a Table, Nested Tables, Accessing Tables Forms: Introducing Forms, Form Controls, Sending Form Data to the Server Frames: Introducing Frameset, <frame> Element, Creating Links Between Frames, Settinga Default Target Frame Using **<base>** Element, Nested Frame sets, Inline or Floating Frames with **<iframe>**. Changing font size, color of text using <font> Element, scrolling text/image using <marquee> Element

UNIT-II:
Cascading Style Sheets: Introducing CSS, where you can Add CSS Rules. **CSS Properties**: Controlling Text, Text Formatting, Text Pseudo Classes, Selectors, Lengths, Introducing the Box Model. **More Cascading Style Sheets:** Links, Lists, Tables, Outlines, the: focus and: activate Pseudo classes Generated Content, Miscellaneous Properties, Additional Rules, Positioning and Layout with CSS, **Page Layout**: Understating the Site's Audience, Page Size, Designing Pages, Coding your Design, Developing for Mobile Devices. **Design Issues:** Typography, Navigation, Tables, Forms.

UNIT-III:
Learning Java Script: How to Add Script to Your Pages, the Document Object Model, Variables, Operators, Functions, Control Statements, Looping, Events, Built - In Objects, Working with Java Script: Practical Tips for Writing Scripts, Form Validation, Form Enhancements, Java Script Libraries, Putting your site on the web: Metatags, testing yoursite, taking the Leap to Live, Telling the World about your site, Understanding your visitors.

UNIT-IV:
XML-Introduction, XML Basics, Structuring Data, XML Name spaces, Document Type Definitions (DTDs), W3CXML Schema Documents, XML Vocabularies, Extensible Stylesheet Language and XSL Transformations, Document Object Model (DOM).

UNIT-V:
Ajax-Enabled Rich Internet Applications: introduction, history of Ajax, traditional web applications Vs Ajax Applications, RIAs with Ajax, Ajax example using XML Http Request object, XML and DOM, creating full scale Ajax-enabled application, Dojo Tool kit.

TEXT BOOK:
1. Jon Duckett, Beginning HTML, XTML, CSS and JavaScript
2. Dieteland Dietel: "Internet and World Wide Web – How to Program", 5th Edition, PHI/Pearson Education, 2011.

REFERENCE BOOKS:
1. Chris Bates, Web Programming
2. M.Srinivasan, Web Technology: Theory and Practice
3. Achyut S.Godbole, Atul Kahate, Web Technologies
4. Kogent Learning Solutions Inc, Web Technologies Black Book
5. Ralph Moseley and M.T.Savaliya, Developing Web Applications

COURSE OUTCOMES:
Students shall be able to
1. Write well-structured, easily maintained, standards-compliant, accessible HTML code.
2. Write well-structured, easily maintained, standards-compliant CSS code to present HTML pages indifferent way
3. Use Java Script to add dynamic content to pages.
4. Effectively debug Java Script code, making use of good practice and debugging tools.
5. Use Java Script to access and use web services for dynamic content (AJAX, JSON, etc.)

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		**2**	2	2	2							**2**
CO2		**2**	2	2	2							**2**
CO3		**2**	2	2	2				2			**2**
CO4		**2**	3	3	3				2	2		**3**
CO5		**2**	3	3	3				2	2		**3**

(A403603) FUNDAMENTALS OF MANUFACTURING PROCESSES
(Open Elective-II Offered by Mechanical Engineering Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT–I:

Casting: Steps involved in making a casting – Advantage of casting and its applications; Patterns – Pattern making, Types, Materials used for patterns, pattern allowances and their construction; Properties of moulding sands, Methods of Melting – Crucible melting and cupola operation–Defects in castings; Casting processes–Types–Sandmoulding, Centrifugal casting, die- casting, Investment casting, shell moulding; Principles of Gating – Requirements – Types of gates, Design of gating systems–Riser– Function, types of Riser and Riser design.

UNIT–II:

Welding: Classification – Types of welds and welded joints; Gas welding - Types, oxy-fuel gas cutting, Arc welding, forge welding, submerged arc welding, Resistance welding, Thermit welding. Inert Gas Welding - TIG Welding, MIG welding, explosive welding, Laser Welding; Soldering and Brazing; Heat affected zone in welding, Welding defects–causes and remedies; destructive and non-destructive testing of welds.

UNIT–III:

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

UNIT–IV:

Extrusion of Metals: Basic extrusion process and its characteristics. Hot extrusion and cold extrusion - Forwardextrusion and backward extrusion – Impact extrusion – Extruding equipment – Tube extrusion and pipe making, Hydrostatic extrusion. Forces in extrusion

UNIT–V:

Forging Processes: Forging operations and principles – Tools – Forging methods – Smith forging, Drop Forging – Roll forging – Forging hammers: Rotary forging – forging defects – cold forging, swaging, Forces in forging operations.

TEXT BOOKS:

1. Manufacturing Technology/P.N.Rao/McGraw Hill
2. Manufacturing Engineering and Technology/KalpakjinS/Pearson.

REFERENCE BOOKS:

1. Metal Casting /T.V Ramana Rao /New Age
2. Métal Fabrication Technology/Mukherjee/PHI

COURSE OUTCOMES:

For given product, one should be able to identify the manufacturing process.

1. Understand the idea for selecting materials for patterns.
2. Learn different type sand allowances of patterns used in casting and analyze the components of moulds.
3. Design core, core print and gating system in metal casting processes Understand arc, gas, solid state and resistance welding processes.
4. Develop process – maps for metal forming processes using plasticity principles.
5. Identify the effect of process variables to manufacture defect free products.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	2	1	1		-	-	-	1	1
CO2	2	2	2	2			1	-	-	-	1	1
CO3	2	2	2	2			1	-	-	-	1	1
CO4	2	2	2	2			1	-	-	-	1	1
CO5	3	3	3	2	2	2		-	-	-	1	1

(A403604) FUNDAMENTALS OF AUTOMOBILE ENGINEERING
(Open Elective-II Offered by Mechanical Engineering Department)
B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT–I:
Introduction: Components of four-wheeler automobile – chassis and body – power unit – power transmission rearwheel drive, front wheel drive, 4-wheel drive – types of automobile engines, engine construction – engine lubrication, splash and pressure lubrication systems, oil filters, oil pumps – crank case ventilation – engine service, reboring, decarburization

UNIT–II:
Fuel System: S.I. Engine: Fuel supply systems, Mechanical and electrical fuel pumps – Carburetor – types – air filters–petrol injection. **C.I. Engines:** Requirements of diesel injection systems, types of injection systems, fuel pump, nozzle, Alternative fuels for Automobiles - injection, Classification, Properties, Hybrid vehicles injection timing, testing of fuel, pumps. **Cooling System:** Cooling Requirements, AirCooling, Liquid Cooling and Forced Circulation System–Radiators Types – Cooling Fan - water pump, thermostat, evaporating cooling – pressure sealed cooling – antifreeze solutions.

UNIT–III:
Electrical System: Charging circuit, generator, current – voltage regulator – starting system, bendix drive mechanism solenoid switch, lighting systems, Horn, wiper, fuel gauge – oil pressure gauge, engine temperature indicator etc. **Ignition System:** Function of an ignition system, battery ignition system, constructional features of storage battery, auto transformer, contact breaker points, condenser and spark plug – Magneto coil ignition system, electronic ignition system using contact breaker, electronic ignition using contact triggers – spark advance and retard mechanism.

UNIT–IV:
Transmission System: Clutches, principle, types- cone clutch, single plate clutch, multi plate clutch, magnetic andcentrifugal clutches, fluid fly wheel – Gear boxes, types, sliding mesh, construct mesh, synchro mesh gear boxes, epicyclic gear box, over drive torque converter, Propeller shaft – Hoatch – Kiss drive, Torque tube drive universal joint, differential rear axles – types – wheels and tyres. **Steering System:** Types of steering mechanism – Ackerman steering mechanism, Davis steering mechanism

UNIT-V:
Suspension System: Objects of suspension systems – rigid axle suspension system, torsion bar, shockabsorber, Independent suspension system. **Braking System:** Mechanical brake system, Hydraulic brake system, Master cylinder, wheel cylinder tandem master cylinder Requirement of brake fluid, Pneumatic and vacuum brakes

TEXT BOOKS:
1. Automobile Engineering, Vol.1 & Vol.2/KripalSingh
2. Automobile Engineering, Vol.1 & Vol.2 by K.M Gupta, Umesh publication

REFERENCE BOOKS:
1. A System approach to Automotive Technology by Jack Erjavec, Yes Dee publishing Pvt Ltd.
2. Automobile Engineering/William Crouse
3. Automotive Mechanics/Heitner
4. Alternative fuels of Automobiles by P. Rami Reddy, Front line publications.

COURSE OUTCOMES:
By under going this course, a student shall be able to
1. Identify power generation, transmission and control mechanisms in an automobile
2. Manipulate the chemical, thermal, mechanical and electrical energies in an automobile
3. Infer the interaction between subsystems
4. Analyze how transmission system works
5. Learn different components of suspension systems.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	1	1	1	3	3	-	-	-	-	3
CO2	3	-	1	1	1	3	3	-	-	-	-	3
CO3	3	-	3	2	1	3	3	-	-	-	-	3
CO4	3	-	3	2	1	3	3	-	-	-	-	3
CO5	3	-	1	1	1	3	3	-	-	-	-	3

(A400603) ENTREPRENEURSHIP
(Open Elective-II Offered by MBA Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:

Understanding Entrepreneurial Mindset- The revolution impact of entrepreneurship - The evolution of entrepreneurship - Approaches to entrepreneurship - Process approach - Twenty first centaury trends in entrepreneurship.

UNIT-II:

The individual entrepreneurial mind-set and Personality – The entrepreneurial journey-Stress and the entrepreneur – the entrepreneurial ego –Entrepreneurial motivations, Corporate Entrepreneurial Mindset - the nature of corporate entrepreneur - conceptualization of corporate entrepreneurship Strategy - sustaining corporate entrepreneurship

UNIT-III:

Launching Entrepreneurial Ventures – opportunities identification – entrepreneurial Imagination and Creativity – the nature of the creativity process – Innovation and entrepreneurship. Methods to initiate Ventures - Creating new ventures - Acquiring an Established entrepreneurial venture - Franchising-hybrid-disadvantage of Franchising

UNIT-IV:

Legal challenges of Entrepreneurship - Intellectual property protection-Patents, Copyrights-Trade marks and Trade secrets-Avoiding trademark pitfalls, Formulation of the entrepreneurial Plan - The challenges of new venture start-ups, 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 adaptive 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 "CengageLearning, 1st edition, 2012. **(For PPT, Case Solutions Faculty may visit:login.cengage.com)**
2. Vasant Desai "Small Scale industries and entrepreneurship" Himalaya publishing, 9th Edition, 2017.

REFERENCE BOOKS:

1. Rajeev Roy "Entrepreneurship" 3e, Oxford, 2020.
2. B.Janakiramand, M.Rizwana, "Entrepreneurship Development: Text & Cases, ExcelBooks, 1st Edition, 2011.
3. Stuart Read, Effectual Entrepreneurship, Routledge, 2nd Edition, 2016.
4. Robert Hisrichet al "Entrepreneurship" 6th e, TMH, 2012.

COURSE OUTCOMES:

1. Identify the evolution and approaches of Entrepreneurship.
2. Analyze and develop the conceptualization of corporate Entrepreneurship Personality.
3. Explore different possibilities to start an Enterprise for young Entrepreneurs.
4. Outline challenging bench marks for formulation of Entrepreneurship.
5. Evaluate the application of Strategic action for growing ventures.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	-	-	-	-	-	-	-	-	3	3	-	2
CO3	3	2	3	-	-	2	2	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	2	3
CO5	-	-	3	-	3	-	-	-	-	3	2	-

(A400604) ETHICS IN BUSINESS & CORPORATE GOVERNANCE
(Open Elective -II offered by MBA Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT–I:

Business Ethics in the Changing Environment: Business Ethics, Levels of Business Ethics, Myths about Business Ethics, Stages of Moral Development Kohlberg's Study, Carol Gilligan's Theory, Principles of Ethics.

UNIT–II:

Professional Ethics: Introduction to Professional Ethics, Ethics in Production and Product Management, Ethics of Marketing Professionals, Ethics in HRM, Ethics of Finance and Accounting Professionals, Ethics of Advertisement, Ethics of Media Reporting, Ethics of Healthcare Services. Ethical Dilemma, Mounting Scandals, Ethical Issues, Preparatory Ethics: Proactive Steps, Cyber Ethics.

UNIT–III:

Corporate Governance: Introduction to Corporate Governance, Major Corporate Governance Failures, Need for Corporate Governance, Corporate Governance in India, and Theories of Corporate Governance: Agency Theory, Stewardship Theory and Stakeholder Theory, Problems of Governance in Companies, Role of Capital Markets, Regulator, And Government in Corporate Governance.

Corporate Governance Codes and Committees: Global Reporting Initiative, OECD Principles, Cadbury Committee Report, Kumara Mangalam Birla Committee Report, Naresh Chandra Committee Report, Narayana Murthy Committee Report, SEBI Clause 49 Guidelines, Corporate Governance Committees.

UNIT–IV:

Role of Board: Types of Directors Functions of the Board, Structure of the Board, Role of the Board in Subcommittees, Audit, Compensation Committee, Role, Duties and Responsibilities of Directors, Conflicts of Interest, Remedial Actions, Governance Ratings, Merits and Demerits of Governance Ratings

UNIT–V:

Corporate Social Responsibility (CSR): Models for Implementation of CSR, Scope of CSR, Steps to attain CSR, Business Council for Sustainable Development (BCSD) India, Ethics and Social Responsibility of Business, Social Responsibility and Indian Corporations, CSR as a Business Strategy for Sustainable Development, CSR Committee, Recent Amendments in Companies Act (Sec: 135)

TEXT BOOKS:

1. Jyotsna GB, RC Joshi, Business Ethics and Corporate Governance, TMH, 1e, 2019.
2. Martin J.Ossewaarde, Introduction to Sustainable Development, sage, 1e, 2018.

REFERENCE BOOKS:

1. SK Mandal, Ethics in Business and Corporate Governance, TMH, 2/e, 2017.
2. A.C. Fernando, Corporate Governance: Principles, Policies and Practices, 2nd Edition, Pearson, 2018.
3. C.S.V.Murthy, Business Ethics, 1st Edition, Himalaya Publishing House, 2019.
4. Joseph W. Weiss, Business Ethics, Thomson, 2006.
5. K.Praveen Parboteeach, Business Ethics, Routledge, 2019.

COURSE OUTCOMES:

Students will be able to

1. Understand the Need for Business Ethics and Corporate Governance in India.
2. Apply Knowledge of Established Methodologies of Solving Professional Ethical Issues.
3. Learn Codes and Committees in Corporate Governance.
4. Understand the Role of Board in Corporate Governance.
5. Assess the Stake holder perspective of Corporate Governance.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	3	3	2	3	-	3
CO2	-	-	-	-	-	-	3	3	2	2	-	3
CO3	3	-	-	-	3	-	-	-	-	-	3	-
CO4	-	-	-	-	-	3	3	3	-	-	-	-
CO5	-	-	-	-	3	2	3	-	-	-	2	3

(A401603) REMOTE SENSING & GEO GRAPHICAL INFORMATION SYSTEMS

(Open Elective-II Offered by Civil Engineering Department**)**

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:

Introduction to Photogrammetry: Principles and types of aerial photograph, geometry of vertical aerial photograph, Scale & Height measurement to single vertical aerial photograph, height measurement based on relief displacement, Fundamentals of stereoscopy, fiducial points, parallax measurement using fiducial line.

UNIT-II:

Remote Sensing: Basic concept of remote sensing, Data and Information, Remote sensing data collection, Remote sensing advantages & Limitations, Remote Sensing process. Electromagnetic Spectrum, Energy interactions with atmosphere and with earth surface features (soil, water, vegetation), Indian Satellites and Sensors characteristics, Resolution, Map and Image and False color composite, introduction to digital data, elements of visual interpretation techniques.

UNIT-III:

Geographic Information System: Introduction to GIS; components of a GIS; Geo spatial Data: Spatial Data - Attribute data-Joining Spatial and attribute data; GIS Operations: Spatial Data Input – Attribute data Management -Data display Data Exploration – Data Analysis.

Coordinate Systems: Geographic coordinate System: approximation of the Earth, Datum; Map Projections: Types of Map Projections – Map projection parameters – Commonly used Map Projections- Projected coordinate Systems.

UNIT-IV:

Vector Data Model: Representation of simple features – Topology and its importance; coverage and its data structure, Shape fire; Data models for compost feature Object Based Vector Data Model; Classes and their Relationship; The geo-base data model; Geometric representation of Spatial Feature and data structure, Tomography rules.

UNIT-V:

Raster Data Model: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, Data conversion, and Integration of Raster and Vector data. Data Input: Metadata, on version of Existing data, creating new data; remote sensing data, filed data.

TEXT BOOKS:

1. Remote Sensing and GIS, M. Anji Reddy JNTU Hyderabad, B.S. Publications.
2. Basics of remote sensing & GIS by A. Kumar, Laxmi publications.

REFERENCES:

1. Concepts & Techniques of GIS by C.P.Lo Albert, K.W Young, PHI.
2. Introduction to GIS, Kang, Tsurg Charg. Tata McGraw Hill Education Private Ltd.

COURSE OUTCOMES:

On completion of the course students will be able to

1. Illustrate the principles of photogrammetry
2. Make use of remote sensing process
3. Utilize GIS principles in real life
4. Explain the concepts of topology, OBVDM and tomography
5. Develop the geospatial data model with various file formats

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	3	2	-	3
CO2	3	3	-	-	-	-	-	-	3	2	-	3
CO3	3	3	-	-	-	-	-	-	3	2	-	3
CO4	3	3	-	-	-	-	-	-	3	2	-	3
CO5	3	3	-	-	-	-	-	-	3	2	-	3

(A401604) – SOLID WASTE MANAGEMENT
(Open Elective-II Offered by Civil Engineering Department)
B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:
SolidWaste: Definitions, Types of solid wastes, sources of solidwastes, Characteristics, and perspectives; properties of solidwastes, sampling of Solidwastes, Elements of solidwaste management - Integrated solidwaste management, Solid Waste Management Rules 2016.

UNIT-II:
Engineering Systems for Solid Waste Management: Solid waste generation; on-site handling, storage and processing; collection of solid wastes; Stationary container system and Hauled container systems – Routeplanning-transfer and transport; processing techniques.

UNIT-III:
Engineering Systems for Resource and Energy Recovery: Processing techniques; materials recovery systems; recovery of biological conversion products – Composting, pre and post processing, types of composting, Critical parameters, Problems with composing - recovery of thermal conversion products; Pyrolisis, Gasification, RDF - recovery of energy from conversion products; materials and energy recovery systems.

UNIT-IV:
Land fills: Evolution of land fills – Types and Construction of land fills – Design considerations –Life of land fills – Land fill Problems – Lining of land fills – Types of liners – Leachate pollution and control –Monitoring land fills – Land fills reclamation.

UNIT-V:
Hazardous waste Management:– Sources and characteristics, Effects on environment, Risk assessment, Disposal of hazardous wastes – Secured land fills, incineration - Monitoring – Biomedical waste disposal, E-waste management, Nuclear Wastes, Industrial waste Management

TEXT BOOKS:
1. Tchobanoglous G, Theisen Hand Vigil SA, 'Integrated Solid Waste Management, Engineering Principles and Management Issues', McGraw-Hill, 1993.
2. Vesilind PA, Worrell Wand Reinhart D, 'Solid Waste Engineering', Brooks/Cole Thomson Learning Inc., 2002.

REFERENCE BOOKS:
1. Peavy H.S, Rowe D.R and G. Tchobanoglous, 'Environmental Engineering', McGraw Hill Inc., NewYork, 1985.
2. Qian X, Koerner R Mand Gray DH, 'Geotechnical Aspects of Landfill Design and Construction' Prentice Hall, 2002.

COURSE OUTCOMES:
On completion of the course students will be able to
1. Explain the sources of solid waste and its impact
2. Describe the process of solid waste and its management
3. Illustrate the process of handling hazardous wastes
4. Classify various biomedical waste management systems
5. Apply e-waste management techniques

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	1	-	-	-	-	3	2	1	3
CO2	3	2	-	1	-	-	-	-	3	2	1	3
CO3	3	2	-	1	-	-	-	-	3	2	1	3
CO4	3	2	-	1	-	-	-	-	3	2	1	3
CO5	3	2	-	1	-	-	-	-	3	2	1	3

(A404605) FUNDAMENTALS OF EMBEDDED SYSTEMS
(Open Elective-III offered by ECE Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:
Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems Vs General Computing Systems, History of Embedded Systems, Classification, Major Application Areas, Purpose of Embedded Systems

UNIT-II:
TypicalEmbedded System: Core of the Embedded System: General Purpose and Domain Specific Processors, Memory, ROM, RAM, Memory selection for Embedded Systems, Sensors and Actuators, Communication Interface: On-board and External Communication Interfaces**.**

UNIT–III:
EmbeddedFirmware: Reset Circuit, Brown-out Protection Circuit, Oscillator Unit, Real Time Clock, Watchdog Timer, Embedded Firmware Design Approaches and Development Languages.

UNIT–IV:
RTOS Based Embedded System Design: Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multi processing and Multi tasking, Task Scheduling.

UNIT–V:
Task Communication: Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization issues, Task Synchronization Techniques, Device Drivers

TEXT BOOKS:
1. Introduction to Embedded Systems – Shibu K.V, McGraw Hill
2. Embedded Systems – Raj Kamal, TMH

REFERENCE BOOKS:
1. Embedded System Design – Frank Vahid, Tony Givargis, John Wiley.
2. Embedded Systems – Lyla, Pearson, 2013
3. An Embedded Software Primer - David E Simon, Pearson Education

COURSE OUTCOMES:
At the end of the course, the student will be able to:
1. Explain the basics of embedded systems and classify its applications
2. Compare various types of memories, sensors and Input/Output devices.
3. Summerize the embedded firmware for various applications.
4. Interpret the characteristics of Real time operating Systems
5. Illustrate the concepts of shared memory and task communications

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3	1	1									
CO3	2											1
CO4	2	1	1	1								
CO5	3				1							

(A404606) DATA COMMUNICATIONS
(Open Elective-III Offered by ECE Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:
Introduction to data communications, networking, signals, noise, modulation and demodulation, Data communication network architecture, layered network architecture, open systems inter connection, data communications circuits, serial and parallel data transmission, data communications circuit arrangements, data communication networks, alternate protocolsuites. Information capacity, bits, bitrate, baud, and M-ARY encoding

UNIT-II:
Metallic cable transmission media & optical fiber transmission media: metallic transmission lines, transverse electro magnetic waves, characteristics of electromagnetic waves, transmission line classifications, metallic transmission line types, metallic transmission line equivalent circuit, wave propagation on metallic transmission lines, metallic transmission line losses, block diagram of an optical fiber communications system, optical fiber versus metallic cable facilities.

UNIT-III:
Digital transmission & multiplexing and t-carriers digital transmission: pulse modulation, pulse code modulation, dynamic range, signal–to-quantization noise voltage Ratio, linear versus nonlinear PCM codes Multiplexing: Time - division multiplexing, t1 digital carrier system, north American digital multiplexing hierarchy, digital line encoding, tcarrier systems, European digital carrier system, statistical time –division multiplexing, frame synchronization, frequency-division multiplexing, wave length-division multiplexing, synchronous optical network

UNIT-IV:
Telephone instruments and signals: The subscriber loop, standard telephone set, basic telephone call procedures, call progress stones and signals, cordless telephones, caller id, electronic telephones, paging systems.
The telephone circuit: The local subscriber loop, telephone message - channel noise and noise weighting, units of powers measurement, transmission parameters and private –line circuits, voice – frequency circuit arrangements, cross talk.

UNIT-V:
Data communication codes, barcodes, error control, error detection, error correction, data formats, data communications hardware, character synchronization.

TEXT BOOKS:
1. Introduction to Data Communications and Networking, Wayne Tomasi, Pearson Education.

REFERENCE BOOKS:
1. Data Communications and Networking, Behrouz A Forouzan, Fourth Edition. Tmh.
2. Computer Communications and Networking Technologies, Gallow, Second edition Thomson
3. Computer Networking and Internet, Fred Halsll, Lingana Gouda Kulkarni, Fifth Edition, Pearson Education

COURSE OUTCOMES:
At the end of the course, the student will be able to:
1. Explain the basic concepts of data communication systems.
2. Distinguish various types of transmission Medias for data communications.
3. Compare different multiplexing techniques for digital transmission
4. Analyze different telephone instruments, signal and circuits
5. Identify different error detecting and correcting codes.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2									2
CO2	3	3	2									2
CO3	3	3	2									2
CO4	3	3	2									2
CO5	3	3	2									2

(A402605) NANO TECHNOLOGY
(Open Elective-III offered by EEE Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:

INTRODUCTION: History and Scope, Can Small Things Make a Big Difference? Classification of Nanostructured Materials, Fascinating Nanostructures, Applications of Nanomaterials, Nature: The Best of Nano technologist, Challenges, and FutureProspects.

UNIT-II:

UNIQUE PROPERTIES OF NANOMATERIALS: Microstructure and Defects in Nanocrystalline Materials: Dislocations, Twins, stacking faults and voids, Grain Boundaries, triple and declinations, Effect of Nano-dimensions on Materials Behavior: Elastic properties, Melting Point, Diffusivity, Grain growth characteristics, enhanced solid solubility. Magnetic Properties: Soft magnetic nanocrystalline alloy, Permanent magnetic nano-crystalline materials, Giant Magnetic Resonance, Electrical Properties, Optical Properties, Thermal Properties, and Mechanical Properties.

UNIT-III:

SYNTHESIS ROUTES: Bottom up approaches: Physical Vapor Deposition, Inert Gas Condensation, Laser Ablation, Chemical Vapor Deposition, Molecular Beam Epitaxy, Solgel method, Self-assembly, Top down approaches: Mechanical alloying, Nano-lithography, Consolidation of Nano powders: Shock wave consolidation, Hot isostatic pressing and Cold isostatic pressing, Spark plasma sintering.

UNIT-IV:

TOOLS TO CHARACTERIZE NANO MATERIALS: Ray Diffraction (XRD), Small Angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three-dimensional Atom Probe (3DAP), Nano indentation.

UNIT-V:

APPLICATIONS OF NANOMATERIALS: Nano-electronics, Micro - and Nano –electromechanical systems (MEMS/NEMS), Nano sensors, Nano catalysts, Food and Agricultural Industry, Cosmetic and Consumer Goods, Structure and Engineering, Automotive Industry, Water Treatment and the environment, Nano-medical applications, Textiles, Paints, Energy, Défense and Space Applications, Concerns and challenges of Nano technology.

TEXT BOOKS:

1. Text Book of Nano Science and Nano Technology –B.S. Murthy, P. Shankar, Baldev Raj, B.B. Rathand James Munday, University Press-IIM.
2. Introduction to Nano technology – Charles P. Poole, Jr., and Frank J. Owens, Wley India Edition, 2012.

REFERENCES BOOKS:

1. Nano: The Essentials by T. Pradeep, McGraw – Hill Education.
2. Nano materials, Nano technologies and Design by Michael F. Ashby, Paulo J. Ferreira and Daniel L. Schodek.
3. Transport in Nano structures - David Ferry, Cambridge University press 2000
4. Nano fabrication towards biomedical application: Techniques, tools, Application and impact – Ed. Challa S., S. R. Kumar, J. H. Carola.
5. Carbon Nanotubes: Properties and Applications – Michael J.O' Connell.
6. Electron Transport in Mesoscopic systems - S. Dutta, Cambridge University press

COURSE OUTCOMES:

On completion of the course, students will be able to

1. Classify nanostructured materials
2. Illustrate the characteristics and properties of nano-materials.
3. Identify the synthesis routes of nano-materials
4. Make use of the tools to characterize the nano-materials.
5. Utilize the nano-materials for various applications

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2						2		
CO2	3	3	3							2		
CO3	3	3								2		
CO4	3	3			2					2		
CO5	3	3								2		

(A402606) EV BATTERIES & CHARGING SYSTEM
(Open Elective-III offered by EEE Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

Pre requisites: Basics of Electrical Engineering (or equivalent subject)

UNIT-I:
Battery parameters: Cell and battery voltages, Charge (or Amphour) capacity, Energy stored, Energy density, Specific power, Amphour (orcharge) efficiency, Energy efficiency, Self-discharge rates, Battery geometry, Battery temperature, heating and cooling needs, Battery life and number of deep cycles

UNIT-II:
EVBatteries: Lead Acid Batteries Lead acid battery basics, Special characteristics of lead acid batteries, Battery life andmaintenance, Battery charging, Summary Nickel-based Batteries Introduction, Nickel cadmium, Nickel metal hydride batteries

UNIT-III:
Sodium, Lithium and Metal air batteries: Sodium-based Batteries Introduction, Sodium sulphur batteries, Sodium metalchloride (Zebra) batteries Lithium Batteries Introduction, The lithium polymer battery, the lithium on battery Metal Air Batteries Introduction, The aluminium air battery, the zinc air battery

UNIT-IV:
Charging Infrastructure: Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and-charge zone

UNIT-V:
EV Charging Battery Chargers: Charge equalisation, Conductive (Basic charger circuits, Microprocessor based charger circuit. Arrangement of an off-board conductive charger, Standard power levels of conductive chargers, Inductive (Principle of inductive charging, Soft-switching power converter for inductive charging), Battery indication methods

TEXT BOOKS:
1. James Larminie Oxford Brookes University, Oxford, UK John Lowry Acenti Designs Ltd., UK, Electric Vehicle Technology Explained
2. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., NewYork 2001.

REFERENCE BOOKS:
1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E.Gay, AliEmadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

COURSE OUTCOMES:
On completion of the course, students will be able to
1. Gain knowledge on various battery parameters
2. Classify different types of EV batteries
3. Illustrate Sodium, Lithium and Metal air batteries
4. Understand the different types of Charging Infrastructure.
5. Understand the operation of EV Charging Battery Chargers

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3								2		
CO2	3	3								2		
CO3	3	3								2		
CO4	3	3								2		
CO5	3	3								2		

(A405603) FUNDAMENTALS OF COMPUTER NETWORKS
(Open Electeive-III Offered by CSE Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:
Fundamental of Data Communication and Computer Network: Components, Data Representation, Data Flow, Data and Signal, Classification Network: LAN, WAN, MAN, **And Network Architecture:** Peer to Peer, Client Server Network, History of Internet.

UNIT-II:
Network Model: OSI Reference Model and TCP/IP Protocol Suit
Network Connecting Devices: Hub, Switch, Router, Repeater, Bridge, Gateway, Modem
Network Topologies: Types of Topology - Bus, Ring, Star, Mesh, Tree, Hybrid, and IEEE Standards.

UNIT-III:
Physical Layer: Guided Transmission Media and Unguided Transmission Media
Data Link Layer: Design Issues, Error Detection and Correction, Simplex Stop and wait protocol.

UNIT-IV:
Network Layer: Design Issues, Routing Algorithm: Shortest Path Routing algorithm, Congestion Control, IPv4, IPv6, DHCP
Transport Layer: Process to process Delivery, Addressing, UDP and TCP, Error control and flow control.

UNIT-V:
Application Layer: Domain Name System, E-Mail, FTP, WWW and Http.
Network Security: Cryptography, Symmetric Key and Public Key, Firewall, VPN, Web Security

TEXT BOOKS:
1. Computer Networks, Andrew S Tanenbaum, David.j.Wetherall, 5th Edition. Pearson Education/PHI
2. Data Communications and Networking – Behrouz A. Forouzan. 3rd Edition, TMH.

REFERENCE BOOKS:
1. An Engineering Approach to Computer Networks, S. Keshav, 2nd Edition, Pearson Education.
2. Computer Networking A Top-Down Approach – Kurose James F, Keith W, 6th Edition, Pearson
3. Data communication and Networks – Bhusan Trivedi, Oxford university press, 2016.

COURSE OUTCOMES:
1 Explain the Datain communication and two types of networks architecture.
2 Compare OSI Reference model and TCP/IP Protocol Suit and able to Sketch the different topologies and network connecting devices.
3 Describe about Transmission media in Physical layer and Analyze the Error detection and correction methods in Data link layer.
4 Apply knowledge in developing routing algorithm and Explain transport layer protocols.
5 Examine the Application layer Protocols and Analyze various network security approaches.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2		2								
CO2	2	2		2								
CO3	2	2		2								
CO4	2	2	2	2								
CO5	2	2	2	2								

(A405606) FUNDAMENTALS OF DEVOPS
(Open Electeive-III Offered by CSE Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:
Introduction: Introduction, Agile development model, DevOps, and ITIL. DevOps process and Continuous Delivery, Release management, Scrum, Kanban, delivery pipe line, bottle necks, examples

UNIT-II:
Software development models and DevOps: DevOps Lifecycle for Business Agility, DevOps, and ContinuousTesting. DevOps influence on Architecture: Introducing software architecture, Themono lithic scenario, Architecture rules of thumb, The separation of concerns, Handling database migrations, Microservices, and the data tier, DevOps, architecture, and resilience.

UNIT-III:
Introduction to project management: The need for source code control, The history of source code management, Roles and code, source code management system and migrations, Shared authentication, Hosted Git servers, Different Git server implementations, Docker intermission, Gerrit, The pull request model, Git Lab.

UNIT-IV:
Integrating the system: Build systems, Jenkins build server, Managing build dependencies, Jenkins plugins, and file system layout, The host server, Build slaves, Software on the host, Triggers, Job chaining and build pipelines, Build servers and infrastructure as code, Building by dependency order, Build phases, Alternative build servers, Collating quality measures.

UNIT-V:
Testing Tools and automation: Various types of testing, Automation of testing Prosandcons, Selenium - Introduction, Selenium features, Java Script testing, Testing backend integration points, Test-driven development, REPL – driven development Deployment of the system:Deploymentsystems,Virtualizationstacks,codeexecutionattheclient,
Puppet master and agents, Ansible, Deployment tools: Chef, Salt Stack and Docker

TEXT BOOKS:
1. Joakim Verona. Practical Devops, Second Edition. Ingram shor ttitle; 2nd edition (2018). ISBN-10:1788392574
2. Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's View point. Wiley publications. ISBN:9788126579952

REFERENCE BOOK:
1. LenBass, Ingo Weber, Liming Zhu. DevOps: A Software Architect's Perspective. Addison Wesley; ISBN-10

COURSE OUTCOMES:
On successful completion of this course, students will be able to:
1. Identify components of Devops environment
2. Describe Software development model sand architectures of DevOps
3. Apply different project management, integration, testing and code deployment tool
4. Investigate different DevOps Software development models
5. Assess various Devops practices, Collaborate and adopt Devops in real-time projects

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					2							**2**
CO2		**3**										**2**
CO3			3	3							2	**2**
CO4			3	3					1	1	2	**2**
CO5				3					2	1	2	**2**

(A403605) INDUSTRIAL SAFETY ENGINEERING
(Open Elective III: Offered by Mechanical Engineering Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes andpreventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinkingwater layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and fire fighting, equipment and methods.

UNIT-II:

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT-III:

Wear and Corrosion and their prevention: Wear-types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods

UNIT-IV:

Fault tracing: Fault tracing – concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT-V:

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TEXT BOOKS:

1. Mobley, R. Keith, Lindley R. Higgins, and Darrin J. Wikoff. *Maintenance Engineering Handbook*. New York, NY: Mcgraw-Hill, 2008.
2. Garg H.P. *Industrial Maintenance*. S Chand, 1976.

REFERENCE BOOKS:

1. Graham F.D. "Audels Pumps, Hydraulics and Air Compressors. Theo. "(1998).
2. Winterkorn Hans F., and Hsai-YangFang. *Foundation engineering hand book*. Springer, Boston, MA, 1991.

COURSE OUTCOMES:

At the end of the course, the student should be able to

1. Understand various hazards and their prevention.
2. Apply maintenance techniques to various equipments.
3. Understand types of wear and corrosions and their prevention.
4. Explain fault tracing and its applications.
5. Apply periodic and preventive maintenance techniques to various equipments.

CO-POMAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12
CO1	3	3	3	3	1	-	-	-	1	-	3	3
CO2	3	3	3	3	1	-	-	-	1	-	3	3
CO3	3	3	3	3	1	-	-	-	1	-	3	3
CO4	3	3	3	3	1	-	-	-	1	-	3	3
CO5	3	3	3	3	1	-	-	-	1	-	3	3

(A403606) WASTE TO ENERGY
(Open Elective III: Offered by Mechanical Engineering Department)
B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:
Introduction to Energy from Waste: Classification of waste as fuel–Agro based, Forest residue, Industrial waste MSW–Conversion devices –Incinerators, gasifiers, digestors

UNIT-II:
Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods –Yields and application – Manufacture of pyrolytic oil sand gases, yields and applications.

UNIT-III:
Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating –Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT-IV:
Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT-V:
Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production- Urban waste to energy conversion – Biomass energy programme in India.

TEXT BOOKS:
1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

REFERENCE BOOKS:
1. Food, Feed and Fuel from Biomass, Challal, D.S., IBH Publishing Co. Pvt. Ltd., 1991.
2. Biomass Conversion and Technology, C. Y. Were Ko-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

COURSE OUTCOMES:
By undergoing this course, a student shall be able to
1. Understand different Conversion Devices.
2. Explain Biomass Pyrolysis.
3. Understand the working Principle of biomass gasification
4. Explain Biomass Combustion.
5. Know the application of Bio Gas.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12
CO1	2	3	3	3	2	1	2	-	2	-	-	2
CO2	3	2	2	3	3	1	2	-	2	-	-	2
CO3	3	3	1	3	1	1	2	-	2	-	-	2
CO4	3	3	1	3	1	1	2	-	2	-	-	2
CO5	3	2	1	3	2	1	2	-	1	-	-	2

(A400605) – BASICS OF MARKETING
(Open Elective III: Offered by MBA)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:

Understanding Marketing Management: Concepts of Marketing, Marketing Strategies & Plans, Creating long term Loyalty relationships, Marketing mix, Product Life Cycle

UNIT-II:

Connecting with Customers & Building Strong Brands: Analyzing Competitors, Conducting Marketing Research, Consumer Behaviour, Identifying market segments and targets, crafting Brand Positioning

UNIT-III:

New Product and Promotions: Introducing New Market Offering, Developing Pricing Strategies & Programmes, Designing & Managing Integrated Marketing Communications, Advertising & Sales Promotions, Managing Digital Communication – Online, Social Media & Mobile, Personal Selling

UNIT-IV:

Delivering Value: Managing Retailing, Wholesaling and logistics, designing and Managing Integrated Marketing Channels

UNIT-V:

Sales Management: Nature and Importance of Sales Management, Skills of Sales Manager, Sales objectives, Concepts of Sales organization, Type of Sales organization.

TEXT BOOKS:

- Marketing Management, Philip Kotler, Kevin Lane Keller, Pearson

REFERENCES:

1. Rosalind Masterson, Nichola Philips, David Pickton, Marketing: An Introduction, 5e, Sage Publications, 2021.
2. G. Shainesh Philip Kotler, Kevin Lane Keller, Alexander Cherneb, Jagdish N Sheth, Marketing Management, 16e, Pearson, 2022.
3. Lamb, Hair, Sharma, McDaniel: MKTG, A South Asian Perspective, Cengage Learning, 2016. (For PPT, Case Solutions, videocases, Faculty may visit: login.cengage.com)
4. Philip Kotler, Gray Armstrong, Principles of Marketing, Pearson Education, 18e, 2020.
5. Ramaswamy, Namakumari, Marketing Management, Sage Publications, 6e, 2018.
6. Arun Kumar & N. Meenakshi, Marketing Management, Vikas, 3e, 2016

COURSE OUTCOMES:

On completion of the course students will be able to:

1. Analyze the scope, concepts of Marketing and forecasting techniques in present Global Market Environment.
2. Outline marketing research, consumer behaviour, segmentation and targeting.
3. Develop conceptual knowledge on new product development, marketing mix and promotional mix
4. Illustrate marketing channels of distribution and logistics
5. Identify the skills and importance of sales management.

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12
CO1	-	3	3	-	2	3	-	-	-	3	-	-
CO2	-	-	-	-	3	3	-	3	-	-	2	-
CO3	-	-	-	-	-	3	2	-	3	-	3	-
CO4	-	-	3	-	-	-	-	-	3	-	2	-
CO5	3	-	-	-	-	-	3	-	-	3	-	-

(A405607) CLOUD COMPUTING
(Open Electeive III Offered by CSC Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:
Computing Paradigms: High-Performance Computing, Parallel Computing, Distributed Computing, Cluster Computing, Grid Computing, Cloud Computing, Bio computing, Mobile Computing, Quantum Computing, Optical Computing, Nano computing.

UNIT-II:
Cloud Computing Fundamentals: Motivation for Cloud Computing, The Need for Cloud Computing, Defining Cloud Computing, Definition of Cloud computing, Cloud Computing Is a Service, Cloud Computing Is a Platform, Principles of Cloud computing, Five Essential Characteristics, Four Cloud Deployment Models.

UNIT-III:
Cloud Computing Architecture and Management: Cloud architecture, Layer, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Applications, on the Cloud, Managing the Cloud, Managing the Cloud Infrastructure Managing the Cloud application, Migrating Application to Cloud, Phases of Cloud Migration Approaches for Cloud Migration.

UNIT-IV:
Cloud Service Models: Infrastructure as a Service, Characteristics of IaaS. Suitability of IaaS, Pros and Cons of IaaS, Summary of IaaS Providers, Platform as a Service, Characteristics of PaaS, Suitability of PaaS, Pros and Cons of PaaS, Summary of PaaS Providers, Software as a Service, Characteristics of SaaS, Suitability of SaaS, Pros and Cons of SaaS, Summary of SaaS Providers, Other Cloud Service Models.

UNITV:
Cloud Service Providers: EMC, EMC IT, Captiva Cloud Toolkit, Google, Cloud Platform, Cloud Storage, Google Cloud Connect, Google Cloud Print, Google App Engine, Amazon Web Services, Amazon Elastic Compute Cloud, Amazon Simple Storage Service, Amazon Simple Queue, service, Microsoft, Windows Azure

TEXT BOOKS:
1. Essentials of cloud Computing: K.Chandrasekhran, CRC press, 2014

REFERENCE BOOKS:
1. Cloud Computing: Principles and Paradigms by Rajkumar Buyya, James Broberg and Andrzej M.Goscinski, Wiley, 2011.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C.Fox, Jack J.Dongarra, Elsevier, 2012.
3. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly, SPD, rp 2011.

COURSE OUTCOMES:
The student shall be able to
1. Explain Distributed System Modeling, Clustering and Virtualization
2. Discuss basic concepts of cloud computing.
3. Distinguish Infrastructure as a Service (IAAS) & Platform and Software as a Service (PAAS/SAAS).
4. Design & implement cloud computing applications.
5. Explore some important cloud computing driven commercial systems.

CO- PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3					2						
CO2	3					2		2				
CO3	3						2					
CO4	3	1	1		1							
CO5	3	2										

(A401605) ENERGY EFFICIENT BUILDINGS

(Open Elective-III Offered by Civil Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:

Climates and buildings, Thermal properties and energy content of building materials, Psychrometry, thermal comfort: Criteria and various parameters, Air conditioningsystems, Energyconservationtechniques in Air conditioning systems. Climate and comfort zones, Introduction to the design of shading devices, Overhangs, Factors that effects energy uses in buildings: ventilationanditssignificance.

UNIT-II:

Passive and active methods of heating and cooling, Passive heating concepts: direct heat gain, indirect heat gain, isolated gain and sun spaces. Passive cooling concepts: evaporative cooling, radiative cooling; application of wind, water and earth for cooling; shading, paints and cavity walls for cooling; roof radiation traps; earth air-tunnel.

UNIT-III:

Heat transmission in buildings: surface co-efficient: air cavity, Internal and external surfaces Overall thermal transmittance, Wall and windows; Heat transfer due to ventilation/infiltration, Internal heat transfer; Decrement factor; Phase lag; Lighting (Daylighting and Electric lighting), Design of day-lighting, Concept of sol-air temperature and its significance.

UNIT-IV:

Estimation of building loads, Steady state method, Network method, Numerical method, Correlations.Energy conservation through site selection, Planning and design; Siting and orientation Green buildings, Zero emission buildings. Energy Efficient Landscape Design: Modification of micro climatic through landscape element for energy conservation.

UNITV:

Bioclimatic classification of India; Passive concepts appropriate for the various climatic zones in India; Typical design of selected buildings in various climatic zones; Thumb rules for design of buildings and building codes Energy Efficient Landscape Design: Modification of micro climatic through landscape element for energy conservation

TEXT BOOKS:

1. Tiwari GN, Goyal RK, Greenhouse Technology:
   Fundamentals, Design Modeling and Application, Narosa Publishing House
2. Krieder J, Rabi A, Heating and Cooling of Buildings: Design for Efficiency, McGraw Hill.

REFERENCE BOOKS:

1. Archie, Culp W, Principles of Energy Conservation, McGraw Hill.
2. Callaghan PO, Energy Management, McGraw-Hill Book Company.
3. Williams J R, Passive Solar Heating, Ann Arbar Science.
4. Majumder Milli, Energy Efficient Buildings, TERI, NewDelhi.

COURSE OUTCOMES:

On completion of the course students will be able to

1. Identify different Energy conservation techniques in Air conditioning systems
2. Demonstrate a good ability to calculate the energy balance of buildings
3. Assess whether there is a potential conflict between energy conservation and indoor climate for different energy saving measures
4. Evaluate different opportunities to save energy with measures regarding both building technology and building services engineering
5. Able to design different buildings in various climatic zones

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12
CO1	3	3	-	2	3	3	-	-	3	2	-	3
CO2	3	3	-	2	3	3	-	-	3	2	-	3
CO3	3	3	-	2	3	3	-	-	3	2	-	3
CO4	3	3	-	2	3	3	-	-	3	2	-	3
CO5	3	3	-	2	3	3	-	-	3	2	-	3

(A401606) ENVIRONMENTAL POLLUTION
(Open Elective-III Offered by Civil Department)

B. Tech. (ME): VIII Semester

L	T	P	C
3	0	0	3

UNIT-I:
Air Pollution: Air pollution Control Methods – Particulate control devices – Methods of Controlling Gaseous Emissions–Air quality standards, Noise Pollution: Noise standards, Measurement and control methods – Reducing residential and industrial noise – ISO: 14000

UNIT-II:
Industrial waste water Management: Strategies for pollution control – Volume and Strength reduction – Neutralization – Equalization – Proportioning –Common Effluent Treatment Plants –Recirculation of industrial wastes –Effluent standards.

UNIT-III:
Solid Waste Management: Solid Waste Management: solid waste characteristics –basics of on-site handling andcollection – separation and processing –Incineration-Composting-Solid waste disposal methods –fundamentals ofLandfilling.HazardousWaste:Characterization–Nuclearwaste–Biomedical wastes – Electronic wastes Chemical wastes – Treatment and management of hazardous waste-Disposal and Control methods.

UNIT-IV:
Environmental Sanitation: Environmental Sanitation: Environmental Sanitation Methods for Hostels and Hotels, Hospitals, Swimming pools and public bathing places, social gatherings (melas and fares), Schools and Institutions, Rural Sanitation-low cost waste disposal methods.

UNIT-V:
Sustainable Development: Sustainable Development: Definition-elements of sustainable developments – Indicators of sustainable development – Sustainability Strategies - Barriers to Sustainability – Industrialization and sustainable development – Cleaner production in achieving sustainability - sustainable development.

TEXT BOOKS:
1. Peavy, H. S., Rowe, D.R, Tchobanoglous, "Environmental Engineering", G. Mc - Graw Hill International Editions, New York 1985..
2. G.Henryand G.W.Heinke, "Environmental Science and Engineering", Pearson Education.

REFERENCE BOOKS:
1. G.L.Karia and R.A.Christian, "Waste water treatment –concepts and design approach", Prentice Hall of India
2. M.N.Rao and H.V.N.Rao, "Air pollution", Tata Mc.Graw Hill Company.
3. Ruth F. "Weiner and Robin Matthews Environmental Engineering", 4th Edition Elesevier, 2003.
4. K.V.S.G. Murali Krishna, "Air Pollution and Control" by, Kousal & Co. Publications, NewDelhi.

COURSE OUTCOMES:
On completion of the course students will be able to
1. Define the air pollution control methods
2. Able to evaluate Volume and Strength reduction
3. Identify the different ways to dispose Solid waste
4. Identify the sanitation methods.
5. Products that accelerate more sustainable lifestyles

CO-PO MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	P09	PO10	PO11	PO12
CO1	3	3	-	2	-	2	3	-	3	2	-	3
CO2	3	3	-	2	-	2	3	-	3	2	-	3
CO3	3	3	-	2	-	2	3	-	3	2	-	3
CO4	3	3	-	2	-	2	3	-	3	2	-	3
CO5	3	3	-	2	-	2	3	-	3	2	-	3

(A403804) MAJOR PROJECT PHASE - II

B. Tech. (ME): VIII Semester

L	T	P	C
0	0	18	9

(A403805) TECHNICAL SEMINAR

B. Tech. (ME): VIII Semester

L	T	P	C
0	0	4	2