NARSIMHA REDDY ENGINEERING COLLEGE
An Autonomous Institution| Affiliated to JNTUH | Approved by AICTE
Accredited by NBA & NAAC with 'A' Grade

ACADEMIC REGULATIONS (NR-25)

FOR

B.Tech Regular Four Year Degree Courses

(For the Batches Admitted From 2025-2026)

&

B. Tech (Lateral Entry Scheme)

(For the Batches Admitted From 2026-2027)

MECHANICAL ENGINEERING

INSTITUTE VISION

To produce competent professionals who can contribute to the industry, research and societal benefits with environment consciousness and ethical values.

INSTITUTE MISION

M1: Adapt continuous improvements in innovative teaching-learning practices and state-of-the-art infrastructure to transform students as competent professionals and entrepreneurs in multi- disciplinary fields.

M2: Develop an innovative ecosystem with strong involvement and participation of students and faculty members.

M3: Impart National development spirit among the students to utilize their knowledge and skills for societal benefits with ethical values.

DEPARTMENT VISION

To provide a professional and conducive environment to foster outcome based teaching learning with intellectual, ethical and cultural sensitivities to lead in the field of Mechanical Engineering.

DEPARTMENT MISSION

M1: To produce skilled graduates with leadership qualities and team working abilities, thus enhancing their employability and self sustainability in the environment.

M2: To emerge as a centre for research & consultancy in the field of Mechanical Engineering and be an incubation centre for Technocrats.

M3: To inculcate the habit of continuous learning through advanced technologies with ethical values.

ACADEMIC REGULATIONS (NR25) FOR B.TECH REGULAR STUDENTS WITH EFFECT FROM THE ACADEMIC YEAR 2025-26:

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

Narsimha Reddy Engineering College (NRCM) offers new regulations termed as NR-25 regulations in line with National Educational Policy for four-year (eight semesters) **Bachelor of Technology** (B.Tech.) degree programme, under Choice Based Credit System (CBCS), with effect from the academic year **2025-26.**

2.0 Eligibility for Admission

2.1 Admissions to the undergraduate (UG) programme shall be made either on the basis of the merit rank obtained by the qualified students at the entrance test conducted by Telangana Government (EAPCET) or as per the guidelines of Telangana Council of Higher Education, subject to reservations as prescribed by the government from time to time.

2.2 The medium of instruction 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 and a maximum period of **eight** academic years starting from the date of commencement of first year first semester, failing which student shall forfeit seat in B.Tech. course. Each student has to secure a minimum of 160 credits out of 164 credits for successful 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.

3.2.1 Semester Scheme

The undergraduate programme is of four academic years and there shall be two semesters in each academic year. There shall be a minimum of 15 weeks of instruction, excluding the mid- term and semester-end exams. Around 15 instruction hours, 30 instruction hours and 45 hours of learning need to be

followed per one credit of theory course, practical course and project/field-based learning respectively. In each semester, there shall be 'Continuous Internal Evaluation (CIE)' and 'Semester End Examination (SEE)' under Choice Based Credit System (CBCS). The curriculum/course structure suggested by AICTE is followed as a reference document.

3.2.2 Credit Courses

All courses offered in each semester are to be registered by the student. Against each course in the course structure, the L: T: P: SL: C (lecture periods: tutorial periods: practical periods: Self Learning: credits) pattern has been defined.

All courses offered in each semester are to be registered by the student. Against each course in the course structure, the L: T: P: SL: C (lecture periods: tutorial periods: practical periods: Self Learning: credits) pattern has been defined

- One credit is allocated for one hour per week in a semester for lecture (L) or Tutorial (T) session.
- One credit is allocated for two hours per week in a semester for Laboratory/ Practical (P) session.

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- One credit is allocated for three hours per week in a semester for Project/Mini-Project (SL) session.

For example, a theory course with three credit weightage requires three hours of classroom instruction per week, totaling approximately 45 hours of instruction over the entire semester.

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:

S. No.	Broad Course Classification	Course Group / Category	Course Description
1	Foundation Courses (FnC)	BS – Basic Sciences	Includes Mathematics, Physics and Chemistry courses
2		ES - Engineering Sciences	Includes Fundamental Engineering Courses
3		HS – Humanities and Social Sciences	Includes courses related to Humanities, Social Sciences and Management

4	Core Courses (CoC)	PC – Professional Core	Includes core courses related to the parent branch of Engineering.
5	Elective Courses (EℓC)	PE – Professional Electives	Includes elective courses related to the parent branch of Engineering.
6		OE – Open Electives	Elective courses which include inter-disciplinary courses or courses in an area outside the parent branch of Engineering.
7	Project Core	Project Work	B.Tech. Project Work
8	Other Core Courses (OCC)	Industry Training/ Internship/ Industry Oriented Mini- project	Industry Training/ Internship/ Industry Oriented Mini- Project
9		Seminar	Seminar based on core contents related to parent branch of Engineering.
10	Skill Development Courses (SDC)	-	Courses designed to help individuals gain, improve, or refine specific skills
11	Value Added Courses (VAC)	-	Courses to build professional values, traditional knowledge and sensitization of societal issues

4.0 Mandatory Induction Programme

An institution program of one week duration for the UG students entering the institution, right at the start shall be implemented. Normal classes commence only after the induction programme is conducted. Following activities could be part of the induction programme i) Physical Activity ii) Creative Arts, iii) Imparting Universal Human Values, iv) Literary Activities, v) Lectures by Eminent People, vi) Visits to Local Areas and vii) Familiarization to department as well as entire institute and viii) Making students understand Innovative practices at the college premises etc.

5.0 Course Registration

5.1 A faculty advisor / mentor shall be assigned to a group of around 20 students, who will advise the students about the undergraduate programme, its course structure and curriculum, choices/options of the courses, based on their competence, progress, pre-requisites and interest.

5.2 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 semester courses shall be completed two weeks before the commencement of SEEs (Semester End Examinations) of the preceding semester.

5.3 A student can apply for **on-line** registration, **only after** obtaining the '**written approval**' from faculty advisor/mentor, 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/ mentor and the student.

5.4 A student shall register for all the courses offered in a semester as specified in the course structure.

5.5 Course options exercised through **on-line** registration are final and **cannot** be changed; further, alternative choices also will not be considered. However, if the 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 alternative choice either for a new course (subject to offering of such a course), or for another existing course. Such alternative arrangements will be made by the Head of the Department, with due notification and time-framed schedule, within **a week**, but before the commencement of class- work of the semester.

5.6 The Head of the Department / Course Coordinator should review vacant slots in the timetable of each section once in every week or fortnight. The vacant slots in the time-table may be allocated to the subject teachers who could not take classes in proportion to the number of weeks completed from the commencement of the semester.

5.7 Two faculty members may be allocated for the tutorial session of problematic course for better interaction/practice and to minimise the failures in the subject.

5.8 **Professional Electives:** The students have choose six Professional Electives (PE-I to PE-VI) from the six baskets of professional electives given. Students have the flexibility to choose from the list of professional electives offered by the department or opt to register for the equivalent Massive Open Online Courses (MOOCs) as listed from time to time by the Institute.

5.9 **Open Electives**: Students have to choose three Open Electives (OE-I, II & III) from three baskets of Open Electives given by other than the parent department or opt to register for the equivalent Massive Open Online Courses (MOOCs) as listed

from time to time by the Institute. However, the student can opt for an Open Elective course offered by his parent department, if the student has not studied that course so far. Similarly, Open Elective courses being studied should not match with any courses of the forthcoming semesters.

5.10 **Provision for Early Registration of MOOCs:**

For a professional elective or open elective in a semester, students are allowed to register for an equivalent MOOCs course listed from time to time by the Institute one semester in advance. For example, a Professional Elective of III Year II Semester shall be allowed to register under MOOCs platform in III year I Semester.

The credits earned in one semester in advance can be submitted in the subsequent semester for the assessment.

The students who have registered in advance in an equivalent MOOCs course and fail to secure any pass grade in the MOOCs course, can register for the regular course offered in the following semester of their course structure.

5.11 **Conversion of Marks Secured in MOOCs into Grades**: Marks secured in the internal and external evaluations of a MOOCs course shall be scaled to 40 and 60 marks respectively. The sum of these two components shall be considered as the total marks out of 100. The corresponding grade shall then be determined as per the marks-to-grades conversion rules specified in Clause 10.3.

5.12 MOOCs are allowed for professional and open elective courses and for a few Minors & Honors courses.

5.13 **Additional learning resources:**

Students are encouraged to acquire additional course-related knowledge by auditing learning resources from MOOCs platforms for each course offered in their course structure. These additional courses are not meant for earning credits but are intended to enhance knowledge. The Institute shall notify such courses from time to time through their portals for the benefit of students. They are categorized into three types: prerequisite, reinforcement, and aspirational. Prerequisite courses help students gain familiarity and provide sufficient background. Reinforcement courses aim to offer different perspectives on learning, while aspirational courses focus on next-level or advanced learning.

6.0 Rules to offer Elective courses

6.1 An elective course may be offered to the students, only if a minimum of 25% of class strength opts for it.

6.2 Same elective course for different sections may be offered by different faculty members. The selection of elective course by students will be based on first come first serve and / or CGPA criterion.

6.3 If the number of students registrations are more than the strength of one section, then it is choice of the concerned Department to offer the same course for more than one section based on the resources available in the department.

7.0 Attendance requirements:

7.1 A student shall be eligible to appear for the semester-end examinations, if the student acquires a minimum of 75% of aggregate attendance of all the courses for that semester.

7.2 Shortage of attendance in aggregate upto 10% (securing 65% and above but 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.

7.3 A stipulated fee shall be payable for condoning of shortage of attendance as notified in the respective college websites.

7.4 **Two hours** of attendance for each theory course shall be considered, if the student appears for the mid-term examination of that course.

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

7.6 Students whose shortage of attendance is not condoned in any semester, are not eligible to take their semester-end examinations of that semester. They get detained and will not be promoted to the next semester. Their registration for that semester shall stand cancelled, including internal marks. They may seek re-registration for that semester in the next academic year.

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

8.0 Criteria for Earning of Credits in a Course

8.1 A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course, if the student secures not less than 35% (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 course.

8.2 A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to Field Based Research Project / Industry Oriented Mini Project / Internship, 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/she (i) does not submit a report on Field-Based Research Project/Industry Oriented 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 Field-Based Research Project / Industry Oriented Mini Project / Internship evaluations.

8.3 A student eligible to appear in the semester-end examination for any course, is absent from it or failed (thereby failing to secure **'C'** grade or above) may re-appear for that course in the supplementary examination as and when it is conducted. In such cases, internal marks assessed in continuous internal evaluation (CIE) earlier for that course will be carried over, and added to the marks obtained in the SEE supplementary/make-up examination. If the student secures sufficient marks for passing, **'C'** grade or above shall be awarded as specified in clause 10.3.

9.0 Distribution of Marks and Evaluation

9.1 The performance of a student in every course (including Value Added Courses and Skill Development Courses, Laboratory/Practical and Project Work) will be evaluated for 100 marks each, with 40 marks allotted for CIE (Continuous Internal Evaluation) and 60 marks for SEE (Semester End-Examination), irrespective of the credits allocated.

9.2 **Continuous Internal Evaluation (CIE)**

9.2.1 **Theory Courses:**

For theory courses, 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, totaling to 30 marks. Total duration of mid-term examination is two hours.

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

The objective/quiz paper is set with multiple choice, fill-in the blanks and match the following type of questions for a total of 10 marks (with a weightage of 4M from Unit-1, 4M from Unit-2, 2M from Unit-3 for Mid-I Examination and 2M from

Unit-3, 4M from Unit-4, 4M from Unit-5 for Mid-II Examination).

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. Questions will be drawn from the mid-term exam syllabus, ensuring uniform coverage of all topics.

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

2. Student shall submit two assignments and the **average of 2 Assignments** each for 5 marks shall be taken. 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.
3. Five marks for the Viva-Voce/PPT/Poster Presentation/Working Model/Case Study on a topic in the concerned subject. This assessment shall be completed before II Mid- Term Examination.

9.2.2 **Engineering Drawing and Computer Aided Drafting Course:**

For this course, 20 marks will be allocated for day-to-day assessments conducted during drawing practice sessions**,** and another 20 marks will be allocated for the mid-term examination**.** In the mid-term examination, students shall attempt any four out of six given questions**.** The first mid-term exam will be conducted in the conventional mode using a drawing board**,** while the second mid-term exam will be conducted using a CAD package.

9.3 A **Computer-Based Test (CBT**) in each course is available for students who either:

1. missed one of the two mid-term examinations due to unavoidable circumstances, or
2. attended both mid-term examinations but wish to improve their internal marks.

The CBT will be conducted at the end of the semester and will carry a total of 30 marks. The marks obtained in the CBT will be considered equivalent to those obtained in one mid-term examination. Zero marks will be awarded to students who are absent from the mid-term examination. The average of the best two scores from the three exams (the two mid-term exams and the CBT), combined with other internal assessment components, will constitute the Continuous Internal Improvement (CII) marks for that specific course. CBT exams shall be conducted by the Institute.

9.4 Semester End Examination for theory courses

9.4.1 Theory Courses:

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

- Part-A is compulsory, consists of five short answer questions covering all units of syllabus; each question carries two marks.
- Part-B consists of five questions carrying 10 marks each. There shall be two questions asked in the question paper from each unit with either-or choice and the student should answer either of the two questions. The student shall answer one question from each of five units.

9.4.2 Engineering Drawing and Computer Aided Drafting Course:

Question paper consists of five questions carrying 12 marks each. There shall be two questions asked in the question paper from each unit with either-or choice and the student should answer either of the two questions. The student shall answer one question from each of five units.

There shall be no section with short answer questions.

9.4.3 Duration of SEE:

The duration of Semester End Examination of theory and drawing courses is 3 hours.

9.5 Semester End Examination for Practical Courses:

For practical courses there shall be a Continuous Internal Evaluation (CIE) during the semester for 40 marks and semester-end examination for 60 marks. The breakup of the continuous internal evaluation for 40 marks is as follows:

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

The Semester End Examination for practical courses shall be conducted with an external examiner and the laboratory course teacher. The external examiner shall be appointed from the college outside their cluster.

In the Semester End Examination for practical courses held for 3 hours, rubrics of evaluation for 60 marks is as given 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.

For any change of experiment, 5 marks will be deducted from the total of 60 marks. If second time change of experiment is requested, another five marks will be deducted from the 60 marks. No third change will be permitted.

9.6 **Field-based Research Project:**

There shall be a Field-based Research Project in the intervening summer between II-II and III-I Semesters. Students will register for this project immediately after II Year II Semester examinations and pursue it during summer vacation. The Field-based Research Project shall be submitted in a report form and presented before the committee in III year I semester. It shall be evaluated for 100 external marks. The evaluation committee shall consist of an External Examiner, Head of the Department, Supervisor of the Project and a Senior Faculty Member of the department. There shall be no internal marks for Field-based Research Project. Student shall have to earn 40% marks, i.e 40 marks out of 100 marks. 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 committee as per schedule, or (iii) secures less than 40% marks in this course.

9.7 **Internship/Industry Oriented Mini Project:**

There shall be an Internship/Industry Oriented Mini Project in collaboration with an industry from their specialization. Students shall register for this project immediately after III Year II Semester Examinations and pursue it during summer vacation. Internship should be carried out at an organization (or) Industry. The Industry Oriented Mini Project shall be submitted in a report form and presented before the committee in IV Year I Semester before the semester end examination. It shall be evaluated for 100 external marks. The committee consists of an External Examiner, Head of the Department, Supervisor of the

Industry Oriented Mini Project/Internship, and a Senior Faculty Member of the Department.

9.7.1 For evaluating industry-oriented mini-projects, it is preferable to appoint an external examiner from the industry, ideally from one of the organizations/ industries with which the institute has established / proposing to establish collaborations.

9.8 **UG Project Work:**

9.8.1 The UG project work shall be initiated at the beginning of the IV Year II Semester and the duration of the project work is one semester. The student must present in consultation with his/her supervisor, the title, objective and plan of action of his/her Project work to the departmental committee for approval within two weeks from the commencement of IV Year II Semester. Only after obtaining the approval of the departmental committee, the student can start his/her project work.

9.8.2 Student has to submit project work report at the end of IV Year II Semester. The project work shall be evaluated for 100 marks. Out of which 40 marks and 60 marks are allocated for CIE and External Evaluation respectively.

9.8.3 For internal evaluation, the departmental committee consisting of Head of the Department, Project Supervisor and a Senior Faculty Member shall evaluate the project work for 40 marks. The distribution of marks is as follows:

Objective(s) of the work done	- 05 Marks
Methodology adopted	- 15 Marks
Results and Discussions	- 15 Marks
Conclusions and Outcomes	- 05 Marks
TOTAL	**– 40 Marks**

9.8.4 The External Evaluation shall be conducted by the external examiner for a total of 60 marks. It shall comprise the presentation of the work, communication skills, and viva-voce, with a weightage of 20 marks, 15 marks, and 25 marks respectively.

The topics for main Project shall be different from the topic of Industry Oriented Mini Project/ Internship/SDC. 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.

9.8.5 For conducting viva-voce exam of project work, Principal selects an external examiner from the list of experts in the relevant branch submitted by the Head of the Department.

9.8.6 A student who has failed, may re-appear once for the above evaluation, when it is scheduled again; if student fails in such 'one re-appearance' evaluation also, he/she has to appear for the same in the next subsequent year, as and when it is scheduled.

9.9 Skill Development Courses:

Four Skill Development Courses are included in the Curriculum in II-I, II-II, III-I and III-II semesters. Each Skill Development Course carries one credit. The evaluation pattern will be same as that of a laboratory course including the internal and external assessments.

The objective of Skill Courses is to develop the cognitive skills as well as the psycho-motor skills.

9.10 **Value-Added Courses:**

The evaluation of Value-Added Courses shall be similar to that of theory courses. However, the scheduling of these mid-term exams and semester-end examinations may not be combined with main-stream examinations. One hour /45 mins proctored mid-term examination shall be conducted in the regular class by the same subject teacher. It should not impact the conduct of other classes on that day.

The scheduling of the semester-end examinations shall also be intimated by the Institute time to time.

10.0 Grading Procedure

10.1 Absolute grading system is followed for awarding the grades to each course

10.2 Grades will be awarded to indicate the performance of students in each Theory, Laboratory, Industry-Oriented Mini Project/ Internship/ Skill development course and Project Work. Based on the percentage of marks obtained (Continuous Internal Evaluation plus Semester End Examination, both taken together) as specified in clause 8 above, a letter grade shall be given as explained in the following clause.

10.3 To measure the performance of a student, a 10-point grading system is followed. The mapping between the percentage of marks secured and the corresponding letter grade is as follows:

Range of % of Marks Secured in a Course	Letter Grade	Grade Points (GP)
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

10.4 A student shall be declared successful or 'passed' in a semester, if he/she secures **'C'** grade or above in every course (ie GP ≥ 5).

10.5 A student who has obtained an '**F'** grade in any course shall be deemed to have '**failed'** and is required to re-appear for a supplementary exam as and when conducted. In such cases, internal marks in those courses will remain the same as those obtained earlier.

10.6 To a student who has not appeared for an examination in any course, '**Ab'** grade will be allocated in that course, and he/she is deemed to have '**Failed'**. Such student will be required to re-appear for supplementary/make-up exam as and when conducted. The internal marks in those courses will remain the same as those obtained earlier.

10.7 The students earn a Grade Point (G) in each course, on the basis of letter grade secured in that course. Every student who passes a course will receive grade point **GP ≥ 5** ('C' grade or above).

10.8 The 'Credit Points' (C) are computed by multiplying the grade point with credits for a given course.

Credit Points (C) = Grade Point (G) x Credits

10.9 The Semester Grade Point Average (SGPA) is calculated only when all the courses offered in a semester are cleared by a student. It is calculated by dividing the sum of credit points (ΣCG) secured from all courses registered in a semester, by the total number of credits registered during that semester. SGPA is rounded off to **two** decimal places. SGPA for each semester is thus computed as

SGPA = { Σ□ □□ □□ } / { Σ□ □=□ □□ }

where 'i' is the course indicator index (considering all courses in a semester), 'N' is the no. of courses registered for the semester (as listed under the course structure of the branch), C_i is the no. of credits allotted to the i^{th} course, and G_i

represents the grade points corresponding to the letter grade awarded for that i^{th} course.

10.10 If a student earns more than 160 credits, only the courses corresponding to the best 160 credits shall be considered for the computation of CGPA of B.Tech. degree.

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 for the courses correspond to best 160 credits out of **all** registered courses in **all** semesters, and the total number of credits correspond to those selected courses. CGPA is rounded off to **two** decimal places. CGPA is thus computed at the end of each semester, from the I year II semester onwards, as per the formula

$$\mathbf{CGPA = \{ \sum^{M} C_j G_j \} / \{ \sum^{M} C_j \}}$$

where '**M'** is the total no. of courses corresponding to the best 160 credits from the courses registered in all eight semesters, 'j' is the course indicator index (takes into account all courses from 1 to 8 semesters), C_j is the no. of credits allotted to the j^{th} course, and G_j represents the grade points (GP) corresponding to the letter grade awarded for that j^{th} course.

Illustration of the Calculation of SGPA:

Course	Credits	Letter Grade	Grade Points	Credit Points
Course 1	4	A	8	4 x 8 = 32
Course 2	3	O	10	3 x 10 = 30
Course 3	3	C	5	3 x 5 = 15
Course 4	3	B	6	3 x 6 = 18
Course 5	3	A	8	3 x 8 = 24
Course 6	2	A+	9	2 x 9 = 18
Course 7	1	C	5	1 x 5 = 5
Course 8	1	O	10	1 x 10 = 10
	20			152

SGPA = 152/20 = 7.6

The CGPA of the entire B.Tech. programme shall be calculated considering the best 160 credits earned by the student

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

10.13 SGPA of a semester will be mentioned in the semester Memorandum of Grades if all courses of that semester are cleared in first attempt. Otherwise, the SGPA shall be mentioned only on the Memorandum of Grades in which sitting he passed his last exam in that semester.

11.0 Declaration of Results and issue of Grade Memo

11.1 While declaring the results, the web-version should display the marks earned by the students with the internal and external marks break-up. However, in the memorandum of grades, the marks need not be shown

After the completion of each semester, a certificate of memorandum of grades shall be issued to all the registered students, indicating the letter grades and credits earned. It will show the details of the courses registered (course code, course title, no. of credits), letter grade and credits earned.

12.0 Withholding of Results

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

13.0 Supplementary Examinations:

13.1 At the end of each semester, along with regular semester examinations, supplementary examinations shall be conducted for the students who have back-log subjects.

13.2 Advanced supplementary examinations in IV Year II Semester courses may be conducted for those who failed in any course offered in IV Year II Semester. It may enable the students to receive their B.Tech. provisional certificate at an early date. Advanced supply examinations may be scheduled within one month period after the declaration of the final semester results.

There shall be no supplementary examination in the successive semester. The students who could not secure any pass grade in advance supplementary examinations have to wait for regular series examination of next batch to write their back-log examination.

14.0 Promotion Rules

S.No.	Promotion	Conditions to be Fulfilled
1	First year first semester to first year second semester	Regular course of study of first year first semester and fulfilment of attendance requirement.
2	First year second semester to Second year first semester	(i) Regular course of study of first year second semester and fulfilment of attendance requirement (ii) Must have secured at least 25% of the total credits up to first year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
3.	Second year first semester to Second year second semester	Regular course of study of second year first semester and fulfilment of attendance requirement.
4	Second year second semester to Third year first semester	(i) Regular course of study of second year second semester and fulfilment of attendance requirement. (ii) Must have secured at least 25% of the total credits up to second year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
5	Third year first semester to Third year second semester	Regular course of study of third year first semester and fulfilment of attendance requirement.
6	Third year second semester to Fourth year first semester	Regular course of study of third year second semester and fulfilment of attendance requirement.
7	Fourth year first semester to Fourth year second semester	Regular course of study of fourth year first semester and fulfilment of attendance requirement.

15.0 Re-admission after Detention

i. A student detained due to lack of credits, shall be promoted to the next academic year only after acquiring the required number of credits.

ii. A student detained due to shortage of attendance shall be admitted in the same semester in the successive academic years.

iii. When a student is readmitted in the following academic years, the academic regulations under which the student seeks re-admission shall only be applicable to this student, not the academic regulations in which he got admitted in his/her first year of study.

16.0 Credit Exemption

A student (i) shall register for all courses covering 164 credits as specified and listed in the course structure and (ii) earn 160 or more credits to successfully complete the undergraduate programme.

- Best 160 credits shall be considered for CGPA computation. The student can avail exemption of courses ***totaling up to 4 credits*** other than Professional core courses, Laboratory Courses, Seminars, Project Work and Field Based Research Project / Industry Oriented Mini Project / Internship, for optional drop out from these 164 credits registered;
- The semester grade point average (SGPA) of each semester shall be mentioned at the bottom of the grade card, when all the subjects in that semester have been passed by the student.
- Credits earned by the student in either a Minor or Honors program cannot be counted towards the required 160 credits for the award of the B.Tech. degree.

17.0 Award of Degree

17.1 A student who registers for all the courses specified in the course structure and secures the required number of 160 credits 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.

17.2 A student who qualifies for award of the degree as listed in item 17.1 shall be placed in the following classes.

17.3 A student with final CGPA (at the end of the undergraduate programme) ≥ 7.5, and fulfilling the following conditions - shall be placed in '**First Class with Distinction'**:

i) Should have passed all the courses in '**First Appearance'**.

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 ≥ 7.5 shall be placed in **'First Class'.**

17.4 Students with final CGPA (at the end of the undergraduate programme) ≥ 6.5 but < 7.5 shall be placed in **'First Class'.**

17.5 Students with final CGPA (at the end of the undergraduate programme) ≥ 5.5 but < 6.5, shall be placed in '**Second Class'**.

17.6 All other students who qualify for the award of the degree (as per item 17.1), with final CGPA (at the end of the undergraduate programme) ≥ 5.00 but < 5.5, shall be placed in '**pass class**'.

17.7 **Grace Marks:**

Grace marks shall be given to those students who complete the course work of four year B.Tech. degree, not secured pass grade in not more than three subjects and adding a specified grace marks enables the student to pass the subject(s) as well as gets eligibility to receive the provisional degree certificate.

Grace marks for students admitted under the NR-25 Academic Regulations should not exceed **0.15%** of the total maximum marks in all eight semesters (excluding the marks allocated for value added courses and skill development courses).

18.0 Award of Gold Medals

18.1 Students fulfilling the conditions listed under item 17.3 alone will be eligible for award of '**Gold Medal**'.

18.2 If more than one student secures the same highest CGPA, then the following tie resolution criteria, in the same order of preference shall be followed for selecting the Gold Medal winner, until the tie is resolved: 1) more number of times secured highest SGPAs, ii) more number of O and A+ grades in that order and iii) highest SGPA in the order of first semester to eight semester.

19.0 Conversion of CGPA into equivalent Percentage of Marks

19.1 The following formula shall be used for the conversion of CGPA into equivalent marks, whenever it is necessary.

$$\text{Percentage (\%) of Marks} = (\text{Final CGPA} - 0.5) \times 10$$

20.0 Honours and Minor Degree Programs

Honours and Minor Degree programs will be available in all branches of B.Tech. degree. Minor Degree programs will commence from II Year II Semester and continue till IV Year I semester and Honours Degree programs will commence from III Year I Semester and continue till IV Year II semester.

21.0 Multiple Entry Multiple Exit Scheme (MEME)

21.1 **Exit Option after Second Year:**

Students enrolled in the 4-Year B.Tech. program are permitted to exit the program after successful completion of the second year (B.Tech. II Year II Semester). The students who desire to exit after the II year shall formally inform the exit plan one semester in advance i.e. at the commencement of II Year II Semester itself. Such students need to fulfil the additional requirements as specified in Clause 21.2 described below.

Upon fulfilling the requirements like earning all the credits up to II Year II Semester and successfully completing the additional requirements, the students will be awarded a 2-Year Undergraduate (UG) Diploma in the concerned engineering branch.

21.2 **Additional Requirements for Diploma Award:**

To qualify for the diploma under the exit option, students must also complete 2 additional credits through one of the following Institute-prescribed pathways:

Work-based Vocational Course:

Participation in a practical, hands-on vocational training program relevant to the engineering field, typically conducted during the summer term.

Internship/Apprenticeship:

Completion of a minimum 8-week internship or apprenticeship in their related field to gain practical industry exposure.

In addition, students must clear any associated course(s) and submit the internship/ apprenticeship report as per the Institute schedule and guidelines.

21.3 **Re-entry into the B.Tech. Program**

Students who have exited the B.Tech. program with a 2-Year UG Diploma may apply for re- entry into the Third Year (Fifth Semester) of the B.Tech. program. Re-entry is subject to the following conditions:

- The student must surrender the awarded UG Diploma Certificate.
- Students who wish to rejoin in III Year must join the same B.Tech. program and same college from which the student exited. Before rejoining, students should check for continuation of the same branch at the college. If the specific branch is closed in that particular college, then student should consult the Institute for the possible alternative solutions.

- Re-registered students will be governed by the academic regulations in effect at the time of re-entry, regardless of the original regulations under which they were admitted.
- If a student opts to continue his/her studies without a gap after being awarded the diploma, they must register for the third-year courses before the commencement of classwork.

21.4 **Break in Study and Maximum Duration**

Students are allowed to take a break of up to four years after completion of II Year II Semester with prior Institute permission through the Principal of the college.

Re-entry after such a break is subject to the condition that the student completes all academic requirements within twice the duration of the program (i.e., within 8 years for a 4-year B.Tech. program).

22.0 Transitory Regulations for the students re-admitted in NR-25 Regulations:

22.1 Transitory regulations are applicable to the students detained due to shortage of attendance as well as detained due to the shortage of credits and seek permission to re-join the B.Tech. programme, where NR-25 regulations are in force.

22.2 A student detained due to shortage of attendance and re-admitted in NR-25 regulations: Such students shall be permitted to join the same semester, but in NR-25 Regulations.

22.3 A student detained due to shortage of credits and re-admitted in NR-25 regulations: Such students shall be promoted to the next semester in NR-25 regulations, only after acquiring the required number of credits as per the corresponding regulations of his/her previous semester.

22.4 A student who has failed in any course in a specific regulation has to pass those courses in the same regulations.

22.5 If a student is readmitted to NR-25 Regulations and has any course with 80% of syllabus common with his/her previous regulations, that particular course in R-25 Regulations will be substituted by an equivalent course of NR-23 regulations by the Institute. All these details are summarized in a set of look- up Table; one set for each B. Tech. branch.

22.6 **Look Up Table of equivalence courses**

22.6.1 A lookup table will be provided for the benefit of students. This lookup table will include all the courses to be registered by students who have been re-admitted under the NR-25 Academic Regulations from the NR-23 Academic Regulations. Separate lookup tables will be provided for the following categories of students:

1. Students re-admitted into the I Year II Semester of the NR-25 Regulations
2. Students re-admitted into the II Year I Semester of the NR-25 Regulations
3. Students re-admitted into the II Year II Semester of the NR-25 Regulations
4. Students re-admitted into the III Year I Semester of the NR-25 Regulations
5. Students re-admitted into the III Year II Semester of the NR-25 Regulations
6. Students re-admitted into the IV Year I Semester of the NR-25 Regulations
7. Students re-admitted into the IV Year II Semester of the NR-25 Regulations For every B.Tech. branch there shall be separate set of seven lookup tables.

22.6.2 Applicability of Look-up Table: The above look-up table shall be applicable for i) students who seek readmission from NR-23 regulations to NR-25 regulation for the equivalence courses.

22.6.3 These look-Up Tables are not applicable for the students who seek transfer from other Institution to NRCM. Such students should consult the University regarding equivalent courses.

22.7 The NR-25 Academic Regulations are applicable to a student from the year of re-admission. However, the student is required to complete the study of B.Tech. degree within the stipulated period of eight academic years from the year of first admission.

23.0 Student Transfers:

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

23.2 The students seeking transfer to NRCM from various other Universities/Institutions is having back-logs at the previous University/institute, have to pass the courses offered at NRCM which are equivalent to the failed courses at the previous University/institute.

23.3 The transferred students from other Universities/Institutions to NRCM, shall be given a chance to write CBTs for getting CIE component in the **equivalent course(s)** as per the clearance letter issued by the University.

24.0 Value Added Courses

24.1 Faculty members who have received a certificate in Innovation and Entrepreneurship / Entrepreneurship from a reputed foundation/organization may be given preference to teach the "Innovation and Entrepreneurship" course. This certificate course should include an assessment. Total training duration (online or physical), excluding assessment, should be at least 30 hours. Faculty

members from all disciplines with innovative mindset and aptitude to co-create an entrepreneurial ecosystem are eligible to teach this subject.

24.2 Faculty members who have credited a course on Intellectual Property Rights in their UG or PG programme or credited an equivalent course in MOOCs platform/ reputed foundation/ organization in which assessment is a part, may be given preference to teach the elective course on Intellectual Property Rights.

24.3 To ensure quality delivery and standardization in teaching the **Indian Knowledge System (IKS)** and other value-added courses, the following guidelines must be adhered to:

i) faculty members must undergo a Faculty Development Program (FDP) organized by UGC-MMTTC (Malaviya Mission Teacher Training Centre), **or** Any other recognized and competent institution/organization offering similar certified programs,

ii) the total instructional duration of the FDP should be a around 32 hours or more,

iii) all sessions in the FDP must be conducted by certified and qualified resource persons with recognized expertise in the respective domains,

iv) A formal assessment component must be included as part of the FDP.

25.0 Mapping with the Sustainable Development Goals

All the courses specified in the course structure of every programme are mapped with the one or more sustainable development goals.

26.0 Scope

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

26.2 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.

26.3 The Institute 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 Institute authorities.

26.4 Where the words “he”, “him”, “his”, occur in the regulations, they include “she”, “her”, “hers”.

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ACADEMIC REGULATIONS FOR B.TECH (LATERAL ENTRY SCHEME) FROM THE AY 2026-27

Eligibility for the award of B.Tech. Degree (LES)

1. The LES students after securing admission shall pursue a course of study for not less than three academic years and not more than six academic years
2. The student shall register for 123/124 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 student can avail exemption of courses ***totaling up to 3/4 credits*** other than Professional core courses, Laboratory Courses, Seminars, Project Work and Field Based Research Project/ Industry Oriented Mini Project / Internship, for optional drop out
4. The students, who fail to fulfil the requirement for the award of the degree in six academic years from the year of admission, shall forfeit their seat in B.Tech
5. The attendance requirements of B.Tech. (Regular) shall be applicable to B.Tech. (LES).
6. **Promotion rule**

S. No	Promotion	Conditions to be fulfilled
1	Second year first semester to Second year second semester	Regular course of study of second year first semester and fulfilment of attendance requirement.
2	Second year second semester to Third year first semester	(i) Regular course of study of second year second semester and fulfilment of attendance requirement. (ii) Must have secured at least 25% of the total credits up to second year second semester from all the relevant regular and supplementary examinations, whether the student takes those examinations or not.
3	Third year first semester to Third year second semester	Regular course of study of third year first semester and fulfilment of attendance requirement.
4	Third year second semester to Fourth year first semester	Regular course of study of third year second semester and fulfilment of attendance requirement.
5	Fourth year first semester to Fourth year second semester	Regular course of study of fourth year first semester and fulfilment of attendance requirement.

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

8. LES students are not permitted to exit the B.Tech. program after completion of second year (B.Tech. II Year II Semester).

MALPRACTICE RULES DISCIPLINARY ACTION FOR/ IMPROPER CONDUCT IN EXAMINATION

	Nature of Malpractices/ Improper conduct	Punishment
	If the student:	
1 (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, cell phones, pager, palm computers or any other form material concerned with or related to the subject of the examination (theory or practical) in which student is appearing but has not made use of (material shall include any marks on the body of the student which can be used as an aid in the subject of the examination	Expulsion from the examination hall and cancellation of the performance in that subject only
b	Gives assistance or guidance or receives it from any other student orally or by any other body language methods or communicates through cell phones with any student or persons in or outside the exam hall in respect of any matter	Expulsion from the examination hall and cancellation of the performance in that subject only of all the students involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the student is appearing.	xpulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The hall ticket of the student is to be cancelled and sent to the University. Academic planner tools
3	Impersonates any other student in connection with the examination.	The student who has impersonated shall be expelled from examination hall. The student is also debarred and forfeits the seat. The performance of the original student who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be allowed to appear for examinations of the remaining subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by

		the student is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the chief superintendent/assistant – superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the student(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The students also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.

	disrupt the orderly conduct of the examination.	
7.	Leaves the exam hall taking away answer script or intentionally tears off the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat.
8.	Possesses any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred and forfeits the seat.
9.	If student of the college, who is not a student for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8	xpulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The student is also debarred and forfeits the seat. Person(s) who do not belong to the college will be handed over to the police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the student has already appeared for including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the student has appeared for including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the	

	University for further action to award a suitable punishment. Academic planner tools	

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PROGRAM OUTCOMES (POs):

PO1: Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/development of solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct investigations:: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering tool usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The engineer and the world: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: Project management and finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-long learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

PROGRAM SPECIFIC OUT COMES (PSOs):

PSO1: Be able to develop competency in formulating design using basic mathematics and modern tools.

PSO2: Be able to manufacture a product to meet the societal needs.

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PSO3: Be able to work professionally in thermal engineering domain area.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS):

PEO-I: To apply knowledge of fundamental sciences and engineering skills required to solve mechanical engineering problems of a complex kind.

PEO-II: To function as a coherent unit leading multidisciplinary design teams, and deliver results based on sound principles considering functionality, elegance, safety and sustainability.

PEO-III: To have an outlook beyond mechanical engineering and step into various interdisciplinary streams and to pursue professional practices in industries.

KNOWLEDGE AND ATTITUDE PROFILE (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, reuse of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

SUSTAINABLE DEVELOPMENT GOALS (SDGs):

SDG-1: No Poverty

- NRCM provides scholarships through state and central government schemes to over 950+ students annually.
- Institutional financial aid covers tuition and transportation for economically weaker sections.
- The Career Development Center runs skill-based training programs to uplift socio-economically disadvantaged students.

SDG-2: Zero Hunger

- Mid-day meals and subsidized food are made available for hostel and day-scholar students from poor backgrounds.
- The college practices food waste minimization through monitored mess operations and awareness programs.
- Student-led initiatives coordinate food donation drives in collaboration with NGOs.

SDG-3: Good Health and Well-being

- NRCM organizes regular medical check-up camps in collaboration with local hospitals.
- On-campus health center provides basic care and first-aid with visiting doctors on call.
- Physical education programs and wellness workshops are embedded into the campus lifestyle.

SDG-4: Quality Education

- NRCM ensures inclusive learning through bridge courses and remedial classes.
- Digital classrooms and LMS platforms are utilized to support blended learning.
- The institution partners with industries to provide internships and certification programs.

SDG-5: Gender Equality

- NRCM maintains a balanced gender ratio and has a strong anti-harassment cell.
- Women empowerment cell conducts regular workshops on leadership and self-defense.
- Female faculty and student representation is promoted in all committees.

SDG-6: Clean Water and Sanitation

- NRCM has implemented rainwater harvesting and efficient water usage systems.
- The campus ensures clean drinking water and hygienic sanitation facilities for all.
- Awareness programs on water conservation are conducted for students and staff.

SDG-7:

- **Affordable and Clean Energy**
- Solar panels have been installed on campus buildings for sustainable power.
- Energy audits are conducted periodically to monitor consumption patterns. NRCM promotes the use of LED lights and energy-efficient appliances.

SDG-8: Decent Work and Economic Growth

- The Career Development Center facilitates placements and skill development programs.
- Entrepreneurship cells and incubation support are provided for startups.
- MoUs with companies offer real-time projects and industrial exposure.

SDG-9: Industry, Innovation, and Infrastructure

- NRCM has established research labs, IoT, and AI centers of excellence.
- Technical fests and hackathons are organized to boost innovation.
- Students participate in national-level innovation competitions.

SDG-10: Reduced Inequalities

- Scholarships are offered irrespective of caste, creed, or gender.
- Student mentoring and counseling ensure inclusive academic support.
- Programs are conducted to sensitize students on equity and inclusion.

SDG-11: Sustainable Cities and Communities

- Campus greenery is maintained with over 2,000 trees and plants.
- NRCM collaborates with local bodies on urban development projects.
- Students are encouraged to design sustainable housing and smart city models.

SDG-12: Responsible Consumption and Production

- Waste segregation and recycling units are active on campus.
- Workshops on sustainable practices are included in the curriculum.
- Procurement policies emphasize eco-friendly and reusable materials.

SDG-13: Climate Action

- NRCM conducts climate change awareness campaigns and tree plantation drives.
- Environmental Science is mandatory for all students.
- Participation in the International Day for Climate Action is encouraged.

SDG-14: Life Below Water

- Students engage in coastal clean-up drives and plastic awareness campaigns.
- Environmental clubs study marine pollution and water ecosystem conservation.
- Projects on microplastic impact and aquatic health are taken up.

SDG-15: Life on Land

- NRCM maintains a botanical garden and biodiversity registers on campus.
- Tree-planting initiatives are undertaken regularly by NSS and Eco Club.
- Wildlife protection and biodiversity conservation seminars are organized.

SDG-16: Peace, Justice and Strong Institutions

- NRCM has transparent grievance redressal mechanisms and student councils.
- Sessions on ethics, human values, and constitutional duties are mandatory.
- Legal awareness and democratic participation programs are held annually.

SDG-17: Partnerships for the Goals

- NRCM actively collaborates with NGOs, industries, and academic institutions.
- Participates in global SDG networks and knowledge exchanges.
- Engages in MoUs with sustainability-focused organizations.

B.TECH in MECHANICAL ENGINEERING

COURSE STRUCTURE & SYLLABUS (NR25 Regulations)

Applicable from AY 2025-2026 Batch I Year I Semester

S.No.	Course Code	Course Title	C	L	T	P	Credits
1.	25MA101	Matrices and Calculus	BS	3	1	0	4
2.	25PH102	Advanced Engineering Physics	BS	3	0	0	3
3.	25CS103	C Programming and Data Structures	ES	3	0	0	3
4.	25ME104	Engineering Drawing and Computer Aided Drafting	ES	2	0	2	3
5.	25EE105	Elements of Electrical and Electronics Engineering	ES	3	0	0	3
6.	25CS106	C Programming and Data Structures Lab	ES	0	0	2	1
7.	25EE107	Elements of Electrical and Electronics Engineering Lab	ES	0	0	2	1
8.	25PH108	Advanced Engineering Physics Lab	BS	0	0	2	1
9.	25ME110	Engineering Workshop	ES	0	0	2	1
		Induction Program		-	-	-	-
		Total Credits		**15**	**1**	**8**	**20**

I Year II Semester

S.No.	Course Code	Course Title	C	L	T	P	Credits
1.	25MA201	Ordinary Differential Equations and Vector Calculus	BS	3	0	0	3
2.	25CH202	Applied Chemistry	BS	3	0	0	3
3.	25EN203	English for Skill Enhancement	HS	3	0	0	3
4.	25CS204	Python Programming	ES	3	0	0	3
5.	25ME205	Material Science and Metallurgy	ES	3	0	0	3
6.	25ME206	Engineering Mechanics	ES	3	0	0	3
7.	25CH207	Engineering Chemistry Lab	BS	0	0	2	1
8.	25CS209	Python Programming Lab	ES	0	0	2	1
9.	25EN210	English Language and Communication Skills Lab	HS	0	0	2	1
		Total Credits		**17**	**0**	**8**	**21**

II YEAR I SEMESTER

S.No.	Course Code	Course Title	C	L	T	P	Credits
1.	25ME301	Mechanics of Solids	PC	3	0	0	3
2.	25MA302	Probability, Statistics and Complex Variables	BS	3	0	0	3
3.	25ME303	Thermodynamics	PC	3	1	0	4
4.	25ME304	Production Technology	PC	3	0	0	3
5.	25ME305	Fluid Mechanics and Hydraulic Machines	PC	3	0	0	3
6.	25ME306	Production Technology Lab	PC	0	0	2	1
7.	25ME307	Material Science and Mechanics of Solids Lab	PC	0	0	2	1
8.	25ME308	Fluid Mechanics and Hydraulic Machines Lab	PC	0	0	2	1
9.	25ME309	Design Thinking and Ideation	SD	0	0	2	1
	25ME301	Mechanics of Solids	PC	3	0	0	3
		Total Credits		**15**	**1**	**10**	**20**

II YEAR II SEMESTER

S.No.	Course Code	Course Title	C	L	T	P	Credits
1.	25ME401	Kinematics of Machinery	PC	3	0	0	3
2.	25ME402	Thermal Engineering-I	PC	3	0	0	3
3.	25ME403	Design of Machine Elements	PC	3	0	0	3
4.	25ME404	Instrumentation and Control Systems	PC	3	0	0	3
5.	25ME405	Operations Research	PC	2	0	0	2
6.	25MB406	Innovation and Entrepreneurship	PC	2	0	0	2
7.	25ME407	Conventional and Computer Aided Machine Drawing	PC	0	0	2	1
8.	25ME408	Instrumentation and Control Systems Lab	PC	0	0	2	1
9.	25ME409	Thermal Engineering-I Lab	PC	0	0	2	1
10.	25ME410	Data Analytics and Python for Engineers	SD	0	0	2	1
11.	25VA400	Indian Knowledge System	VA	1	0	0	1
		Total Credits		**17**	**0**	**8**	**21**

III YEAR I SEMESTER

S.No.	Course Code	Course Title	C	L	T	P	Credits
1.	25ME501	Design of Transmission Elements	PC	3	0	0	3
2.	25ME502	Thermal Engineering- II	PC	3	0	0	3
3.	25ME503	Metrology and Machine Tools	PC	3	0	0	3
4.		Professional Elective-I	PE	3	0	0	3
5.		Open Elective-I	OE	2	0	0	2
6.	25ME508	Thermal Engineering-II Lab	PC	0	0	2	1
7.	25ME509	Metrology and Machine Tools Lab	PC	0	0	2	1
8.	25ME510	Modelling and Drafting Lab	PC	0	0	2	1
9.	25ME511	Field Based Research Project	PC	0	0	4	2
10.	25ME512	Modelling and Simulation Tools Lab	SD	0	0	2	1
11.	25VA500	Gender Sensitization and Human Values and Professional Ethics	VA	1	0	0	1
		Total Credits		**15**	**0**	**12**	**21**

III YEAR II SEMESTER

S.No.	Course Code	Course Title	C	L	T	P	Credits
1.	25ME601	Dynamics of Machinery	PC	3	0	0	3
2.	25ME602	Heat Transfer	PC	3	1	0	4
3.	25MB603	Business Economics and Financial Analysis	BS	3	0	0	3
4.		Professional Elective-II	PE	3	0	0	3
5.		Open Elective–II	OE	2	0	0	2
6.	25ME608	Heat Transfer Lab	PC	0	0	2	1
7.	25ME609	Applied Manufacturing Lab	PC	0	0	2	1
9.	25ME610	Kinematics and Dynamics Lab	PC	0	0	2	1
10.	25EN611	English for Employability Skills Lab	BS	0	0	2	1
		Total Credits		**15**	**1**	**10**	**20**

IV YEAR I SEMESTER

S.No.	Course Code	Course Title	C	L	T	P	Credits
1	25ME701	Finite Element Methods	PC	3	0	0	3
2	25ME702	Robotics and Automation	PC	3	0	0	3
3	25ME703	Industrial Engineering and Management	PC	3	0	0	3
4		Professional Elective-III	PE	3	0	0	3
5		Professional Elective–IV	PE	3	0	0	3
6		Open Elective –III	OE	2	0	0	2
7	25ME712	Troubleshooting of Mechanical Systems Lab	PC	0	0	2	1
8	25ME713	Robotics and Automation Lab	PC	0	0	2	1
9	25ME714	Industry Oriented Mini Project/Internship	PC	0	0	4	2
		Total Credits		**17**	**0**	**08**	**21**

IV YEAR II SEMESTER

S.No.	Course Code	Course Title	C	L	T	P	Credits
1		Professional Elective – V	PE	3	0	0	3
2		Professional Elective – VI	PE	3	0	0	3
3	25ME809	Project Work	PC	0	0	42	14
		Total Credits		**6**	**0**	**42**	**20**

PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE – I

25ME504	Product Design and Manufacturing
25ME505	Hydraulics and Pneumatics
25ME506	CAD&CAM
25ME507	Renewable Energy Sources

PROFESSIONAL ELECTIVE – II

25ME604	Additive Manufacturing
25ME605	Micro Manufacturing
25ME606	Artificial Intelligence in Mechanical Engineering
25ME607	Advanced Machining Processes

PROFESSIONAL ELECTIVE – III

25ME704	Mechanical Vibrations
25ME705	Mechanics of Composite Materials and Structures
25ME706	Refrigeration and Air-Conditioning
25ME707	Mechatronic Systems

PROFESSIONAL ELECTIVE – IV

25ME708	Plant Maintenance and Reliability Engineering
25ME709	Total Quality Management
25ME710	Database Management Systems
25ME711	Production Planning and Control

PROFESSIONAL ELECTIVE – V

25ME801	Power Plant Engineering
25ME802	Computational Fluid Dynamics
25ME803	Electric and Hybrid Vehicles
25ME804	Artificial Neural Networks

PROFESSIONAL ELECTIVE – VI

25ME805	Automobile Engineering
25ME806	Sustainable Engineering
25ME807	AI/ML for Design Analysis
25ME808	Project Management

OPEN ELECTIVES

OPEN ELECTIVE-I:

25ME513	Optimization Techniques
25ME514	Industrial Robotics

OPEN ELECTIVE-II:

25ME611	Artificial Intelligence in Mechanical Engineering
25ME612	Non-Conventional Sources of Energy

OPEN ELECTIVE-III:

25ME715	Engineering Materials
25ME716	Digital Manufacturing

MATRICES AND CALCULUS

B Tech I Year I Sem: CE / CSE / CSE (AI&ML) / CSE (CS) / ECE / EEE / IT / ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
25MA101	Basic Sciences	**L**	**T**	**P**	4	**CIE**	**SEE**	**TOTAL**
		3	1	0		40	60	100
Contact Classes: 45	**Tutorial Classes:** 15	**Practical Classes:** Nil				**Total Classes:** 60		

COURSE OBJECTIVES:

To learn

1. How to Solve systems of linear equations using matrix methods
2. Analyzing eigenvalues and eigenvectors in diagonalization of matrices and apply them to reduce quadratic forms to canonical form
3. Geometrical approach to the mean value theorems and their application to the mathematical problems
4. Finding maxima and minima of functions of two and three variables
5. Evaluation of multiple integrals and their applications

COURSE OUTCOME:

Student will be able to

1. Apply matrix operations to solve systems of linear equations using rank and inverse, Gauss Seidel methods
2. The student will reduce quadratic forms to canonical form using eigenvalues and eigenvectors and interpret their nature for engineering applications
3. To apply mean value theorems in analyzing functions, study and trace curves for better visualization
4. To apply partial derivatives in solving problems related to maxima, minima, and engineering applications
5. Evaluate double and triple integrals in various coordinate systems and apply them to compute areas and volumes

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 and Non-Homogeneous equations. 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 matrix – Cayley-Hamilton Theorem (without proof) – Finding inverse and power of a matrix by Cayley-Hamilton Theorem. Quadratic forms and Nature of the Quadratic Forms – Reduction of Quadratic form to canonical form by Orthogonal Transformation

UNIT-III:

Single Variable Calculus

Limit and Continuous of functions and its properties. 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 (All the theorems without proof). Curve Tracing: Curve tracing in cartesian coordinates

UNIT-IV:

Multivariable Calculus (Partial Differentiation and applications)

Definitions of Limit and continuity – 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) – Change of variables for double integrals (Cartesian to polar). Evaluation of Triple Integrals – Change of variables for triple integrals (Cartesian to Spherical and Cylindrical polar coordinates). Applications: Areas by double integrals and volumes by triple integrals

TEXTBOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
2. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5th Editon, 2016

REFERENCE BOOKS:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint, 2002
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008
4. H. K. Dass and Er. Rajnish Verma, Higher Engineering Mathematics, S Chand and Company Limited, New Delhi

ADVANCED ENGINEERING PHYSICS

B Tech I Year I Semester: CE / CSE (AI&ML) / CSE (CS) / EEE / IT / ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25PH102	Basic Sciences	3	0	0	3	40	60	100
Contact Classes: 45	**Tutorial Classes:** Nil	**Practical Classes:** Nil				**Total Classes:** 45		
Prerequisite: 10+2 Physics								

COURSE OBJECTIVES:

1. To study crystal structures, defects, and material characterization techniques like XRD and SEM
2. To understand fundamental concepts of quantum mechanics and their applications in solids
3. To introduce quantum computing principles, quantum gates, and basic quantum algorithms
4. To learn the properties and applications of magnetic and dielectric materials
5. To explore the working and applications of lasers and fibre optics in modern technology

COURSE OUTCOME:

1. Analyze crystal structures, identify defects, and apply different technique for material characterization
2. Apply quantum mechanical principles to explain particle behaviour in infinite potential well
3. Analyze the behavior of Qubits using Bloch's sphere representation, explore quantum gates and measurements, and evaluate quantum algorithms such as Deutsch-Jozsa, Shor, and Grover
4. Classify magnetic and dielectric materials and evaluate their applications in emerging technologies
5. Analyze the construction and working of various types of LASERs and optical fibres, and evaluate their applications in modern technologies

UNIT-I:

Crystallography & Materials Characterization

Introduction: Unit Cell, Space Lattice, Basis, Lattice Parameters, Crystal Structures, Bravais Lattices, Packing Factor: SC, BCC, FCC; Miller Indices, Inter-Planar Distance.

Defects In Crystals (Qualitative): Point Defects, Line Defects, Surface Defects and Volume Defects. X -Ray Diffraction: Bragg's Law, Powder Method, Calculation of Average Crystallite Size Using Debye Scherrer's Formula.

Concept of Nanomaterials: surface to volume ratio, scanning electron microscopy (SEM): block diagram, working principle

UNIT-II:

Quantum Mechanics

Quantum Mechanics: Introduction, de-Broglie Hypothesis, Heisenberg Uncertainty Principle, postulates of quantum mechanics: operators in quantum mechanics, eigen values and eigen functions, expectation value;

Schrödinger's Time Independent Wave Equation, Physical Significance Of Wave Function, Particle in a 1-d Box, Bloch's theorem (qualitative), Kronig-Penney model (qualitative): E-k diagram, effective mass of electron, formation of energy bands, origin of bandgap, classification of solids, concept of discrete energy levels and quantum confinement in nanomaterials

UNIT-III:

Quantum Computing

Introduction, Linear Algebra for Quantum Computation, Dirac's Bra and Ket Notation and their Properties, Hilbert Space, Bloch's Sphere, Concept of Quantum Computer, Classical Bits, Qubits, Multiple Qubit System, Quantum Computing System for Information Processing, Evolution of Quantum Systems, Quantum Measurements, Entanglement, Quantum Gates, Challenges and Advantages of Quantum Computing over Classical Computation, Quantum Algorithms: Deutsch- Jozsa, Shor, Grover

UNIT-IV:

Magnetic and Dielectric Materials

Magnetic Materials: Classification of Magnetic Materials, Weiss Domain Theory of Ferromagnetism, Hysteresis, Soft and Hard Magnetic Materials, Synthesis of Ferrimagnetic Materials Using Sol-Gel Method.

Applications: Magnetic Hyperthermia for Cancer Treatment, Magnets for EV, Giant Magneto Resistance (GMR) device.

Dielectric Materials: Types Of Polarization (Qualitative): Electronics, Ionic & Orientation; Ferroelectric, Piezoelectric, Pyroelectric Materials and their applications: Ferroelectric Random- Access Memory (Fe-Ram), Load Cell and Fire Sensor

UNIT-V:

Laser and Fibre Optics

LASER: Introduction to Laser, Characteristics of Laser, Einstein Coefficients and Their Relations, Meta-Stable State, Population Inversion, Pumping, Lasing Action, Ruby Laser, He-Ne Laser, Semiconductor Diode Laser.

Applications: Bar Code Scanner, Lidar for Autonomous Vehicle.

Fibre Optics: Introduction to Fibre Optics, Total Internal Reflection, Construction of Optical Fibre, Acceptance Angle, Numerical Aperture, Classification of Optical Fibres, Losses in Optical Fibre.

Applications: Optical Fibre for Communication System, Sensor for Structural Health Monitoring

TEXTBOOKS:

1. Walter Borchardt-Ott, Crystallography: An Introduction, Springer
2. Charles Kittel, Introduction to Solid State Physics, John Wiley & Sons, Inc
3. Thomas G. Wong, Introduction to Classical and Quantum Computing, Rooted Grove
4. Modern Engineering Physics by Dr. K. Vijay Kumar, Dr. Chandralingam, S.Chand Publications

REFERENCE BOOKS:

1. Jozef Gruska, Quantum Computing, McGraw Hill
2. Michael A. Nielsen & Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press
3. John M. Senior, Optical Fiber Communications Principles and Practice, Pearson Education Limited

C PROGRAMMING AND DATA STRUCTURES

B Tech I Year I Semester: CE / ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25CS103	**Engineering Sciences**	**3**	**0**	**0**	**3**	**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Fundamentals of Computers								

COURSE OBJECTIVES:

1. To introduce the fundamentals of C programming constructs such as variables, operators, data types, control structures and I/O
2. To strengthen programming skills through modular programming using functions, recursion and arrays and strings
3. To provide knowledge of advanced C concepts including pointers, structures, unions and Dynamic memory allocation
4. To understand file concepts and enable students to apply operations on files
5. To provide insight into the basic concepts of data structures

COURSE OUTCOME:

The student will learn

1. To analyze problem-solving techniques and demonstrate proficiency in using control structures, arrays, functions and recursion to solve computational problems
2. To implement pointers, structure, and dynamic memory allocation for efficient program development
3. To perform file operations and manipulations using C programming
4. To analyze, debug, and optimize C programs to provide correct and efficient solution
5. To analyze various searching and sorting algorithms and apply various data structures concepts such as stacks, queues in problem solving

UNIT-I:

Introduction to Computers – Computer Systems, Computing Environments, Computer Languages, Creating and running programs, Software Development

Introduction to C Language – Background, Simple C programs, Identifiers, Basic data types, Variables, Constants, Input / Output

Structure of a C Program – Operators, Bit-wise operators, Expressions, Precedence and Associatively, Expression Evaluation, Type conversions, Statements

UNIT-II:

Statements – if and switch statements, Repetition statements – while, for, do-while statements, Loop examples, other statements related to looping – break, continue, go to, Recursion

Designing Structured Programs- Functions, basics, user defined functions, inter function communication, recursive functions.

Arrays – Concepts, using arrays in C array applications, two – dimensional arrays, multidimensional arrays

UNIT-III:

Pointers – Introduction, Pointers for inter function communication, pointers to pointers, compatibility,

Pointer Applications – Passing an array to a function, Memory allocation functions, array of pointers

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

UNIT-IV:

Derived types – The Typedef, enumerated types**,**

Structures – Declaration, definition and initialization of structures, accessing structures, operations on structures, complex structures.

Unions – Referencing unions, initializers, unions and structures.

Dynamic memory allocation: Introduction, malloc, calloc, realloc, free.

Input and Output – Text vs Binary streams, standard library functions for files, converting file types, File programs – copy, merge files

UNIT-V:

Sorting- selection sort, bubble sort, insertion sort,

Searching-linear and binary search methods.

Data Structures – 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

TEXTBOOKS:

1. C Programming & Data Structures, B.A.Forouzan and R.F. Gilberg, Third Edition, Cengage Learning
2. Problem Solving and Program Design in C, J.R. Hanly and E.B. Koffman, Fifth Edition, Pearson Education
3. The C Programming Language, B.W. Kernighan and Dennis M.Ritchie, PHI/Pearson Education

REFERENCE BOOKS:

1. C & Data structures – P. Padmanabham, 3rd Edition, B.S. Publications
2. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press
3. Programming in C – Stephen G. Kochan, III Edition, Pearson Education
4. C for Engineers and Scientists, H. Cheng, McGraw-Hill International Edition
5. Data Structures using C – A. M. Tanenbaum, Y. Langsam, and M.J. Augenstein, Pearson Education / PHI
6. C Programming & Data Structures, E. Balagurusamy, TMH
7. C Programming & Data Structures, P. Dey, M Ghosh R Thereja, Oxford University Press
8. C & Data structures – E V Prasad and N B Venkateswarlu, S. Chand & Co

ENGINEERING DRAWING AND COMPUTER AIDED DRAFTING

B Tech I Year I Semester: CE / CSE (AI&ML) / CSE (CS) / EEE / IT / ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME104	**Engineering sciences**	**2**	**0**	**2**	**3**	**40**	**60**	**100**
Contact Classes: 30	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 60**		

COURSE OBJECTIVES:

1. To introduce the fundamentals of engineering drawing and projection systems
2. To develop skills in constructing orthographic, isometric, and sectional views
3. To train students in interpreting and creating technical drawings using CAD tools
4. To familiarize students with dimensioning standards and drafting conventions
5. To bridge manual drafting techniques with computer-aided drafting practices

COURSE OUTCOME:

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

1. Explain the fundamentals of engineering graphics and construct basic geometrical figures, scales, and curves using conventional drafting methods
2. Apply the principles of orthographic projection to draw projections of points, lines, and planes using
3. Construct projections and sectional views of regular solids and analyze their spatial orientations with auxiliary planes using CAD techniques
4. Develop lateral surfaces of prisms, cylinders, pyramids, and cones using standard engineering drawing using both manual and CAD tools
5. Generate isometric projections and convert between isometric and orthographic views of simple and compound solids using conventional and computer-aided methods

UNIT-I:

Introduction to Engineering Graphics (Conventional)

Principles of Engineering Graphics and their Significance, Geometrical Constructions, Scales, Plain and Diagonal, Conic Sections including the Rectangular Hyperbola, General method only. Cycloid, Epicycloid and Hypocycloid

UNIT-II:

Orthographic Projections (Conventional)

Principles of Orthographic Projections, Conventions, Projections of Points and Lines, Projections of Plane regular geometric figures. Auxiliary Planes. Computer aided orthographic projections, points, lines and planes. Introduction to Computer aided drafting, views, commands and conics

UNIT-III:

Projections of Regular Solids (Conventional and Computer Aided)

Auxiliary Views, Sections, Prism, Cylinder, Pyramid, Cone, Computer aided projections of solids, sectional views

UNIT-IV:

Development of Surfaces (Conventional and Computer Aided)

Prism, Cylinder, Pyramid and Cone

UNIT-V:

Isometric Projections (Conventional and Computer Aided)

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. Conversion of Isometric Views to Orthographic Views and Vice- versa, Conventions. Conversion of orthographic projection into isometric view

Note:

1. The End Semester Examination will be in conventional mode.
2. CIE – I will be in conventional mode.
3. CIE – II will be using Computer

TEXTBOOKS:

1. Engineering Drawing, N. D. Bhatt, Charotar, 54th Edition, 2023
2. Engineering Drawing and graphics Using AutoCAD, T. Jeyapoovan and Vikas, S. Chand and company Ltd., 3rd Edition, 2010

REFERENCE BOOKS:

1. Engineering Drawing, Basant Agrawal and C.M. Agrawal, McGraw Hill, 3rd Edition, 2019
2. Engineering Graphics and Design, WILEY, John Wiley and Sons Inc, 3rd Edition, 2020
3. Engineering Drawing, M. B. Shah and B.C. Rane, Pearson, 2nd Edition, 2009
4. Engineering Drawing, N. S. Parthasarathy and Vela Murali, Oxford, 1st Edition, 2015
5. Computer Aided Engineering Drawing, K. Balaveera Reddy, CBS Publishers, 2nd Edition, 2015

ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING

B Tech I Year I Semester: CE / ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
25EE105	**Engineering Sciences**	**L**	**T**	**P**	**3**	**CIE**	**SEE**	**TOTAL**
		3	**0**	**0**		**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

COURSE OBJECTIVES:

1. To introduce the concepts of electrical circuits and its components
2. To understand magnetic circuits, DC circuits and AC single phase and 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 and transistors, and
7. To impart the knowledge of various configurations, characteristics and applications

COURSE OUTCOME:

1. To analyze and solve electrical circuits using network laws and theorems
2. To understand and analyze basic Electric and Magnetic circuits
3. To study the working principles of Electrical Machines
4. To introduce components of Low Voltage Electrical Installations
5. To identify and characterize diodes and various types of transistors

UNIT-I:

D.C. Circuits: Electrical circuit elements (R, L and C), voltage and current sources, KVL and 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, Three phase 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

TEXTBOOKS:

1. Basic Electrical and electronics Engineering, M S Sukija and TK Nagasarkar, Oxford University, 1 st Edition, 2012
2. Basic Electrical and electronics Engineering, D P Kothari and I J Nagarath, McGraw Hill Education, 2nd Edition, 2020

REFERENCE BOOKS:

1. Electronic Devices and Circuits, R. L. Boylestad and Louis Nashelsky, PEI and PHI,9th Edition, 2006
2. Millman's Electronic Devices and Circuits, J. Millman, C. C. Halkias and Satyabrata Jit, TMH, 2nd Edition, 1998
3. Engineering Circuit Analysis, William Hayt and Jack E. Kemmerly, McGraw Hill, 6th Edition, 1971
4. Linear circuit analysis, Raymond A. De Carlo and Pen, Min, Lin, Oxford University Press, 2nd edition, 2004
5. Network Theory, N. C. Jagan and C. Lakshminarayana, McGraw Hill, 2nd Edition, 2005
6. Network Theory, Sudhakar and Shyam Mohan Palli, Tata McGraw Hill, 2nd Edition, 2011
7. Fundamentals of Electrical Engineering, L. S. Bobrow, Oxford University Press, 12th edition, 2003
8. Electrical and Electronic Technology, E. Hughes, Pearson Education, 10th Edition, 2010
9. Electrical Engineering Fundamentals, V. D. Toro, Prentice Hall India, 2nd Edition, 1989

C PROGRAMMING AND DATA STRUCTURES LAB

B Tech I Year I Semester: CE / ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
25CS106	Engineering Sciences	**L**	**T**	**P**	1	**CIE**	**SEE**	**TOTAL**
		0	0	2		40	60	100
Contact Classes: Nil	**Tutorial Classes:** Nil	**Practical Classes:** 30				**Total Classes:** 30		
Prerequisite: Fundamentals of Computers								

COURSE OBJECTIVES:

The students will learn the following:

1. To work with an IDE to create, edit, compile, run and debug programs
2. To analyze the various steps in program development.
3. To develop programs to solve basic problems by understanding basic concepts in C like operators, control statements etc
4. To develop modular, reusable and readable C Programs using the concepts like functions, arrays etc
5. To analyzed at a structures concept such as searching and sorting

COURSE OUTCOME:

The student is expected to be able to:

1. Formulate the algorithms for simple problems, translate given algorithms to a working and correct program
2. Correct syntax errors as reported by the compilers, identify and correct logical errors encountered during execution and implement simple numeric problems of a real word using conditional and control structures
3. Represent and manipulate data with arrays, strings and design programs in modular fashion through functions and display data using structures
4. Create, read and write to and from simple text and binary files
5. Implement various searching and sorting techniques to solve real world problems

List of Experiments:

1. Write a C program to find the sum of individual digits of a positive integer
2. Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence
3. 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
5. Write a C program to find the factorial of a given integer
6. Write a C program to find the GCD (greatest common divisor) of two given integers
7. Write a C program to solve Towers of Hanoi problem
8. Write a C program, which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement)

9. Write a C program to find both the largest and smallest number in a list of integers
10. Write a C program that uses functions to perform the following:
    i. Addition of Two Matrices
    ii. Multiplication of Two Matrices
11. Write a C program that uses functions to perform the following operations:
    i. To insert a sub-string in to a given main string from a given position.
    ii. To delete n Characters from a given position in a given string.
12. Write a C program to determine if the given string is a palindrome or not
13. Write a C program that displays the position or index in the string S where the string T begins, or – 1 if S doesn't contain T
14. Write a C program to count the lines, words and characters in a given text
15. Write a C program to generate Pascal's triangle
16. Write a C program to construct a pyramid of numbers
17. Write a C program that uses functions to perform the following operations:
    i. Reading a complex number
    ii. Writing a complex number
    iii. Addition of two complex numbers
    iv. Multiplication of two complex numbers

    (Note: represent complex number using a structure.)
18. i. Write a C program which copies one file to another.
    ii. Write a C program to reverse the first n characters in a file. (Note: The file name and n are specified on the command line.)
19. i. Write a C program to display the contents of a file.
    ii. Write a C program to merge two files into a third file (i.e., the contents of the first file followed by those of the second are put in the third file)
20. Write a C program that uses functions to perform the following operations on singly linked list.:
    i) Creation ii) Insertion iii) Deletion iv) Traversal
21. Write C programs that implement stack (its operations) using
    i) Arrays ii) Pointers
22. Write C programs that implement Queue (its operations) using
    i) Arrays ii) Pointers
23. Write a C program that implements the following sorting methods to sort a given list of integers in ascending order i) Bubble sort ii) Selection sort iii)Insertion sort
24. Write C programs that use both recursive and non recursive functions to perform the following searching operations for a Key value in a given list of integers:
    i) Linear search ii) Binary search

TEXTBOOKS:

1. C Programming & Data Structures, B.A. Forouzan and R. F. Gilberg, Third Edition, Cengage Learning
2. Let us C, Yeswanth Kanitkar
3. C Programming, Balaguruswamy

ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGINEERING LAB

B Tech I Year I Semester: CE / ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
25EE107	Engineering Sciences	**L**	**T**	**P**	1	**CIE**	**SEE**	**TOTAL**
		0	0	2		40	60	100
Contact Classes: Nil	**Tutorial Classes:** Nil	**Practical Classes:** 30				**Total Classes:** 30		

COURSE OBJECTIVES:

1. To introduce the concepts of electrical circuits and its components
2. To understand magnetic circuits, DC circuits and AC single phase and 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 and transistors, and
7. To impart the knowledge of various configurations, characteristics and applications

COURSE OUTCOME:

1. To analyze and solve electrical circuits using network laws and theorems
2. To understand and analyze basic Electric and Magnetic circuits
3. To study the working principles of Electrical Machines
4. To introduce components of Low Voltage Electrical Installations
5. To identify and characterize diodes and various types of transistors

List of Experiments:

PART-A: ELECTRICAL

1. Verification of KVL and KCL
2. A) Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single Phase Transformer
   B) Verification of Relationship between Voltages and Currents (StarDelta, DeltaDelta, Delta Star, StarStar) in a Three Phase Transformer
3. Measurement of Active and Reactive Power in a balanced Three phase circuit
4. Performance Characteristics of a Separately Excited DC Shunt Motor
5. Performance Characteristics of a Three phase Induction Motor
6. No Load Characteristics of a Three phase Alternator
7. Open Circuit Characteristics (OCC) of DC shunt generator

PART-A: ELECTRONICS

1. Study and operation of (i) Multimeters (ii) Function Generator (iii) Regulated Power Supplies (iv) CRO
2. P-N Junction diode characteristics
3. Zener diode characteristics and Zener as voltage Regulator
4. Input and Output characteristics of Transistor in CB, CE configuration
5. Full Wave Rectifier with and without filters 6. Input and Output characteristics of FET in CS configuration

TEXTBOOKS:

1. Basic Electrical and electronics Engineering, M.S. Sukija and T.K. Nagasarkar, Oxford University press, 1stEdition, 2012
2. Basic Electrical and electronics Engineering, D.P. Kothari and I.J. Nagarath, McGraw Hill Education, 2nd Edition,2020

REFERENCE BOOKS:

1. Electronic Devices and Circuits, R. L. Boylestad and Louis Nashelsky, PEI and PHI, 9th Edition, 2006
2. Millman's Electronic Devices and Circuits, J. Millman,C. C. Halkias and Satyabrata Jit, TMH, 2 nd Edition, 1998
3. Engineering Circuit Analysis, William Hayt and Jack E. Kemmerly, McGraw Hill, 6th Edition, 1971
4. Linear circuit analysis, Raymond A. De Carlo and Pen, Min, Lin, Oxford University Press 2nd Edition, 2004
5. Network Theory, N. C. Jagan and C. Lakshminarayana, McGraw Hill, 2nd Edition, 2005
6. Network Theory, Sudhakar and Shyam Mohan Palli, Tata McGraw Hill, 2nd Edition, 2011
7. Fundamentals of Electrical Engineering, L. S. Bobrow, Oxford University Press, 12th Edition 2003
8. Electrical and Electronic Technology, E. Hughes, Pearson Education, 10th Edition, 2010
9. Electrical Engineering Fundamentals, V. D. Toro, Prentice Hall India, 2nd Edition, 1989

ADVANCED ENGINEERING PHYSICS LAB

B Tech I Year I Semester: CE / CSE (AI&ML) / CSE (CS) / EEE / IT / ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
25PH108	Basic Sciences	**L**	**T**	**P**	1	**CIE**	**SEE**	**TOTAL**
		0	0	2		40	60	100
Contact Classes: Nil	**Tutorial Classes:** Nil	**Practical Classes:** 30				**Total Classes:** 30		

COURSE OBJECTIVES:

1. To provide practical exposure to advanced concepts in solid-state and modern physics
2. To synthesize and study the physical properties of materials like semiconductors, ferromagnetic, and ferroelectric substances
3. To perform semiconductor characterization using Hall effect and band gap experiments
4. To explore the working principles of lasers and optical fibers through hands-on experiments
5. To develop skills in data analysis, interpretation, and scientific reporting

COURSE OUTCOME:

1. Synthesize and analyze nanomaterials such as magnetite (Fe_3O_4) using chemical methods
2. Determine key electrical, magnetic, and optical properties of semiconductors and other functional materials
3. Characterize semiconductors using Hall effect and energy gap measurement techniques
4. Demonstrate working knowledge of laser systems and optical fiber parameters through experimental study
5. Apply scientific methods for accurate data collection, analysis, and technical report writing

List of Experiments:

1. Synthesis of magnetite (Fe3O4) powder using sol-gel method
2. Determination of energy gap of a semiconductor
3. Determination of Hall coefficient and carrier concentration of a given semiconductor
4. Determination of magnetic moment of a bar magnet and horizontal earth magnetic field
5. Study of B-H curve of a ferro magnetic material
6. Study of P-E loop of a given ferroelectric crystal
7. Determination of dielectric constant of a given material
8. Determination of Curie's temperature of a given ferroelectric material
9. A) Determination of wavelength of a laser using diffraction grating
   B) Study of V-I characteristics of a given laser diode
10. A) Determination of numerical aperture of a given optical fibre
    B) Determination of bending losses of a given optical fibre

Note: Any 8 experiments are to be performed

ENGINEERING WORKSHOP

B Tech I Year I Semester: CE / ECE / IT / ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
25ME110	Engineering Sciences	**L**	**T**	**P**	1	**CIE**	**SEE**	**TOTAL**
		0	0	2		40	60	100
Contact Classes: Nil	**Tutorial Classes:** Nil	**Practical Classes:** 30				**Total Classes:** 30		
Prerequisite: Practical Skill								

COURSE OBJECTIVES:

1. To introduce students to basic manufacturing processes and workshop practices
2. To provide hands-on training in carpentry, fitting, welding, sheet metal, and machining
3. To develop skills in using hand tools and measuring instruments
4. To enhance safety awareness and proper handling of workshop equipment
5. To build a foundational understanding of industrial production and fabrication

COURSE OUTCOME:

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

1. Understand the basic manufacturing processes and operations.
2. Use hand tools and equipment safely and efficiently
3. Perform basic operations in carpentry, fitting, welding, sheet metal work, and machining
4. Read and interpret workshop drawings
5. Develop teamwork, time management, and quality awareness in a workshop environment

1. TRADES FOR EXERCISES:

At least two exercises from each trade:

1. Carpentry: T- Lap Joint, Dovetail Joint, Mortise and Tenon Joint
2. Fitting: V- Fit, Dovetail Fit, Semi- circular fit and L-fit
3. Tin Smithy: Square Tin, Rectangular Tray and Conical Funnel
4. Foundry: Preparation of Green Sand Mould using Single Piece and Split Pattern
5. Welding Practice: Arc Welding and Gas Welding
6. House wiring: Parallel and Series, Two-way Switch and Tube Light

2. TRADES FOR DEMONSTRATION AND EXPOSURE

Plumbing, Machine Shop, Metal Cutting, Power tools in construction and Wood Working

TEXTBOOKS:

1. Workshop Practice, B. L. Juneja, Cengage Learning India, 1st edition, 2015
2. Workshop Practice Manual, K. Venkata Reddy, BS Publication, 6th Edition, Rpt.2025

REFERENCE BOOKS:

1. Workshop Manual, K. Venugopal, Anuradha Publications, 2012 edition, 2012

ORDINARY DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

B Tech I Year II Semester: CE / CSE / CSE (AI&ML) / CSE (CS) / ECE / EEE / IT / ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25MA201	**Basic Sciences**	**3**	**0**	**0**	**3**	**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Mathematical Knowledge at pre-university level								

COURSE OBJECTIVES:

To learn

1. To skills in solving first-order ODEs using methods such as separation of variables, integrating factor, exact equations, and linear equations
2. The formulation and solution techniques of higher-order linear differential equations with constant coefficients
3. Solving ordinary differential equations using Laplace transforms techniques
4. The skills in applying gradient, divergence, curl, and directional derivatives in engineering problems
5. The important theorems like Green's, Gauss's, and Stokes' theorems and their applications

COURSE OUTCOME:

Student will be able to

1. Solve first-order differential equations including exact, linear, and Bernoulli types, and apply them to model physical phenomena such as cooling and growth processes
2. Solve higher-order linear differential equations with constant coefficients and apply the method of variation of parameters to handle non-homogeneous terms
3. Apply Laplace transform techniques to solve initial value problems and evaluate integrals using standard methods
4. Differentiate vector functions and compute gradient, divergence, curl, and directional derivatives
5. Evaluate line, surface, and volume integrals and apply Green's, Gauss's, and Stokes' theorems to solve problems in vector calculus

UNIT-I:

First Order Ordinary Differential Equations

Exact differential equations – Equations reducible to exact differential equations – linear and Bernoulli's equations – Orthogonal Trajectories (only in Cartesian Coordinates). Applications: Newton's law of cooling – Law of natural growth and decay

UNIT-II:

Ordinary Differential Equations of Higher Order

Higher order linear differential equations with constant coefficients: Non-Homogeneous terms of the type , sin , cos polynomials in x, (), () Method of variation of parameters

UNIT-III:

Laplace Transforms

Laplace Transforms: Laplace Transform of standard functions – First shifting theorem – Laplace transforms of functions multiplied by 't' and divided by 't' – Laplace transforms of derivatives and integrals of function – 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 – Divergence and Curl – Directional derivatives – Vector Identities – Scalar potential functions – Solenoidal and Irrotational vectors

UNIT-V:

Vector Integration

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

TEXTBOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010
2. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5th Edition, 2016

REFERENCE BOOKS:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint, 2002
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008
4. H. K. Dass and Er. Rajnis

ENGINEERING CHEMISTRY

B Tech I Year II Semester: CE / CSE (AI&ML) / CSE (CS) / EEE / IT / ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
25CH202	Basic Sciences	**L**	**T**	**P**	3	**CIE**	**SEE**	**TOTAL**
		3	0	0		40	60	100
Contact Classes: 45	**Tutorial Classes:** Nil	**Practical Classes:** Nil				**Total Classes:** 45		

COURSE OBJECTIVES:

1. To develop adaptability to new advances in Engineering Chemistry and acquire the essential skills to become a competent engineering professional
2. To understand the industrial significance of water treatment, fundamental principles of battery chemistry, and the impact of corrosion along with its control methods for structural protection
3. To impart foundational knowledge of various energy sources and their practical
4. Applications in engineering
5. To equip students with an understanding of smart materials, biosensors, and analytical techniques applicable in engineering, industrial, environmental, and biomedical fields

COURSE OUTCOME:

1. Analyze the hardness of water and apply suitable treatment methods for potable and boiler water systems
2. Explain electrochemical cell concepts and evaluate corrosion types and prevention techniques
3. Classify energy sources and illustrate the working of modern batteries, fuel cells, and synthetic fuel technologies
4. Differentiate types of polymers and explain their synthesis, properties, and applications
5. Apply knowledge of smart materials, biosensors, cement chemistry, phase rule, and lubricants to analyze their properties, mechanisms, and industrial applications

UNIT-I:

Water and its treatment:

Introduction- Hardness, types, degree of hardness and units. Estimation of hardness of water by complexometric method - Numerical problems. Potable water and its specifications (WHO) - Steps involved in the treatment of potable water - Disinfection of potable water by chlorination and break point chlorination. Defluorination - Nalgonda technique.

Boiler troubles: Scales, Sludges and Caustic embrittlement. Internal treatment of boiler feed water - Calgon conditioning, Phosphate conditioning, Colloidal conditioning. External treatment methods - Softening of water by ion- exchange processes. Desalination of brackish water – Reverse osmosis

UNIT-II:

Electrochemistry and Corrosion:

Introduction- Electrode potential, standard electrode potential, Nernst equation (no derivation), electrochemical cell - Galvanic cell, cell representation, EMF of cell - Numerical problems. Types of electrodes, reference electrodes - Primary reference electrode - Standard Hydrogen Electrode (SHE), Secondary reference electrode - Calomel electrode. Construction, working and determination of pH of

unknown solution using SHE and Calomel electrode.

Corrosion: Introduction- Definition, causes and effects of corrosion – Theories of corrosion, chemical and electrochemical theories of corrosion, Types of corrosion: galvanic, water-line and pitting corrosion. Factors affecting rate of corrosion - Nature of the metal, Nature of the corroding environment. Corrosion control methods - Cathodic protection Methods - Sacrificial anode and impressed current methods

UNIT-III:

Energy sources:

Batteries: Introduction – Classification of batteries - Primary, secondary and reserve batteries with examples. Construction, working and applications of Zn-air and Lithium ion battery. Fuel Cells – Differences between a battery and a fuel cell, Construction and applications of Direct Methanol Fuel Cell (DMFC)

Fuels: Introduction and characteristics of a good fuel, Calorific value – Units - HCV, LCV-Dulong's formula - Numerical problems.

Fossil fuels: Introduction, Classification, Petroleum - Refining of Crude oil, Cracking - Types of cracking - Moving bed catalytic cracking. LPG and CNG composition and uses.

Synthetic Fuels: Fischer-Tropsch process, Introduction and applications of Hythane and Green Hydrogen

UNIT-IV:

Polymers:

Definition - Classification of polymers: Based on origin and tacticity with examples – Types of polymerization - Addition (free radical addition mechanism) and condensation polymerization. Plastics, Elastomers and Fibers: Definition and applications (PVC, Buna-S, Nylon-6,6). Differences between thermoplastics and thermo setting plastics, Fiber reinforced plastics (FRP).

Conducting polymers: Definition and Classification with examples - Mechanism of conduction in trans poly-acetylene and applications of conducting polymers.

Biodegradable polymers: Polylactic acid and its applications

UNIT-V:

Advanced Materials:

Smart materials: Introduction, Classification with examples - Shape Memory Alloys – Nitinol.

Biosensor - Definition, Amperometric Glucose monitor sensor.

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

Phase rule: Definition – Phase, component, degrees of freedom. Phase rule equation. Phase diagrams - One component system - water. Two component system - Lead silver system.

Lubricants: Definition and characteristics of a good lubricant – thin film mechanism of lubrication, properties of lubricants - viscosity, cloud and pour point, flash and fire point

TEXTBOOKS:

1. Engineering Chemistry by P.C. Jain and M. Jain, Dhanpatrai Publishing Company, 2010
2. Engineering Chemistry by Rama Devi, Dr. P. Aparna and Rath, Cengage learning, 2025

REFERENCE BOOKS:

1. Engineering Chemistry: by Thirumala Chary Laxminarayana & Shashikala, Pearson Publications (2020)
2. Engineering Chemistry by Shashi Chawla, Dhanpatrai and Company (P) Ltd. Delhi 2011
3. Engineering Chemistry by Shikha Agarwal, Cambridge University Press, Delhi 2015
4. Engineering Analysis of Smart Material Systems by Donald J. Leo, Wiley, 2007
5. Challenges and Opportunities in Green Hydrogen by Editors: Paramvir Singh, Avinash Kumar Agarwal, Anupma Thakur, R.K Sinha
6. E-Content- https://doi.org/10.1142/13094 | October 2023

ENGLISH FOR SKILL ENHANCEMENT

B Tech I Year II Semester: CE / CSE (AI&ML) / CSE (CS) / IT / ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25EN203	**Humanities & Sciences**	**3**	**0**	**0**	**3**	**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

COURSE OBJECTIVES:

This course will enable the students to:

1. Improve their vocabulary
2. Use appropriate sentence structures in their oral and written communication
3. Develop their reading and study skills
4. Equip students to write paragraphs, essays, précis and draft letters
5. Acquire skills for technical report writing

COURSE OUTCOME:

Students will be able to:

1. Comprehend texts and produce precise formal writing using effective reading strategies and structured language
2. Apply language skills to produce coherent texts on digital transformation using effective structure and organization
3. Comprehend poetic themes of gratitude and attitude, and apply language skills for effective personal and professional communication
4. Comprehend entrepreneurial ideas and apply language skills to produce concise, context- driven communication
5. Apply language and reading skills to understand professional ethics and produce structured technical reports

UNIT-I:

Theme: Perspectives

Lesson on 'The Generation Gap' by Benjamin M. Spock from the prescribed textbook titled English for the Young in the Digital World published by Orient Black Swan Pvt. Ltd.

Vocabulary:

The Concept of Word Formation -The Use of Prefixes and Suffixes - Words Often Misspelt - Synonyms and Antonyms

Grammar:

Identifying Common Errors in Writing with Reference to Parts of Speech particularly Articles and Prepositions – Degrees of Comparison

Reading:

Reading and Its Importance- Sub Skills of Reading – Skimming and Scanning.

Writing:

Sentence Structures and Types -Use of Phrases and Clauses in Sentences

Importance of Proper Punctuation- Techniques for Writing Precisely –Nature and Style of Formal Writing

UNIT-II:

Theme: Digital Transformation

Lesson on 'Emerging Technologies' from the prescribed textbook titled English for the Young in the Digital World published by Orient BlackSwan Pvt. Ltd.

Vocabulary: Homophones, Homonyms and Homographs

Grammar: Identifying Common Errors in Writing with Reference to Noun-pronoun Agreement and Subject-verb Agreement.

Reading: Reading Strategies-Guessing Meaning from Context – Identifying Main Ideas – Exercises for Practice

Writing: Paragraph Writing – Types, Structures and Features of a Paragraph - Creating Coherence – Linkers and Connectives - Organizing Principles in a Paragraph – Defining-Describing People, Objects, Places and Events – Classifying- Providing Examples or Evidence - Essay Writing - Writing Introduction and Conclusion

UNIT-III:

Theme: Attitude and Gratitude

Poems on 'Leisure' by William Henry Davies and 'The Road Not Taken' by Robert Frost from the prescribed textbook titled English for the Young in the Digital World published by Orient Black Swan Pvt. Ltd.

Vocabulary: Words Often Confused - Words from Foreign Languages and their Use in English.

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

Reading: Sub-Skills of Reading – Identifying Topic Sentence and Providing Supporting Ideas - Exercises for Practice.

Writing: Format of a Formal Letter-Writing Formal Letters E.g.., Letter of Complaint, Letter of Requisition, Job Application with CV/Resume –Difference between Writing a Letter and an Email - Email Etiquette

UNIT-IV:

Theme: Entrepreneurship

Lesson on 'Why a Start-Up Needs to Find its Customers First' by Pranav Jain from the prescribed textbook titled English for the Young in the Digital World published by Orient Black Swan Pvt. Ltd.

Vocabulary: Standard Abbreviations in English – Inferring Meanings of Words through Context – Phrasal Verbs – Idioms.

Grammar: Redundancies and Clichés in Written Communication – Converting Passive to Active Voice and Vice-Versa.

Reading: Prompt Engineering Techniques– Comprehending and Generating Appropriate Prompts - Exercises for Practice

Writing: Writing Practices- Note Making-Précis Writing

UNIT-V:

Theme: Integrity and Professionalism

Lesson on 'Professional Ethics' from the prescribed textbook titled English for the Young in the Digital World published by Orient BlackSwan Pvt. Ltd.

Vocabulary: Technical Vocabulary and their Usage– One Word Substitutes – Collocations.

Grammar: Direct and Indirect Speech - Common Errors in English (Covering all the other aspects of grammar which were not covered in the previous units)

Reading: Survey, Question, Read, Recite and Review (SQ3R Method) – Inferring the Meaning and Evaluating a Text- Exercises for Practice

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

TEXTBOOKS:

1. Board of Editors. 2025. English for the Young in the Digital World. Orient Black Swan Pvt. Ltd

REFERENCE BOOKS:

1. Swan, Michael. (2016). Practical English Usage. Oxford University Press. New Edition
2. Karal, Rajeevan. 2023. English Grammar Just for You. Oxford University Press. New Delhi.
3. 2024. Empowering with Language: Communicative English for Undergraduates. Cengage Learning India Pvt. Ltd. New Delhi
4. Sanjay Kumar & Pushp Lata. 2022. Communication Skills – A Workbook. Oxford University Press. New Delhi
5. Wood, F.T. (2007). Remedial English Grammar. Macmillan
6. Vishwamohan, Aysha. (2013). English for Technical Communication for Engineering Students. Mc Graw-Hill Education India Pvt. Ltd

PYTHON PROGRAMMING

B Tech I Year II Semester: CE / ECE / EEE / ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25CS204	**Engineering Sciences**	**2**	**0**	**0**	**2**	**40**	**60**	**100**
Contact Classes: 30	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 30**		
Prerequisite: Basic knowledge of computer fundamentals, C programming								

COURSE OBJECTIVES:

Introduce the fundamentals of Python programming for problem-solving

1. Develop skills to write structured, modular, and efficient Python code
2. Enable students to use Python's built-in data structures and libraries effectively
3. Provide knowledge on file handling, exception handling, and object-oriented programming in Python
4. Equip students with the ability to apply Python for real-world applications including data processing and automation

COURSE OUTCOME:

1. Write Python programs using variables, operators, expressions, and control structures
2. Implement Python programs using built-in data structures like lists, tuples, sets, and dictionaries
3. Apply modular and object-oriented programming principles in Python
4. Handle files, exceptions, and apply Python libraries for problem-solving
5. Develop small-scale applications in Python for automation and data manipulation

UNIT-I:

Introduction to Python and Basics of Programming

Introduction to Python: Features, Applications, Installation, IDEs, Python Syntax, Indentation, Comments, Variables, Data Types, Type Casting, Operators: Arithmetic, Relational, Logical, Assignment, Membership, Identity, Bitwise, Input/Output functions (input(), print()), Control Structures: if, if-else, if-elif-else, Nested Conditions, Looping: for, while, Nested Loops, break, continue, pass

UNIT-II:

Data Structures in Python

Strings: Creation, Indexing, Slicing, Methods, String Formatting, Lists: Creation, Indexing, Slicing, List Comprehension, Methods, Tuples: Properties, Indexing, Methods, Sets: Creation, Operations, Methods, Dictionaries: Creation, Access, Methods, Dictionary Comprehension, Iterating over data structures

UNIT-III:

Functions and Modules

Functions: Defining, Calling, Parameters, Return Values, Types of Arguments: Positional, Keyword, Default, Variable Length, Scope of Variables: Local and Global, Lambda Functions, Map, Filter, Reduce, Recursion in Python, Modules: Importing, Creating User-defined Modules, Standard Modules (math, random, datetime), Packages in Python

UNIT-IV:

File Handling and Exception Handling

File Handling: Opening, Reading, Writing, Appending, File Modes, File Methods, Working with CSV and JSON Files, Exception Handling: try, except, else, finally, Built-in Exceptions, Raising Exceptions, Introduction to Regular Expressions (re module)

UNIT-V:

Object-Oriented Programming and Applications

OOP Basics: Classes, Objects, Attributes, Methods, Constructor (__init__), self keyword, Inheritance: Single, Multiple, Multilevel, Hierarchical, Method Overriding, Method Overloading (conceptual), Encapsulation and Polymorphism, Application Development: Data Processing Script, Basic Calculator, File Organizer, Simple Data Analysis with pandas

TEXTBOOKS:

1. Python Programming: Using Problem Solving Approach by Reema Thareja
2. Python Crash Course by Eric Matthes, Learning Python by Mark Lutz

REFERENCE BOOKS:

1. Introduction to Python Programming by Gowrishankar S., Veena A
2. Python Cookbook by David Beazley and Brian K. Jones
3. Fluent Python by Luciano Ramalho, Automate the Boring Stuff with Python by Al Sweigart

MATERIAL SCIENCE AND METALLURGY

B Tech I Year II Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME205	Engineering Sciences	3	0	0	3	40	60	100
Contact Classes: 45	**Tutorial Classes:** Nil	**Practical Classes:** Nil				**Total Classes:** 45		

COURSE OBJECTIVES:

1. To understand the structure and properties of engineering materials
2. To study phase diagrams and heat treatment processes of ferrous and non-ferrous alloys
3. To analyze the mechanical behavior of materials under various loading conditions
4. To identify microstructures and predict material performance in service conditions
5. To introduce testing methods and failure mechanisms of materials

COURSE OUTCOME:

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

1. Identify the types of Crystal structures and their defects
2. Analyze different phases in Iron-Carbon diagram and their microstructures
3. Illustrate the importance of heat treatment in achieving required properties
4. Apply the knowledge of heat treatment to enhance surface properties
5. Analyze the properties and micro structures of ferrous and non-ferrous alloys

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, Eutectoid, Peritectoid and monotectic reactions. Iron, Iron carbide phase diagrams and microstructural aspects of ledeburite, Austenite, Pearlite, Ferrite and Cementite

UNIT-III:

Heat treatment: Isothermal transformation diagrams for FeC alloys and microstructures development: Martensite, Bainite, Annealing, Normalizing, Hardening, Tempering and Spheroidising

UNIT-IV:

Cooling Curves and Surface Hardening: Continuous cooling curves and interpretation of final microstructures and properties, Thermo mechanical treatments: Austempering, Martempering. Surface hardening methods: Case hardening, Carburizing, Nitriding, Cyaniding, Carbo Nitriding. Flame and induction hardening, Vacuum and plasma hardening

UNIT-V:

Alloys and Composites: 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

TEXTBOOKS:

1. Introduction to Physical Metallurgy, Sidney H. Avner, McGraw Hill,2nd Edition, 2017
2. Material Science and Engineering, V. Raghavan, Prentice Hall of India Private Limited, 5th Edition, 2004

REFERENCE BOOKS:

1. Mechanical Metallurgy, George E. Dieter, Tata McGraw Hill, 3rd Edition, 2013
2. Engineering Materials, Kenneth G. Budinski and Michael K. Budinski, Prentice Hall of India Private Limited, 9th Edition, 2009
3. Engineering Materials and Metallurgy, U. C. Jindal, Pearson, 1st Edition, 2011
4. Materials Science and Engineering: An Introduction, William. D. Callister and David G. Rethwisch, John Wiley and Sons, 10th Edition, 2018

ENGINEERING MECHANICS

B Tech I Year II Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME206	**Engineering Sciences**	**3**	**0**	**0**	**3**	**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

COURSE OBJECTIVES:

The objectives of this course are to

1. Explain the resolution of a system of forces, compute their resultant and solve problems using equations of equilibrium
2. Perform analysis of bodies lying on rough surfaces
3. Locate the centroid of a body and compute the area moment of inertia and mass moment of inertia of standard and composite sections
4. Explain kinetics and kinematics of particles, projectiles, curvilinear motion, centroidal motion and plane motion of rigid bodies
5. Explain the concepts of work energy method and its applications to translation, rotation and plane motion and the concept of vibrations

COURSE OUTCOME:

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

1. Understand force systems, moments, couples, and equilibrium conditions for coplanar and spatial rigid bodies
2. Explain friction laws, types, motion analysis, and calculate centroids and centers of gravity for various shapes
3. Calculate area and mass moments of inertia for sections and composite bodies using appropriate theorems
4. Analyze particle dynamics involving rectilinear and curvilinear motion, work-energy principles, and impulse-momentum concepts
5. Apply kinetics of rigid bodies, D'Alembert's principle, and work-energy methods in plane motion

UNIT-I:

Introduction to Engineering Mechanics

Force Systems: Basic concepts, Rigid Body equilibrium, System of Forces, Parallelogram law, Coplanar Concurrent Forces, Components of forces in Space, Resultant, Moment of Forces and its Application.

Couples and Resultant of Force System: Equilibrium of Force Systems, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems

UNIT-II:

Friction and Centre of Gravity

Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction. Motion of Bodies, Wedge friction, Screw jack and Differential Screw jack.

Centroid and Centre of Gravity: Centroid of Lines, Areas and Volumes from first principle, centroid of composite sections, Centre of Gravity and its implications, Theorem of Pappus

UNIT-III:

Moment of Inertia

Definition, Area Moment of Inertia, Moment of inertia of Plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections. Product of Inertia, Parallel Axis Theorem, Perpendicular Axis Theorem.

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

UNIT-IV:

Dynamics of a Particle

Rectilinear motion, Plane curvilinear motion: Rectangular and Polar coordinates. Relative and constrained motion, Newton's law of motion for a particle (rectangular, path, and polar coordinates).

Impulse and momentum: Linear, Angular, Elastic Impact (Direct and oblique).

UNIT-V:

Kinetics of Rigid Bodies:

Introduction, Types of motion, Instantaneous centre of rotation in plane motion and simple problems. D' Alembert's principle and its applications in plane motion and connected bodies.

Work-Energy Method: Work-Energy principle and its application in plane motion of connected bodies or Systems, Work energy Applied to particle motion, Kinetics of rigid body rotation

TEXTBOOKS:

1. Singer's Engineering Mechanics – Statics and Dynamics, Reddy Vijay Kumar K. and J. Suresh Kumar. B.S Publications, 3rd Edition, Rpt. 2024
2. Engineering Mechanics, Shames and Rao, Pearson Education, 1st Edition, 2005

REFERENCE BOOKS:

1. Vector Mechanics for Engineers – Statics and Dynamics, Beer F.P and Johnston E.R Jr., Mc Graw Hill, 12th Edition, 2019
2. Engineering Mechanics, Dumir P.C, Sengupta and Srinivas, Universities Press, 1st Edition, 2020
3. Engineering Mechanics, Hibbeler R.C, Pearson, 14th Edition, 2017
4. Engineering Mechanics, Arshad Noor, Zahid and Goel, Cambridge University Press,1st Edition, 2018
5. Engineering Mechanics, Basudeb Bhattacharyya, Oxford University Press, 2nd Edition, 2014

ENGINEERING CHEMISTRY LAB

B Tech I Year II Semester: CE / CSE (AI&ML) /CSE (CS) / EEE / IT / ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
25CH207	Basic Sciences	**L**	**T**	**P**	1	**CIE**	**SEE**	**TOTAL**
		0	0	2		40	60	100
Contact Classes: Nil	**Tutorial Classes:** Nil	**Practical Classes:** 30				**Total Classes:** 30		
Pre requisite: The course includes experiments based on fundamental principles of chemistry essential for engineering students, aiming to develop practical skills and reinforce theoretical concepts								

COURSE OBJECTIVES:

Students will

1. Understand and perform experiments based on core chemical principles relevant to engineering applications
2. Learn to estimate the hardness of water to assess its suitability for drinking purposes
3. Acquire the ability to perform acid-base titrations using instrumental methods such as conductometry, potentiometry, and pH metry
4. Gain hands-on experience in synthesizing polymers like Bakelite and Nylon – 6, 6 in the laboratory
5. Learn to determine the unknown concentration of potassium permanganate ($KMnO_4$) using a calibration curve

COURSE OUTCOME:

1. Perform volumetric, potentiometric, conductometric, and pH-metric titrations to estimate concentrations of ions and acids in various solutions
2. Demonstrate polymer synthesis techniques like preparation of Bakelite and Nylon-6,6 and explain their properties
3. Measure physical properties such as viscosity and surface tension of liquids using viscometer and stalagmometer and analyze molecular interactions
4. Investigate the corrosion rate of mild steel in different conditions and evaluate the effectiveness of corrosion inhibitors
5. Analyze the construction, working, and applications of advanced energy devices and smart materials through virtual labs and simulations

List of Experiments:

1. **Volumetric Analysis:** Estimation of Hardness of water by EDTA Complexometry method
2. **Conductometry:**
   a) Estimation of the concentration of strong acid by Conductometry.
   b) Estimation of the concentration of strong and weak acid in an acid mixture by Conductometry
3. **Potentiometry:**
   a) Estimation of concentration of Fe^{+2}ion by Potentiometry using $KMnO_4$
   b) Estimation of concentration of strong acid with strong base by Potentiometry using quinhydrone

4. **pH Metry:** Determination of an acid concentration using pH meter
5. **Lubricants:**
    a) Determination of viscosity of a given liquid using Ostwald's viscometer.
    b) Estimation of acid value of given liquid
6. **Preparations:**
    a) Preparation of Bakelite.
    b) Preparation Nylon – 6, 6
7. **Corrosion:** Determination of rate of corrosion of mild steel in the presence and absence of inhibitor
8. Virtual lab experiments:
    a) Construction of Fuel cell and it's working.
    b) Smart materials for Biomedical applications
    c) Batteries for electrical vehicles.
    d) Functioning of solar cell and its applications

REFERENCE BOOKS:

1. Lab manual for Engineering chemistry by B. Ramadevi and P. Aparna, S Chand Publications, New Delhi (2022)
2. Vogel's text book of practical organic chemistry 5th edition
3. Inorganic Quantitative analysis by A.I. Vogel, ELBS Publications
4. College Practical Chemistry by V.K. Ahluwalia, Narosa Publications Ltd. New Delhi (2007)

PYTHON PROGRAMMING LAB

B Tech I Year II Semester: CE / CSE / CSE (AI&ML) / CSE (CS) / ECE / EEE / IT / ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
25CS209	Engineering Sciences	**L**	**T**	**P**	2	**CIE**	**SEE**	**TOTAL**
		0	0	4		40	60	100
Contact Classes: Nil	**Tutorial Classes:** Nil	**Practical Classes:** 60				**Total Classes:** 60		

COURSE OBJECTIVES:

1. To install and run the Python interpreter
2. To learn control structures
3. To Understand Lists, Dictionaries in python
4. To Handle Strings and Files in Python

COURSE OUTCOME:

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

1. Develop the application specific codes using python
2. Understand Strings, Lists, Tuples and Dictionaries in Python
3. Verify programs using modular approach, file I/O, Python standard library
4. Implement Digital Systems using Python

List of Experiments:

1. I. Use a web browser to go to the Python website http://python.org. This page contains information about Python and links to Python-related pages, and it gives you the ability to search the Python documentation.

   II. Start the Python interpreter and type help() to start the online help utility.
2. Start a Python interpreter and use it as a Calculator
3. Write a program to calculate compound interest when principal, rate and number of periods are given
4. Read the name, address, email and phone number of a person through the keyboard and print the details
5. Print the below triangle using for loop.

   5

   4 4

   3 3 3

   2 2 2 2

   1 1 1 1 1
6. Write a program to check whether the given input is digit or lowercase character or uppercase character or a special character(use 'if-else-if' ladder)
7. Python program to print all prime numbers in a given interval (use break)
8. Write a program to convert a list and tuple into arrays.
9. Write a program to find common values between two arrays

10. Write a function called palindrome that takes a string argument and returns True if it is a palindrome and False otherwise. Remember that you can use the built-in function len to check the length of a string
11. Write a function called is sorted that takes a list as a parameter and returns True if the list is sorted in ascending order and False otherwise
12. Write a function called has duplicates that takes a list and returns True if there is any element that appears more than once. It should not modify the original list.
13. Write a function called remove duplicates that takes a list and returns a new list with only the unique elements from the original. Hint: they don't have to be in the same order
14. The wordlist I provided, words.txt, doesn't contain single letter words. So you might want to add "I", "a", and the empty string
15. Write a python code to read dictionary values from the user. Construct a function to invert its content. i.e., keys should be values and values should be keys
16. Add a comma between the characters. If the given word is 'Apple', it should become 'A,p,p,l,e'
17. Remove the given word in all the places in a string?
18. Write a function that takes a sentence as an input parameter and replaces the first letter of every word with the corresponding upper case letter and the rest of the letters in the word by corresponding letters in lower case without using a built-in function?
19. Writes a recursive function that generates all binary strings of n-bit length
20. Write a python program that defines a matrix and prints
21. Write a python program to perform multiplication of two square matrices
22. How do you make a module? Give an example of construction of a module using different geometrical shapes and operations on them as its functions
23. Use the structure of exception handling all general-purpose exceptions
24. Write a function called draw rectangle that takes a Canvas and a Rectangle as arguments and draws a representation of the Rectangle on the Canvas
25. Add an attribute named color to your Rectangle objects and modify draw rectangle so that it uses the color attribute as the fill color.
26. Write a function called draw point that takes a Canvas and a Point as arguments and draws a representation of the Point on the Canvas
27. Define a new class called Circle with appropriate attributes and instantiate a few Circle objects. Write a function called draw circle that draws circles on the canvas
28. Write a python code to read a phone number and email-id from the user and validate it for correctness
29. Write a Python code to merge two given file contents into a third file.
30. Write a Python code to open a given file and construct a function to check for given words present in it and display on found
31. Write a Python code to Read text from a text file, find the word with most number of occurrences
32. Write a function that reads a file file1and displays the number of words, number of vowels, blank spaces, lower case letters and uppercase letters
33. Import numpy, Plotpy and Scipy and explore their functionalities

34. Install NumPypackage with pip and explore it
35. Write a program to implement Digital Logic Gates – AND, OR, NOT, EX-OR
36. Write a GUI program to create a window wizard having two text labels, two text fields and two buttons as Submit and Reset

TEXTBOOKS:

1. Supercharged Python: Take your code to the next level, Overland
2. Learning Python, Mark Lutz, O'reilly

REFERENCE BOOKS:

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
2. Python Programming A Modular Approach with Graphics, Database, Mobile, and Web Applications, Sheetal Taneja, Naveen Kumar, Pearson
3. Introduction to Python Programming, Gowrishakar S, Veena A, CRC Press
4. Programming with Python, A User's Book, Michael Dawson, Cengage Learning, India Edition
5. Python for Data Science, Dr. Mohd Abdul Hameed, Wiley publications
6. Core Python Programming, Dr. R. Nageswara Rao, Dreamtech press
7. Introduction to Python, Gowrishankar S, Veena A., CRC Press

ENGLISH LANGUAGE AND COMMUNICATION SKILLS LAB

B Tech I Year II Semester: CE / CSE (AI&ML) / CSE (CS) / IT / ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25EN210	**Humanities & Sciences**	**0**	**0**	**2**	**1**	**40**	**60**	**100**
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		

COURSE OBJECTIVES:

This course will enable the students to:

LISTENING SKILLS:

1. To enable students develop their active listening skills
2. To equip students with necessary training in listening, so that they can comprehend the speech of people from different linguistic backgrounds

SPEAKING SKILLS:

3. To improve their pronunciation and neutralize accent
4. To enable students express themselves fluently and appropriately
5. To practice speaking in social and professional contexts

COURSE OUTCOME:

Students will be able to:

1. Identify speech sounds and demonstrate basic spoken interaction using formal and informal English in introductory contexts
2. Interpret the speech and infer the intention of the speaker
3. Recognize pronunciation errors, neutralize MTI, and describe objects, people, and events using visual prompts
4. Apply effective listening techniques to extract specific details and develop storytelling skills using creative sequencing
5. Interpret literal and implied meanings in spoken texts and demonstrate non-verbal communication through expressive activities

Exercise – I

CALL Lab:

Instruction: Speech Sounds-Listening Skill - Importance – Purpose - Types- Barriers- Active Listening

Practice: Listening to Distinguish Speech Sounds (Minimal Pairs) - Testing Exercises

ICS Lab:

Diagnostic Test – Activity titled ‘Express Your View’

Instruction: Spoken and Written language - Formal and Informal English - Greetings - Introducing Oneself and Others

Practice: Any Ice-Breaking Activity

Exercise – II

CALL Lab:

Instruction: Listening vs. Hearing - Barriers to Listening

Practice: Listening for General Information - Multiple Choice Questions - Listening Comprehension Exercises (It is essential to identify a suitable passage with exercises for practice.)

ICS Lab:

Instruction: Features of Good Conversation – Strategies for Effective Communication Practice: Role Play Activity - Situational Dialogues –Expressions used in Various Situations – Making Requests and Seeking Permissions – Taking Leave - Telephone Etiquette

Exercise – III

III CALL Lab:

Instruction: Errors in Pronunciation – Tips for Neutralizing Mother Tongue Influence (MTI) Practice: Differences between British and American Pronunciation –Listening Comprehension Exercises

ICS Lab:

Instruction: Describing Objects, Situations, Places, People and Events

Practice: Picture Description Activity – Looking at a Picture and Describing Objects, Situations, Places, People and Events (A wide range of Materials / Handouts are to be made available in the lab.)

Exercise – IV

CALL Lab:

Instruction: Techniques for Effective Listening

Practice: Listening for Specific Details - Listening - Gap Fill Exercises - Listening Comprehension Exercises (It is essential to identify a suitable passage with exercises for practice.)

ICS Lab:

Instruction: How to Tell a Good Story - Story Star- Sequencing-Creativity Practice: Activity on Telling and Retelling Stories – Collage

Exercise – V

CALL Lab:

Instruction: Identifying the literal and implied meaning

Practice: Listening for Evaluation - Write the Summary – Listening Comprehension Exercises (It is essential to identify a suitable passage with exercises for practice.)

ICS Lab:

Instruction: Understanding Non-Verbal Communication Practice: Silent Speech - Dumb Charades Activity

Post-Assessment Test on 'Express Your View'

REFERENCE BOOKS:

1. Shobha, KN & Rayen, J. Lourdes. (2019). Communicative English – A workbook. Cambridge University Press
2. Board of Editors. (2016). ELCS Lab Manual: A Workbook for CALL and ICS Lab Activities. Orient Black Swan Pvt. Ltd
3. Mishra, Veerendra et al. (2020). English Language Skills: A Practical Approach. Cambridge University Press
4. (2022). English Language Communication Skills – Lab Manual cum Workbook. Cengage Learning India Pvt. Ltd
5. Ur, Penny and Wright, Andrew. 2022. Five Minute Activities – A Resource Book for Language Teachers. Cambridge University Press

MECHANICS OF SOLIDS

B Tech II Year I Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME301	**Professional Core**	**3**	**0**	**0**	**3**	**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Engineering Mechanics								

COURSE OBJECTIVES:

1. Understand the concepts of internal forces, moments, stress, strain, and deformation of solids with applications to bars, beams, and columns.
2. Learn the fundamentals of applying equilibrium, compatibility, and force – deformation relationships to structural elements
3. Study twisting of circular bars and hollow shafts acted on by torsional moments.
4. Define the state of stress at a point on a body and to develop stress transformations.
5. Introduce the concept of theories of elastic failure and their significance in the design

COURSE OUTCOME:

The student 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 and Torsion formula and apply to the design of beams and shafts.
4. Understand the theory of failures and Mohr's circle of stresses
5. Evaluate Torsion equation, Torsional moment of resistance and Power transmitted by shafts

UNIT-I:

Stress and Strain: Elasticity and plasticity, Types of stresses and strains, Hooke's law, Stress – strain diagram for mild steel, Working stress, Factor of safety, Lateral strain, Poisson's ratio and volumetric strain, Elastic moduli and the relationship between them, Bars of varying sections, Composite bars, Temperature stresses. Strain energy and 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 and Uniformly Distribute Load, 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 pure bending equation, Determination of bending stresses. Section modulus for rectangular and circular sections of 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: Rectangular, Circular, Triangular, I, T and Angle sections.

UNIT-IV:

Principal Stresses and Strains: Introduction, Stresses on inclined sections 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 Shear Stress Theory, Maximum Principal Strain Theory, Maximum Strain Energy Theory, Distortion Energy Theory (Von Mises Theory).

UNIT-V:

Torsion of Circular Shafts: Theory of pure torsion, Derivation of Torsion equations, 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.

TEXTBOOKS:

1. Strength of Materials, S. Ramamrutham and R. Narayanan, Dhanpat Rai Publishing, 20th Edition, 2020.
2. Elements of Strength of Materials, S.P. Timoshenko and D.H. Young, CBS Publishers, 5th Edition, Reprint 2020.

REFERENCE BOOKS:

1. Mechanics of Materials, Barry J. Goodno and James M. Gere, Cengage,9th Edition, 2018.
2. Strength of Materials, S. S. Rattan, Tata McGraw Hill, 2ndEdition,2011.
3. Strength of Materials, U.C. Jindal, Pearson Education India, 1st Edition, 2012.
4. Engineering Mechanics of Solids, Egor P. Popov and Toader A. Balan, PHI Learning, 2nd Edition, 2010.
5. Strength of Materials, G. H. Ryder, Macmillan Long Man Publications, 3rd Edition, 1961.
6. Strength of Materials, W. A. Nash and M. C. Potter, McGraw Hill, 5th Edition, 2011.

PROBABILITY, STATISTICS AND COMPLEX VARIABLES

B Tech II Year I Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME302	**Basic Sciences**	**3**	**0**	**0**	**3**	**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Mathematics courses of first year of study.								

COURSE OBJECTIVES:

1. The theory of Random Variable, and the applications of common probability distributions (Binomial, Poisson).
2. The basics of sampling, sampling distributions, and the role of the central limit theorem in statistical analysis.
3. Methods for testing hypotheses concerning single and two sample means, proportions, and variances.
4. Cauchy-Riemann equations, harmonic functions, and techniques to find harmonic conjugates using Milne-Thomson method.
5. Evaluation of integrals using Cauchy's integral formula and Cauchy's residue theorem

COURSE OUTCOME:

The student will be able to:

1. Understand and apply discrete and continuous random variables and their probability distributions.
2. Analyze continuous distributions like uniform and normal, apply sampling techniques, and use the Central Limit Theorem for statistical inference.
3. Apply appropriate statistical tests for single and two sample means, proportions, and variances (F-test included)
4. Analyze complex functions for differentiability and analyticity, and apply methods to find harmonic conjugates and study elementary analytic functions.
5. Evaluate complex integrals Cauchy's theorems and apply residue calculus to analyze singularities and series expansions.

UNIT-I:

Variables and Probability Distributions : **8L**

Concept of a Random Variable – Discrete Probability Distributions – Continuous Probability Distributions – Mean of a Random Variable – Variance of a Random Variable.

Discrete Probability Distributions: Binomial Distribution – Poisson distribution

UNIT-II:

Continuous Distributions and sampling: **10L**

Uniform Distribution – Normal Distribution – Areas under the Normal Curve – Applications of the Normal Distribution – Normal Approximation to the Binomial Distributions.

Fundamental Sampling Distributions: Random Sampling – Some Important Statistics – Sampling Distributions – Sampling Distribution of Means – Central Limit Theorem.

UNIT-III:

Tests of Hypotheses (Large and Small Samples) **10L**

Statistical Hypotheses: General Concepts – Testing a Statistical Hypothesis. Single sample: Tests concerning a single mean. Two samples: Tests on two mean (Unknown for equal variance). One sample: Test on a single proportion. Two samples: Tests on two proportions. Two- sample tests concerning variances: F-distribution

UNIT-IV:

Complex Differentiation **10L**

Differentiation of Complex functions – Analyticity – Cauchy-Riemann equations (without proof) – Harmonic Functions – Finding harmonic conjugate – Milne Thomson method – Elementary analytic functions (exponential, trigonometric, logarithm) and their properties.

UNIT-V:

Complex Integration **10L**

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. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, Probability & Statistics for Engineers & Scientists, 9th Ed. Pearson Publishers.
2. S C Gupta and V K Kapoor, Fundamentals of Mathematical statistics, Khanna publications.

REFERENCE BOOKS:

1. T.T. Soong, Fundamentals of Probability and Statistics for Engineers, John Wiley & Sons, Ltd, 2004.
2. Sheldon M Ross, Probability and statistics for Engineers and scientists, academic press

THERMODYNAMICS

B Tech II Year I Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME303	**Professional Core**	**3**	**1**	**0**	**4**	**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		
Prerequisite: Engineering Chemistry and Physics								

COURSE OBJECTIVES:

1. To introduce the basic concepts and laws of thermodynamics.
2. To apply the first and second laws to closed and open systems.
3. To understand the properties of pure substances and their use in thermodynamic processes.
4. To study the working principles and performance of thermodynamic cycles.
5. To prepare students for applications in engines, power plants and refrigeration.

COURSE OUTCOME:

The student will be able to:

1. Understand the basics of Thermodynamics.
2. Apply the first law to both closed and open systems.
3. Evaluate the feasibility of a process w.r.to entropy changes
4. Apply concepts of thermodynamic property relations to ideal gas and real gases
5. Evaluate performance of power cycles and refrigeration cycles

Tables, Codes: Steam Tables and Mollier Chart, Refrigeration Tables.

UNIT-I:

Basic Concepts and First Law of Thermodynamics

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

UNIT-II:

Second Law of Thermodynamics and Availability

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 Substance and Perfect Gas

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 and application of these concepts in various thermodynamic processes, including steam calorimetry.

Perfect Gas Laws, Equation of State, Specific and Universal Gas constants, various Nonflow processes, Properties, end states, Heat and Work Transfer, changes in Internal Energy, Throttling and Free Expansion Processes, Flow processes.

UNIT-IV:

Real Gas models and Perfect Gas Mixtures

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 constant and Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour.

UNIT-V:

Psychrometry and Thermodynamic Cycles

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.

Thermodynamic Cycles: Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle, Dual Cycle, Brayton Cycle, Rankine Cycle, Otto Cycle, Diesel Cycle, Description and representation on P–V and T- S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis, Comparison of Cycles. Refrigeration Cycles: Bell Coleman cycle, Vapour compression cycle, Ammonia, Water Vapor Absorption Cycle, Performance Evaluation.

TEXTBOOKS:

1. Engineering Thermodynamics, P.K. Nag, Mc Graw Hill, 7th Edition, 2020.
2. Fundamentals of Thermodynamics, Richard E. Sonntag and Claus Borgnakke, Wiley, 8th Edition, 2014.

REFERENCE BOOKS:

1. Thermodynamics, Yunus A Cengel, Michael A Boles, Mehmet Kanoglu, McGraw-Hill, 9th Edition, 2019.
2. Thermodynamics, J.P. Holman, McGraw Hill Education, 10th Edition, 2010.
3. Engineering Thermodynamics, Chattopadhyay, Oxford, 2nd Edition, 2015.
4. Engineering Thermodynamics, Rogers, Pearson, 4th Edition, 1996.
5. Engineering Thermodynamics, M Achuthan, PHI, 2nd Edition, 2009.
6. Thermodynamics for Engineers, Kenneth A. Kroos, Merle C. Potter, Cengage, 1st Edition, 2014.

PRODUCTION TECHNOLOGY

B Tech II Year I Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME304	**Professional Core**	**3**	**0**	**0**	**3**	**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Engineering Chemistry and Physics								

COURSE OBJECTIVES:

1. To expose the students to understand the concept of basic casting processes and furnaces.
2. To provide a technical understanding of various joining processes used in the manufacturing industry.
3. To impart the students to the concepts of solid state welding processes.
4. To teach the concepts of rolling and various press working operations.
5. To provide a technical understanding of different metal forming processes like extrusion, forging and high energy rate forming processes.

COURSE OUTCOME:

The student will be able to:

1. Elaborate the fundamentals of various moulding, casting techniques and furnaces.
2. Identify the importance of permanent joining and principle behind different welding processes.
3. Explain the concepts of solid state welding processes.
4. Understand the concepts of rolling and sheet metal operations in metal working.
5. Elaborates the uniqueness of extrusion, forging and high energy rate forming processes in metal working.

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:

Arc Welding: Classification, Types of welds and welded joints and their characteristics, Welding Positions, Arc welding, shielded metal arc welding, Submerged arc welding, Resistance welding, Thermit welding.

UNIT-III:

Gas Welding: Gas welding, Types, Oxyfuel gas cutting, Standard time and cost calculations. Inert Gas Welding, TIG Welding, MIG welding, Friction welding, Friction Stir Welding, Induction welding, Explosive welding, Laser Welding.

Soldering, Brazing, Heat affected zone in welding. Welding defects, Causes and remedies, Destructive and non-destructive testing of welds.

UNIT-IV:

Hot Working and Cold Working: Strain hardening, Recovery, Recrystallization 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.

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.

High Energy Rate Forming Processes: Principles of Explosive Forming, Electro hydraulic Forming, Electro, Magnetic forming and rubber pad forming.

TEXTBOOKS:

1. A Textbook of Production Technology (Manufacturing Processes), Dr. P.C. Sharma, S. Chand Publishing, 11th Revised Edition, 2022.
2. Manufacturing Technology: Foundry, Forming and Welding, P.N. Rao, McGraw Hill Education, Vol. 1, 5th Edition, 2018.

REFERENCE BOOKS:

1. Manufacturing Engineering and Technology, Serope Kalpakjian and Steven R. Schmidt, Pearson, 7th Edition, 2014.
2. Elements of Workshop TechnologyVol.1, S.K. Hajra Choudhury, A.K. Hajra Choudhury and Nirjhar Roy, Media Publishers and Promoters Pvt. Ltd., 1st Edition, 2008.
3. Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Mikell P. Groover, Wiley, 7th Edition, 2023.
4. Production Technology Vol. 1, Sreeramulu, WILEY, 1st Edition, 2018.
5. Production Engineering, P.C. Sharma, S. Chand Publishing, 8th Edition, 1999.
6. Manufacturing processes H. S. Shan, Cambridge University Press, 2nd Edition, 2017.
7. Production Technology: Manufacturing Processes, Technology and AutomationVol.1, R. K. Jain, Khanna Publishers, 19th Edition, 2009.

FLUID MECHANICS AND HYDRAULIC MACHINES

B Tech II Year I Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME305	**Professional Core**	**3**	**0**	**0**	**3**	**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Engineering Chemistry and Physics								

COURSE OBJECTIVES:

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

COURSE OUTCOME:

The student will be able to:

1. Explain the effect of fluid properties on a flow system.
2. Identify type of fluid flow patterns and describe continuity equation.
3. Analyze a variety of practical fluid flow and measuring devices and utilize Fluid Mechanics principles in design.
4. Select and analyze an appropriate turbine with reference to given situation in power plants.
5. Estimate performance parameters of a given Centrifugal and Reciprocating pump.

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 and unsteady, Uniform and non, Uniform, Laminar and turbulent, Rotational and irrotational flows, Equation of continuity for one dimensional flow and three-dimensional flows.

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

UNIT-III:

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.

TEXTBOOKS:

1. Hydraulics, Fluid mechanics and Hydraulic Machinery, Modi and Seth, standard Book House, 22nd Edition, 2019.
2. Fluid Mechanics and Hydraulic Machines, R.K. Bansal, Laxmi Publications, 10th Edition, 2020.

REFERENCE BOOKS:

1. Fluid Mechanics and Hydraulic Machines, Er. R. K. Rajput, S. Chand,2019.
2. Hydraulic Machines: Fluid Machinery, Jagdish Lal, Metropolitan Book Co., 6th Edition, 2016.
3. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, S.K. Kataria and Sons, 22nd Edition, 2018.
4. Fluid Mechanics and Machinery, D. Rama Durgaiah, New Age International publishers, 1st Edition, 2002.
5. Hydraulic Machines, T.R. Banga and S.C. Sharma, Khanna Publishers, 7th Edition, Rpt. 2019.

PRODUCTION TECHNOLOGY LAB

B Tech II Year I Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME306	**Professional Core**	**0**	**0**	**2**	**1**	**40**	**60**	**100**
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		
Prerequisite: Production Technology								

COURSE OBJECTIVES:

1. To provide hands-on experience with casting, welding, forming, and machining operations.
2. To help students understand the working principles of manufacturing processes.
3. To expose students to tools, machines, and equipment used in production workshops.
4. To develop safety awareness and quality control in manufacturing practices.
5. To bridge theoretical knowledge with practical application of manufacturing methods.

COURSE OUTCOME:

The student will be able to:

1. Demonstrate proficiency in metal casting techniques
2. Execute and analyze various welding processes
3. Operate mechanical press tools for sheet metal forming
4. Apply plastic processing techniques for product formation
5. Interpret technical drawings and process parameters to ensure quality and safety

List of Experiments:

I. Metal Casting:

1. Pattern Design and making - 1 Exercise (one casting drawing).
2. Sand properties testing - 1 Exercise (strengths, and permeability)
3. Moulding Melting and Casting -1 Exercise

II. Welding:

1. ARC Welding Lap and Butt Joint - 2 Exercises
2. Spot Welding - 1 Exercise
3. TIG Welding - 1 Exercise
4. Plasma welding and Brazing - 2 Exercises (Water Plasma Device)

III. Mechanical Press Working:

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

IV. Processing of Plastics:

1. Injection Moulding
2. Blow Moulding

Note: Minimum of 12 Exercises need to be performed.

TEXTBOOKS:

1. Dictionary of Mechanical Engineering, G.H.F. Nayler, Jaico Publishing House, 1st Edition, 1999.

MATERIAL SCIENCE AND MECHANICS OF SOLIDS LAB

B Tech II Year I Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME307	**Professional Core**	**0**	**0**	**2**	**1**	**40**	**60**	**100**
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		
Prerequisite: Material Science and Metallurgy; Mechanics of Solids.								

COURSE OBJECTIVES:

1. Learn the fundamental concepts of Metallurgy and Material Science in the context of manufacturing processes.
2. Understand how raw materials are converted into useful products.
3. Gain knowledge of the basic structure and crystal arrangements of materials.
4. Classify and distinguish between different microstructures of steels, cast irons, and non-ferrous alloys.
5. Understand the fundamental concepts of stress, strain, and deformation in solids.
6. Apply the principles to analyze structural elements such as bars, beams, and columns.
7. Study the engineering properties of materials in detail.
8. Emphasize the application of equilibrium, compatibility, and force-deformation relationships.
9. Introduce advanced methods of structural analysis, including the flexibility and stiffness methods.
10. Build upon foundational knowledge from the Engineering Mechanics course.

COURSE OUTCOME:

The student will be able to:

1. Analyze and interpret microstructures of ferrous and non-ferrous materials
2. Evaluate the hardenability and heat treatment response of steels
3. Demonstrate the ability to conduct mechanical tests such as tension, bending, torsion, and spring testing to evaluate material behavior under various loading conditions.
4. Perform hardness and impact tests to determine material resistance to indentation and sudden loading.
5. Analyze experimental data to correlate material properties with structural performance and failure modes.

List of Experiments:

I. MATERIAL SCIENCE LAB

1. Preparation and study of crystal models for simple cubic, body centered cubic, face centered 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.

II. MECHANICS OF SOLIDS LAB

1. Tension test
2. Bending test
3. Torsion test
4. Brinell's hardness and Rockwell hardness test
5. Test on springs
6. Izod Impact and Charpy Impact test

TEXTBOOKS:

1. Laboratory Manual in Engineering Materials, S.K. Hajra Choudhury, Asian Books Pvt. Ltd.
2. Laboratory Manual for Strength of Materials, J.P. Singh, Katson Books.

FLUID MECHANICS AND HYDRAULIC MACHINES LAB

B Tech II Year I Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME308	**Professional Core**	**0**	**0**	**2**	**1**	**40**	**60**	**100**
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		
Prerequisite:								

COURSE OBJECTIVES:

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

COURSE OUTCOME:

The student will be able to:

1. Apply Bernoulli's theorem and flow measurement principles using Venturimeter and Orifice meter to determine discharge and pressure variations in pipelines.
2. Determine friction factor and head losses in pipelines due to sudden contractions and fittings using empirical methods.
3. Evaluate the impact of jets on vanes and analyze force transfer mechanisms in hydraulic systems.
4. Conduct performance tests on hydraulic turbines (Pelton, Francis, Kaplan) and pumps (centrifugal and reciprocating) to assess efficiency and operational characteristics.
5. Interpret experimental data to correlate theoretical fluid dynamics with practical machine behavior, enabling informed design and selection of hydraulic equipment.

List of Experiments:

Fluid Mechanics:

1. Venturimeter.
2. Orifice meter.
3. Friction factor for a given pipe line.
4. Loss of head due to sudden contraction in a pipeline.
5. Application of Bernoulli's Theorem.

Hydraulic Machinery: Performance Test on

1. Impact of jets on Vanes.
2. Pelton Wheel.
3. Francis Turbine.
4. Kaplan Turbine.
5. Single Stage Centrifugal Pump.
6. Multi Stage Centrifugal Pump.
7. Reciprocating Pump.

TEXTBOOKS:

1. Fluid Mechanics and Machinery Laboratory Manual, Sadhu Singh, Khanna Publishers, 2022.
2. Fluid Mechanics and Hydraulic Machines, K. Subramanya, McGraw Hill Education, 2022.

DESIGN THINKING AND IDEATION

B Tech II Year I Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME309	**SD**	**0**	**0**	**2**	**1**	**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		
Prerequisite:								

COURSE OBJECTIVES:

1. To introduce the concept and importance of design thinking in solving complex problems.
2. To enable students to empathize with users and identify genuine needs.
3. To facilitate ideation and creative thinking for problem solving.
4. To guide students in developing prototypes and testing solutions.
5. To build storytelling and communication skills for presenting ideas effectively.

COURSE OUTCOME:

The student will be able to:

1. Understand the fundamentals, process models, and tools of design thinking with application to engineering and service projects.
2. Develop empathy and define user needs using empathy maps, customer journey maps, and personas in problem identification.
3. Apply ideation techniques such as brainstorming, lateral thinking, and storyboarding to generate innovative design solutions.
4. Create and build prototypes using varied fidelity levels to explore and validate design concepts effectively.
5. Test and validate prototypes through user feedback, iterate improvements, and communicate solutions via storytelling for implementation.

UNIT-I:

Fundamentals of Design Thinking: Design Thinking Process: Types of the thinking process, Common methods to change the human thinking process, Design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs Design thinking, Problem solving, the need of design thinking; An approach to design thinking, Design thinking Process model, Design thinking tools.

Case Studies: General, Engineering and Service applications

Activities: Identify an Opportunity and Scope of the Project Explore the possibilities and prepare a design brief.

UNIT-II:

Empathize and Understanding User Needs: Design thinking phases, how to empathize, Role of empathy in design thinking, the purpose of empathy maps, Things to be done prior to empathy mapping, Activities during and after the session, Understanding empathy tools: Customer Journey Map, Personas.

Define: Methods of Define Phase: Storytelling, Critical items diagrams, Define success.

Activities: Apply the methods of empathizing and Define Phases Finalize the problem Statement (User Interview practice, empathy mapping, shadowing or observation study).

UNIT-III:

Ideation and Generating Solutions: Challenges in idea generation, Visualize, Empathize, and Ideate method, Importance of visualizing and empathizing before ideating, Applying the method, Create Thinking, Generating Design Ideas, Lateral Thinking, Analogies, Brain storming, Mind mapping,

National Group Technique, Synectic's, Development of work, Analytical Thinking, Group Activities. Ideation Tools: How Might We? (HMW), Storyboard, Brainstorming. What is design innovation? A mindset for innovation, and asking "What if?" asking "What wows?" and "What works?"

Activities: Apply the methods of Ideate Phase: Generate Lots of Ideas (Brain Storming Sessions, SCAMPER Technique Activity and Rapid Sketching.

UNIT-IV:

Prototyping and Building the Solution: What is a prototype? Prototyping as a mindset, prototype examples, prototyping for products; Why we prototype? Fidelity for prototypes, Process of prototyping, Minimum Viable prototype.

Activities: Apply the Methods of the Prototype Phase: Create prototypes for selected ideas (Paper prototyping, digital prototyping and story board creation).

UNIT-V:

Testing Prototypes and Validation: Prototyping for digital products: What's unique for digital products, Preparation; Prototyping for physical products: What's unique for physical products, Preparation; Testing prototypes with users. Create a Pitch Plan for scaling up Road map for Implementation, Fine tuning and Submission of the project report.

Activities: Collect feedback; iterate and improve the ideas Present your solution using the Storytelling method (Usability testing, Feedback Grid Exercise and Iteration Activity).

Capstone Activity:

Mini Design Challenge: Apply all stages of design thinking on a real-world problem provided by industry/community.

TEXTBOOKS:

1. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, Tim Brown, HarperCollins Publishers Ltd., 2009.
2. Design Thinking for Strategic Innovation, Idris Mootee, John Wiley and Sons Inc., 2013.

TOOLS AND TECHNIQUES USED:

1. Sticky Notes, Whiteboards, Canva, Figma, TinkerCAD, Mind Mapping tools, Sketching Kits, Empathy Maps, Journey Maps and related softwares.

KINEMATICS OF MACHINERY

B Tech II Year II Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME401	**Professional Core**	**3**	**0**	**0**	**3**	**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Basic principles of Mechanics								

COURSE OBJECTIVES:

1. To introduce the concept of machines, mechanisms and related terminologies and the relative motion, velocity, and accelerations of the various elements in a mechanism.
2. To make the students become familiar with the most commonly used mechanisms such as four bar, slider crank, double slider crank mechanisms and their inversions.
3. To provide an overview of straight line motion mechanisms, steering mechanisms and Hooke's joint.
4. To familiarize higher pairs like cams and principles of cams design.
5. To understand the kinematic analysis of gears and gear trains.

COURSE OUTCOME:

The student will be able to:

1. Classify different types of kinematic pairs and analyze their role in mechanisms.
2. Apply graphical and analytical methods to determine velocity and acceleration in mechanisms.
3. Examine various straight-line motion mechanisms, steering gears, and Hooke's joint applications.
4. Analyze cam and follower motions to determine velocity and acceleration characteristics
5. Apply the law of gearing to design and evaluate gear trains and their motion transmission.

UNIT-I:

Mechanisms: Elements or Links, Classification, Rigid Link, Flexible and Fluid link, Types of kinematics pairs, Sliding, Turning, Rolling, Screw and spherical pairs, Lower and Higher pairs, Closed and open pairs, Constrained motion, Completely, Partially or successfully and incompletely constrained.

Mechanism and Machines: Mobility of Mechanisms: Grubler's criterion, classification of machines, Kinematics chain, Inversions of mechanism, Inversions of quadric cycle chain, Single and double slider crank chains, Mechanical Advantage.

UNIT-II:

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

Plane motion of body: Instantaneous center of rotation, Centrodes and Axodes. Three centers in line theorem, Graphical determination of instantaneous center, Determination of angular velocity of points and links by instantaneous center method. Kliens construction, Coriolis acceleration, Determination of Coriolis component of acceleration.

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

UNIT-III:

Straight Line Motion Mechanisms: Exact and approximate copied and generated types, Peaucellier, Hart, Scott Russel, Grasshopper, Watt, Tchebicheff's and Robert Mechanism, Pantographs.

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

Hooke's Joint: Single and double Hooke's joint, Velocity ratio, Application, Problems.

UNIT-IV:

Cams and Followers: Definitions of cam and followers and their uses, Types of followers and cams, Terminology, Types of follower motions, Uniform velocity, Simple harmonic motion, Uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes.

UNIT-V:

Gears and Gear Trains: Friction wheels and toothed gears, Types, Law of gearing, Condition for constant velocity ratio for transmission of motion, Velocity of sliding.

Forms of teeth, Cycloidal and involutes profiles, Phenomena of interferences, Methods of interference. Condition for minimum number of teeth to avoid interference, Expressions for arc of contact and path of contact of Pinion, Gear, Pinion and Rack Arrangements, Introduction to Helical, Bevel and worm gearing.

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

TEXTBOOKS:

1. Theory of Machines and Mechanisms, Uicker, J.J., Pennock G.R and Shigley, Oxford University Press, 4th Edition, 2014.
2. Theory of Machines, Thomas Bevan, CBS Publishers and Distributors, 3rd Edition, 2005.

REFERENCE BOOKS:

1. A Textbook of Theory of Machines, R.K.Bansal and J.S.Brar, Laxmi Publications, 5th Revised Edition, 2010.
2. Theory of Machines, Sadhu Sigh, Pearson Education, 3rd Edition, 2012.
3. Kinematics and Dynamics of Machinery, Robert L. Norton, Tata McGraw Hill, 2009.
4. Mechanisms and Machine Theory, Rao. J.S. and Dukkipati. R.V., Wiley Eastern Ltd., 2nd Edition, 1992.
5. Theory of Machines, S.S. Rattan, Tata McGraw Hill, 4th Edition, 2014.

THERMAL ENGINEERING – I

B Tech II Year II Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME402	**Professional Core**	**3**	**0**	**0**	**3**	**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Thermodynamics								

COURSE OBJECTIVES:

1. Explain the Components of IC Engines and systems.
2. Analyze the stages of combustion to improve the performance of IC engines with respect to fuel economy and control of emissions in global, environmental and social context.
3. Understand and evaluate the performance analysis of the major components and systems of IC engines and their applications.
4. Explore to the components and working principles of rotary, reciprocating, dynamic and axial compressors.
5. Understand the significance of gas turbines in real context in power generation.

COURSE OUTCOME:

The student will be able to:

1. Elaborate the working principles of IC Engine systems and its classification.
2. Explore the combustion stages of SI and CI engines, and factors influence for better combustion.
3. Evaluate the testing and performance parameters of IC engines.
4. Illustrate the function and working principles of rotary, reciprocating, dynamic axial compressors
5. Evaluate the performance of gas turbines and its classification.

UNIT-I:

Power Cycles and IC Engines Classification

Otto, Atkinson, Diesel and Dual Cycles, Description and representation on P-V and T-S Diagrams, Performance Parameters: Mean Effective Pressure and Thermal efficiency evaluation on Air standard basis, Comparison of Cycles, Actual Cycles and Comparison with ideal cycles Classification of IC Engines, Working principles of two and four stroke engines, SI and CI engines, Valve and Port Timing Diagrams.

UNIT-II:

Combustion in SI Engines

Types of SI engines, 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. 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.

UNIT-III:

Combustion in CI Engines

Types of CI 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 engines, Open and divided combustion chambers and fuel injection, Diesel fuel requirements and fuel rating..

UNIT-IV:

Testing and Performance

Parameters of performance, Measurement of cylinder pressure, Fuel consumption, Air intake, Exhaust gas composition, Brake power, Determination of frictional losses and indicated power, Performance test, Heat balance sheet and chart.

UNIT-V:

Compressors

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.

Rotary Compressors: Rotary Compressors (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 and 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.

TEXTBOOKS:

1. I.C. Engines, V. Ganesan, Mc Graw Hill, 4th Edition, 2010.
2. Thermal Engineering, Mahesh M Rathore, Tata Mc Graw Hill, 2010

REFERENCE BOOKS:

1. Applied Thermodynamics for Engineering Technologists, Eastop and McConkey, Pearson, 5th Edition, 1993.
2. Fundamentals of Classical Thermodynamics, Vanwylen G.J and Sonntag R.E., Wiley Eastern, 2nd Edition, 1978.
3. Internal Combustion Engines Fundamentals, John B. Heywood, McGraw Hill, 2nd Edition, 2018.

DESIGN OF MACHINE ELEMENTS

B Tech II Year II Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME403	**Professional Core**	**3**	**0**	**0**	**3**	**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Engineering Mechanics, Mechanics of Solids. **Note:** Design Data books are not permitted in the Examinations. The design must not only satisfy strength criteria but also rigidity criteria.								

COURSE OBJECTIVES:

1. To introduce the basic principles of machine component design.
2. To understand the various modes of failure in mechanical components under different loading conditions.
3. To learn how to apply theories of failure in the safe design of machine elements.
4. To develop the ability to design mechanical components like joints, couplings, shafts, and springs.
5. To familiarize with the use of standard codes and design data books in mechanical design.

COURSE OUTCOME:

The student will be able to:

1. Apply material properties, manufacturing considerations, and failure theories to design machine elements under static loading.
2. Analyze fluctuating stresses and design components for fatigue strength using endurance criteria and failure theories.
3. Design riveted, welded, and bolted joints considering strength, efficiency, and eccentric loading conditions.
4. Develop suitable designs for keys, cotters, and knuckle joints under different loading conditions.
5. Design shafts and couplings for strength, rigidity, and combined loading as per BIS standards.

UNIT-I:

Introduction

General considerations in the design of Engineering Materials and their properties, Selection, Manufacturing consideration in design. Tolerances and fits, BIS codes of steels.

Design for Static Strength: Simple stresses, Combined stresses, Torsional and Bending stresses, Impact stresses, Stress - strain relationship, 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, Gerber's curve, Goodman's line, Soderberg'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, Cotter joints, Spigot and Socket, Sleeve and Cotter, Gib and Cotter joints, Knuckle joints.

UNIT-V:

Shafts and Couplings

Design of solid and hollow shafts for strength and rigidity, Design of shafts for combined bending and axial loads, Shaft sizes, BIS code. Gaskets and seals (stationary and rotary).

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

TEXTBOOKS:

1. Mechanical Engineering Design, Joseph Edward Shigley, McGraw Hill, 10th Edition, 2022.
2. Design of Machine Elements, V.B. Bhandari, McGraw-Hill, 5th Edition, 2010.

REFERENCE BOOKS:

1. Theory of Machines, Dr.N.C.□Pandya and Dr.C.S.Shah, Charotar Publishing House Pvt. Ltd., 21st Edition, 2022.
2. Design of Machine Elements – I, Anup Goel, Technical Publications, 2020.
3. Machine Design, Jindal, Pearson, 1st Edition, 2010.
4. Design of Machine Elements, V. M. Faires, Macmillan, 4th Edition, 1965.
5. Design of Machine Elements - I, M.H Annaiah, New Age International Publishers, 1st Edition, 2010.

INSTRUMENTATION AND CONTROL SYSTEMS

B Tech II Year II Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME404	**Professional Core**	**3**	**0**	**0**	**3**	**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		

COURSE OBJECTIVES:

1. To impart the basic knowledge of the functional blocks of measurement systems.
2. To provide technical understanding of various Temperature and pressure measuring instruments.
3. To expose the students to know the working of various physical variable Level, Flow, Speed and Acceleration measuring instruments.
4. To understand the working of various physical and Electrical Variables Stress, Humidity, Force, Torque and Power measuring instruments.
5. To understand the concept of control system and calculate transfer functions of mechanical and translational systems with different techniques.

COURSE OUTCOME:

The student will be able to:

1. Know the basic knowledge of the functional blocks of measurement systems.
2. Analyze the working of Temperature and Pressure measuring Instruments
3. Elucidate the working of various physical variable Level, flow, Speed and Acceleration measuring instruments.
4. Illustrate the working of stress-strain & humidity instruments
5. Evaluate transfer functions of mechanical and translational systems with different techniques.

UNIT-I:

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 and Pressure

Measurement of Temperature: Various Principles of Measurement, Classification, Expansion Types: 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, Flow and Speed

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, Hotwire 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.

TEXTBOOKS:

1. Principles of Industrial Instrumentation and Control Systems, Chennakesava R Alavala, Cengage Learning, 1st Edition, 2009.
2. Instrumentation – Operations, Measurement, Scope and Application of Instruments, N.V.S. Raju, B.S. Publications, 2016.

REFERENCE BOOKS:

1. Measurement Systems: Applications and design, E. O. Doebelin, TMH, Tata Mcgraw Hill, 6th Edition, 2017.
2. Mechanical Measurements and Control, D. S. Kumar, Metropolitan Book Co. Pvt. Ltd., 2015.
3. Instrumentation, Measurement and Analysis, B.C. Nakra and K.K. Choudhary, TMH, 4th Edition, 2016.
4. Experimental Methods for Engineers, Jack P. Holman, Mc Graw Hill, 8th Edition, 2011.
5. Mechanical and Industrial Measurements, R. K. Jain, Khanna Publishers, 11th Edition, 1995.
6. Mechanical Measurements, Sirohi and Radhakrishna, New Age International, 3rd Edition, 2013.

OPERATIONS RESEARCH

B Tech II Year II Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME405	**Professional Core**	**2**	**0**	**0**	**2**	**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite:								

COURSE OBJECTIVES:

1. To introduce the principles of Operations Research and its applications in engineering and management.
2. To develop problem-solving skills for linear programming, transportation, and assignment problems.
3. To understand and apply models for decision making, queuing theory, and inventory control.
4. To formulate real-world problems using operations research tools.
5. To use optimization techniques for resource allocation and scheduling.

COURSE OUTCOME:

The student will be able to:

1. Understand development, characteristics, and types of Operations Research models and solve linear programming problems using simplex and artificial variable methods.
2. Formulate and solve transportation and assignment problems including variants and the travelling salesman problem.
3. Apply sequencing techniques for different job-machine configurations and devise replacement policies for deteriorating and failed items.
4. Analyze games using game theory concepts and solve inventory problems under deterministic and stochastic demand conditions.
5. Model waiting line systems and use dynamic programming techniques to solve optimization problems like shortest path and linear programming.

UNIT-I:

Introduction and LPP: Definition of Operations Research, Characteristics and phases of OR, Types of models, Operations Research models, applications.
Linear Programming Problem Formulation, Graphical solution, Simplex method.
Artificial variable techniques: Two-phase method, Big- M method.

UNIT-II:

Transportation problem: Formulation, Optimal solution, Unbalanced transportation problem, Degeneracy.
Assignment problem: Formulation, Optimal solution, Variants of Assignment problem, Travelling salesman problem.

UNIT-III:

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

UNIT-IV:

Theory of Games: Introduction, Terminology, Solution of games with saddle points and without saddle points. 2 x 2 games, Dominance principle, m x 2 and 2 x n games, Graphical method.

Inventory: Introduction, Single item, Deterministic models, Wilson, Harris Model, EOQ Derivation, Shortages model, Continuous Supply Model, P- System and Q- System. Purchase inventory models with one price break and multiple price breaks, Stochastic models.

UNIT-V:

Waiting lines: Introduction, Terminology, Single channel, 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.

TEXTBOOKS:

1. Operations Research Theory and Applications, J. K. Sharma, Trinity, 6th Edition, 2016.
2. Operations Research, NVS Raju, BSP Publications, 1st Edition, 2019.

REFERENCE BOOKS:

1. Operations Research, S. D. Sharma, Kedar Nath Ram Nath, 20th edition, 2014.
2. Operations Research: An Introduction, Hamdy A. Taha, PHI, 10th Edition, 2017.
3. Introduction to Operations Research, Hillier and Lieberman, McGraw Hill, 7th Edition, 2002.
4. Operations Research, A. M. Natarajan, P. Balasubramaniam and A. Tamilarasi, Pearson Education, 3rd Edition, 2020.
5. Operations Research, Wagner, PHI Publications, 2nd Edition, 1975.
6. Operations Research, Wagner, PHI Publications, 2nd Edition, 1975.

INNOVATION AND ENTREPRENEURSHIP

B Tech II Year II Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME406	**MS**	**2**	**0**	**0**	**2**	**40**	**60**	**100**
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite:								

COURSE OBJECTIVES:

1. To familiarize on the basic concepts of innovation, entrepreneurship and its importance.
2. To Identify and analyze the process of problem-opportunity identification, market segmentation, and idea generation techniques.
3. To initiate prototype development and understand minimum viable product.
4. To develop initial Business and financial planning and Go-to-Market strategies
5. To impart knowledge on establishing startups, venture pitching and IPR

COURSE OUTCOME:

The student will be able to:

1. Analyze the fundamentals of innovation and entrepreneurship, including types, leadership mindsets, and their role in economic development.
2. Identify and validate real-world problems and customer needs using various ideation techniques and design thinking principles.
3. Assess market opportunities and develop a functional prototype or Minimum Viable Product (MVP) for a proposed solution.
4. Formulate a robust business and financial model using the Lean Canvas approach and a Go-To-Market (GTM) strategy.
5. Prepare for venture launch by understanding startup registration, funding, legal aspects, and Intellectual Property Rights (IPR).

UNIT-I:

Fundamentals of Innovation and Entrepreneurship

Innovation: Introduction, need for innovation, Features, Types of innovations, innovations in manufacturing and service sectors, fostering a culture of innovation, planning for innovation. **Entrepreneurship:** Introduction, types of entrepreneurship attributes mindset of entrepreneurial and intrapreneurial leadership, Role of entrepreneurs in economic development. Woman Entrepreneurship, Importance of on-campus startups. Understanding to build entrepreneurial mindset, attributes and networks individuals while on campus.

Core Teaching Tool: Simulation, Game, Industry Case Studies (Personalized for students – 16 industries to choose from), Venture Activity

UNIT-II:

Problem and Customer Identification

Identification of gap, problem, analyzing the problem from a industry perspective, real-world problems, market and customer segmentation, validation of customer problem fit, Iterating problem-customer fit, Competition and Industry trends mapping and assessing initial opportunity, Porter's Five Force Model. Idea generation, Ideation techniques: Brainstorming, Brain writing, Round robin, and SCAMPER,

Design thinking principles, Mapping of solution to problem.

Core Teaching Tool: Several types of activities including: Class, game, Gen AI, 'Get out of the Building' and Venture Activity.

UNIT-III:

Opportunity assessment and Prototype development

Identify and map global competitors, review industry trends, and understand market sizing: TAM, SAM, and SOM. Assessing scope and potential scale for the opportunity.

Understanding prototyping and Minimum Viable Product (MVP). Developing a prototype: Testing, and validation.

Core Teaching Tool: Venture Activity, no-code Innovation tools, Class activity.

UNIT-IV:

Business & Financial Models

Introduction to Business Model and types, Lean Canvas Approach: 9-block lean canvas model, building lean canvas for your startup. Business planning: components of Business plan- Sales plan, People plan and financial plan, Financial Planning: Types of costs, preparing a financial plan for profitability using a financial template, understanding the basics of Unit economics, Economies of Scale and analyzing financial performance. Go-To-Market (GTM) approach – Selecting the Right Channel, creating digital presence, and building customer acquisition strategy.

Core Teaching Tool: Founder Case Studies – Sama and Securely Share; Class activity and discussions; Venture Activities.

UNIT-V:

Startups and IPR

Startup requirements, building founding team members and mentors, pitch preparation, start- up registration process, funding opportunities and schemes, institutional support to entrepreneurs, startup lifecycle, documentation, legal aspects in startup, venture pitching readiness, National Innovation Startup Policy (NISP) and its features.

Patents, Designs, Patentability, Procedure for grants of patents. Indian Scenario of Patenting. International Scenario: International cooperation on Intellectual Property. Patent Rights: Scope of Patent Rights. Copyright, trademark, and GI. Licensing and transfer of technology.

Core Teaching Tool: Expert talks; Cases; Class activity and discussions; Venture Activities.

SUGGESTED READINGS:

1. John R Bessant, Joe Tidd, Innovation and Entrepreneurship, 4E, Wiley, Latest Edition.
2. Ajay Batra, The Stratup Launch Book- A Practical Guide for Launching Customer Centric Ventures, Wiley, 2020. (For Core Teaching Tool).
3. Entrepreneurship Development and Small Business Enterprises, Poornima M Charantimath, 3E, Pearson, 2018.
4. D.F. Kuratko and T.V. Rao, Entrepreneurship: A South-Asian Perspective, Cengage Learning, 2013.
5. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Sabyasachi Sinha (2020). Entrepreneurship, McGrawHill, 11th Edition.
6. NISP -Brochure inside pages - startup_policy_2019.pdf

CONVENTIONAL AND COMPUTER AIDED MACHINE DRAWING

B Tech II Year II Semester: ME									
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME407	**Professional Core**	**0**	**0**	**2**	**1**	**40**	**60**	**100**
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		
Prerequisite: Engineering Graphics								

COURSE OBJECTIVES:

1. To understand the principles and standards of engineering and machine drawing.
2. To develop skills in visualizing and creating orthographic views of machine components.
3. To learn part modeling and assembly drawing using CAD tools.
4. To interpret symbols, tolerances, and fits used in machine drawing.
5. To prepare detailed drawings of mechanical parts and assemblies as per industry standards.

COURSE OUTCOME:

The student will be able to:

1. Interpret and represent machine elements such as threads
2. Prepare detailed drawings of mechanical joints including cotter
3. Create assembly drawings of steam engine components
4. Utilize computer-aided drafting tools to model machine elements and assemblies
5. Apply drawing standards

List of Experiments:

Drawing of Machine Elements and Simple parts:

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

1. Screw threads, nuts and bolts, set screws.
2. Keys, cotter 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 conventional drawing

Assembly Drawings:

Drawing of assembled views for the part drawing 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 conventional drawing

NOTE:

1. First angle projection to be adopted.
2. All the drawing components, Assembly to be drawn using any Computer aided drafting packages.

TEXTBOOKS:

1. Machine Drawing, N.D.Bhatt, Charotar Publication, 51st Edition, 2022
2. Machine Drawing with Auto CAD, Goutham Pohit and Goutam Ghosh, Pearson, 2016.

REFERENCE BOOKS:

1. Machine Drawing, Bhattacharyya, Oxford, 2011.
2. Machine Drawing, Ajeet Singh, Mc Graw Hill, 2nd Edition, 2012.

Note: External examination is conducted in conventional mode and internal evaluation to be done by both conventional as well as using computer aided drafting.

INSTRUMENTATION AND CONTROL SYSTEMS LAB

B Tech II Year II Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME408	**Professional Core**	**0**	**0**	**2**	**1**	**40**	**60**	**100**
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		
Prerequisite: Basic principles of Instrumentation and control systems								

COURSE OBJECTIVES:

1. To provide hands, on experience in calibration and characterization of various measuring instruments.
2. To develop skills in identifying and analyzing measurement errors.
3. To enable students to perform data analysis using regression techniques.
4. To familiarize students with modern instrumentation used in industrial process control.
5. To provide hands, on experience in calibration and characterization of various measuring instruments.

COURSE OUTCOME:

The student will be able to:

1. Demonstrate the use of mechanical and electronic instruments to measure pressure
2. Apply various temperature measurement techniques using thermocouples
3. Analyze the working principles of transducers for angular displacement
4. Implement SCADA systems for real-time monitoring and control of industrial processes involving pressure
5. Interpret experimental data to assess instrument calibration

List of Experiments:

Calibration and Study of:

1. Pressure Gauges.
2. Transducer for temperature measurement.
3. LVDT transducer for displacement measurement.
4. Strain gauge for temperature measurement.
5. Thermocouple for temperature measurement.
6. Capacitive transducer for angular displacement.
7. Photo and magnetic speed pickups for the measurement of speed.
8. Resistance Temperature Detector (RTD) for temperature measurement.
9. Rotameter for flow measurement.
10. Seismic pickup for the measurement of vibration amplitude of an engine bed at various loads.
11. McLeod gauge for low pressure.

Measurement and control of:

1. Pressure of a process using SCADA system.
2. Level in a tank using capacitive transducer with SCADA.
3. Temperature of a process using resistance temperature detector with SCADA.

Note: Perform a minimum of any 12 out of the 14 Experiments.

LAB MANUALS:

1. Laboratory Manual for Instrumentation and Control Engineering, S. R. Vijayalakshmi, Vikas Publishing House, 2021.
2. Instrumentation and Control Systems Lab Manual, Dr. A. K. Mittal and Dr. A. K. Bandyopadhyay, S. K. Kataria and Sons, 2020.

THERMAL ENGINEERING- I LAB

B Tech II Year II Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME409	**Professional Core**	**0**	**0**	**2**	**1**	**40**	**60**	**100**
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		
Prerequisite: Thermodynamics and Thermal Engineering – I								

COURSE OBJECTIVES:

1. To provide practical knowledge of the working and performance of internal combustion engines and air compressors.
2. To familiarize students with various testing methods like Morse test, retardation test, and heat balance.
3. To enhance the understanding of the effect of different parameters such as air fuel ratio and compression ratio on engine performance.
4. To impart hand son experience in dismantling and assembling of engine components.
5. To introduce basic operations and applications of boilers and their accessories.

COURSE OUTCOME:

The student will be able to:

1. Interpret valve and port timing diagrams to understand the working cycle of two-stroke and four-stroke engines.
2. Conduct performance tests on SI and CI engines under various operating conditions to evaluate power output, fuel consumption, and thermal efficiency.
3. Apply diagnostic techniques such as Morse, retardation, and motoring tests to determine engine frictional losses and individual cylinder performance.
4. Perform heat balance calculations for SI and CI engines to quantify energy distribution and losses.
5. Demonstrate practical skills in engine disassembly, assembly, and component analysis, including volumetric efficiency of compressors and boiler system study.

List of Experiments:

I.C. Engines:

1. Valve, Port Timing Diagrams.
2. Performance Test for 4 Stroke SI engines.
3. Performance Test for 2 Stroke SI engines.
4. Morse, Retardation, Motoring Tests.
5. Heat Balance – CI, SI Engines.
6. Economical Speed Test on a SI engine.
7. Effect of Air Fuel Ratio in a SI engine.
8. Performance Test on a 4Stroke CI Engine at constant speed.
9. Performance Test on Variable Compression Ratio Engine.

Other Experiments:

1. Volumetric efficiency of Air Compressor Unit.
2. Disassembly, Assembly of Engines.
3. Study of Boilers.

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

LAB MANUALS:

1. Internal Combustion Engines Laboratory Manual, Dr. K. Sudhakar and Dr. S. Ramasamy, VSRD Academic Publishing, 2021.
2. Thermal Engineering Lab Manual, Er. R.K. Rajput and Er. R.S. Khurmi, S. Chand Publications, 2022.

DATA ANALYTICS AND PYTHON FOR ENGINEERS

B Tech II Year II Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25ME410	**SD**	**0**	**0**	**2**	**1**	**40**	**60**	**100**
Contact Classes: Nil	**Tutorial Classes: Nil**	**Practical Classes: 30**				**Total Classes: 30**		

COURSE OBJECTIVES:

1. To introduce Python programming for data handling and analysis.
2. To enable data import, cleaning, and transformation.
3. To develop skills in data visualization and statistical analysis.
4. To apply data analytics to engineering problem solving.
5. To introduce real time data analysis using tools like Jupyter or Streamlit.

COURSE OUTCOME:

The student will be able to:

1. Write Python programs for engineering computations and data processing.
2. Clean and transform data using Pandas.
3. Create visualizations using Matplotlib and Seaborn.
4. Perform descriptive and predictive statistical analyses.
5. Analyze engineering datasets for performance insights.

UNIT-I:

Python Fundamentals for Engineering Applications

Basic Python Programming: Writing simple Python scripts for arithmetic, loops, and functions.

Application: Calculate mechanical or electrical parameters (e.g., stress, power, resistance).

Data Types and Structures: Practice using lists, dictionaries, tuples, sets. **Application:** Storing sensor data, part specifications, material properties.

File Handling in Python: Read/write data from .txt, .csv files. Application: Reading experimental or log data from machines.

UNIT-II:

Data Handling and Processing

Data Import and Cleaning using Pandas: Load data from Excel/CSV, handle missing data, remove outliers. **Application:** Clean experimental datasets from lab instruments.

Data Transformation and Aggregation: Grouping, filtering, and summarizing data.

Application: Analyze machine run times, failure logs, or production efficiency.

Data Visualization with Matplotlib and Seaborn: Line plots, bar charts, histograms, box lots.

Application: Visualize stress, strain graphs, sensor trends, or energy consumption.

UNIT-III:

Statistical Analysis and Engineering Insights

Descriptive Statistics: Mean, median, mode, standard deviation, variance.
Application: Analyze tolerance distribution, process variations.
Correlation and Regression Analysis: Perform and interpret linear regression.
Application: Predict thermal efficiency, or material behavior with respect to time/temp.
Hypothesis Testing: Perform t- tests and ANOVA. Application: Test impact of material changes on performance metrics.

UNIT-IV:

Applied Data Analytics

Sensor Data Analysis: Analyze timeseries data from IoT or sensor logs. Application: Predict motor failure or anomalies in temperature/humidity.
Real-time Data Dashboard (Optional with Jupyter/Streamlit): Build a basic data dashboard using Python tools. **Application:** Monitor lab machine metrics or simulate process control.

UNIT-V:

Mini Projects / Case Studies

Engineering Case Study – Predictive Maintenance: Analyze historical machine data to predict failure using regression/classification.
Energy Audit Data Analytics: Load and analyze power consumption data from equipment.
Optimization using Python (SciPy): Solve basic optimization problems (e.g., minimize cost, material use)

TEXT BOOKS:

1. Python for Data Analysis, Wes McKinney, O'Reilly Media, 3rd Edition,2022.
2. Think Python: How to Think Like a Computer Scientist, Allen B. Downey, Green Tea Press / O'Reilly Media, 2nd Edition, 2015.
3. Python Programming: An Introduction to Computer Science, John M. Zelle and Franklin,Beedle and Associates Inc.,3rd Edition,2016.
4. Data Analytics: Made Accessible, Anil Maheshwari, Amazon Digital Services / CreateSpace Independent Publishing, 1st Edition, 2014.

Tools and Library to be Use: Python, Jupyter Notebook, Pandas, NumPy, Matplotlib, Seaborn, SciPy, Scikit- learn (introductory)

INDIAN KNOWLEDGE SYSTEM

B Tech II Year II Semester: ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**		**CIE**	**SEE**	**TOTAL**
25VA400	**VA**	**1**	**0**	**0**	**1**	**40**	**60**	**100**
Contact Classes: 11	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 15**		

Bharat is considered one of the oldest civilizations of the world. Some of the archaeological evidences proved the existence of Indus Valley Civilization in 7000 B.C. Bhartiya traditions, culture, cultural activities, rituals, sacraments, painting, art of dancing, art of singing etc. is being practised till the modern times without knowing scientific approaches behind that. Eternity of Indian knowledge system proved itself that not only many rituals but also many traditions, many streams of knowledge like astrology, mathematics, physics, chemistry, biology, language studies, yoga and meditation had been following from the starting till now with some changes, in the form of traditions.

This course is for undergraduate students to inculcate Indian values. It will promote advance study and inter disciplinary research on all aspects of the Indian knowledge system.

COURSE OBJECTIVES:

1. To provide a tribune of the rich culture and traditions of Indian knowledge system to students of various disciplines.
2. To introduce historical account on the education and scientific literature available in ancient Indian traditions and its connections with ancient Indian Philosophy
3. To give insights about the applications of Bharatiya Jnana Parampara
4. To introduce Indian approach towards health and wellbeing
5. To elaborate vast contribution of ancient Indian researchers, engineers, scientists and architects to the modern world

COURSE OUTCOME:

The student will be able to:

1. Understand nature, scope and related fields of Indian knowledge system.
2. Demonstrate the scientific literature available in ancient Indian traditions
3. Understanding the application of Bharatiya Jnana Parampara
4. Understand Indian approach towards Wellbeing
5. Appreciate vast contribution of ancient Indian researchers, engineers, scientists and architects to the modern world

UNIT-I:

Introduction to Indian Knowledge Systems

Meaning, Nature, Scope and Salient Aspects of Bharatiya Jnana Parampara - Introduction to Vedas, Upanishads, Vidya, Kala, Jnana, Shastra - Practices and Continuity of Tradition.

UNIT-II:

Overview of History of Indian Education and Scientific Literature

Gurukul System - Role of Sanskrit in Natural Language Processing - Scientific Literature – Vedic Literature - Available Scientific Treatises - Interlinkings

UNIT-III:

Introduction to Scientific Theories from Pure Sciences from Ancient Indian Knowledge Systems

Overview of theories from available ancient Indian Literature about Physics, Chemistry and Mathematics – Inter linkings and applications

UNIT-IV:

Introduction to Ancient Indian Wellness Systems

Concept of Wellness – Yoga System - Ayurveda System - Ancient Indian Aesthetics.

UNIT-V:

Development of Engineering, Science, Technology & Fine Arts in India

Various Industries - Silk, Cotton and Ship Building - Evolution of Indian Fine Arts – Cave and Temple Architecture, Vastu - Vidya, Sculpture, Forts and Stepwells, Observatories and Paintings - Music and Natyakala - Cultural Traditions & Folk Arts.

- Pedagogy for Teachers: Apart from Class Room Instruction, the following Methods are suggested.
    1. Project based activities and learning.
    2. Presentation and case studies.
    3. Film screening and book reviews.

Visit to historical places, archives centre, research centre or library nearby.

Note: Activities mentioned above are only suggestive. Teacher-educators should encourage students to be innovative

SUGGESTED READINGS:

1. B. Mahadevan, Bhat Vinayak and Nagendra Pavan R.N., (2022) 'Introduction to Indian Knowledge Systems: Concepts and Applications' PHI learning PVT, New Delhi ISBN [9789391818203]
2. Dharmapal (1971) 'Indian Science and Technology in the Eighteenth Century'. Other India Press, Goa.
3. Kapil Kapoor, Singh Avdhesh Kumar, (2005) 'Indian Knowledge Systems' D.K. Printworld (P) Ltd. ISBN 10: 8124603367 / ISBN 13: 9788124603369
4. Chakradeo, Ujwala, Temples of Bharat, Aayu Publications, New Delhi, 2024
5. D.N. Bose, S.N. Sen and B. V. Subbarayappa, A Concise History of Science in India, Indian National Science Academy, New Delhi, 2009.
6. Datta B. and A. N. Singh, History of Hindu Mathematics: Parts I and II, Asia Publishing House, Bombay, 1962.
7. Kapoor, K. (2021), Indian Knowledge System: Nature, Philosophy, Character in Indian Knowledge System, vol. 1, Pub. Indian Institute of Advanced Studies, Shimla
8. Mahadevan, B., Bhat, V.R., Pavana, N. (2022), Philosophical Systems, in Introduction to Indian Knowledge System, Pub. PHI Learning, New Delhi.
9. Mahadevan, B., Bhat, V.R., Pavana, N. (2022), Knowledge: Framework and Classification, in Introduction to Indian Knowledge System, Pub. PHI Learning, New Delhi.