GOVERNMENT OF ANDHRA PRADESH

STATE BOARD OF TECHNICAL EDUCATION AND TRAINING

ANDHRA PRADESH :: MANGALAGIRI

CURRICULUM (C-26)

CONTEMPORARY I INVENTIVE

FUNDAMENTAL I ANALYTICAL

FOR POLYTECHNIC DIPLOMA COURSES IN ANDHRA PRADESH

DIPLOMA IN MECHANICAL ENGINEERING

3 YEARS

GOVERNMENT OF ANDHRA PRADESH

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3 YEAR DIPLOMA
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1. PREAMBLE

The world is evolving rapidly, and education must evolve with it. In today's dynamic environment, our approach to learning must equip students not only with knowledge but also with the practical experience in innovation, critical thinking ability and problem-solving mindset required to excel in both academic and professional spheres.

At the heart of the new curriculum, lies the belief that education should be student-centric, fostering curiosity, creativity and a lifelong passion for learning. The State Board of Technical Education and Training (SBTET), Andhra Pradesh aims to create a safe, supportive, and inclusive learning environment where every student is encouraged to reach their fullest potential. This curriculum is designed to provide a strong foundation for lifelong growth and employability, ensuring that learners graduate not only with a diploma but also with the competence and confidence to thrive in a rapidly changing world.

The SBTET, A.P. has consistently strived to meet the aspirations of all stakeholders i.e., students, parents, industries, academia and society at large by keeping its diploma programmes relevant to emerging technologies and industrial advancements. To this end, SBTET, A.P. has regularly reviewed and updated its curricula through a systematic, evidence-based and consultative process.

Building on the success of earlier curriculum and responding to the demands of new-age technologies, SBTET, A.P. resolved to update the Polytechnic C-23 curriculum and introduce the new curriculum (C-26), aligning it with global technological trends, skill-development goals, and industry expectations. The revision process was initiated in November 2024, with comprehensive feedback collected from all stakeholders i.e., students, parents, industry experts, academia, alumni, faculty, heads of sections and principals across the state.

A pivotal meeting was convened under the chairmanship of Sri. Gummala Ganesh Kumar, I.A.S., Director of Technical Education & Chairman, SBTET, A.P. to

discuss the revamping of the curriculum with an emphasis on industry relevance, academic flexibility, skill orientation and employability.

Further, Sri. Gummala Ganesh Kumar, I.A.S., reiterated the importance of industrial exposure, project-based learning, and practical training in bridging the gap between classroom learning and industry requirements. He highlighted the need to make the curriculum more innovative, flexible, and technology-driven to prepare students for emerging fields such as Artificial Intelligence (AI), Machine Learning (ML), Quantum Computing, Internet of Things (IoT), Drone Technology, and Industry 4.0.

To ensure a holistic and futuristic approach, two regional workshops were conducted with industry experts, academic experts from higher-level institutes and subject experts at Tirupati and Visakhapatnam. The Programme-wise expert committees comprising members from industry, higher-education institutions and polytechnic faculty were constituted. In the subsequent workshops conducted, these committees explored strategies to integrate the following key components into the curriculum, with the objective of enhancing employability and industry readiness:

- Internet of Things (IoT) for all programmes
- A balanced ratio of theory and practical components
- Emerging technologies such as Artificial Intelligence (AI), Machine Learning (ML), Quantum Computing, and Drone Technology
- Industry 4.0 and 5G Technologies
- Introduction of elective courses to provide flexibility and promote specialization in emerging domains
- Inclusion of audit courses to encourage innovative and holistic development, ethics, environmental awareness, entrepreneurship and lifelong learning beyond the core curriculum
- Adoption of Practicum-based Learning, wherein certain courses are designed to be taught through hands-on, activity-oriented, and experiential methods

instead of the conventional lecture mode, enabling students to apply concepts directly through practice and experimentation

A series of workshops, consultations, and validation meetings with subject experts, industrialists, and academicians were conducted to comprehensively review and refine the draft curriculum. The final version was further vetted by industry professionals and academicians from reputed higher-education institutions to ensure academic rigor, practical relevance, and alignment with current and emerging industry needs.

The Curriculum 2026 (C–26) has been developed through the active participation of polytechnic faculty, industry representatives, and expert committees, following an Outcome-Based Education (OBE) framework in accordance with NBA guidelines.

This new curriculum reflects the collective vision of educators, industry experts, and policymakers to develop competent, innovative, ethical and highly employable diploma graduates. It equips learners with the skills, attitudes and mindset needed to embrace future challenges driven by AI, Quantum Computing, IoT, Industry 4.0, 5G and sustainable technologies.

The C–26 Curriculum has been approved by the Board Members, SBTET, Andhra Pradesh, for implementation from the academic year 2026–27.

2. KEY FEATURES OF THE C-26 CURRICULUM

- The C 26 Curriculum introduces AI & ML, Python, Aerospace engineering and IoT as Audit Subjects to prepare students for Industry 4.0.
- Practicum Practical subjects are introduced such as Manufacturing Technology, Refrigeration & Air Conditioning and Communication & Employability skills enhance the hands-on learning skills.
- Modern technologies like automation, robotics, CNC, additive manufacturing and energy systems are added to keep students aligned with current industry needs.
- Digital Manufacturing skills are strengthened through CNC and computer-integrated manufacturing for smart factory applications.
- Students work on real-time projects using 3D printing, automation kits, AI/ML models and CAD tools.
- Practicum subjects are introduced which provides hands-on, real-world learning skills that allows students to apply theoretical knowledge using practical experiments, tools and industry-oriented activities.
- Python programming helps the students perform engineering calculations, automate tasks and analyses the data.
- Students gain exposure to advanced fields like Metrology and Nanotechnology.
- Audit courses in Basic Electrical Engineering and AI/ML provide interdisciplinary and advanced knowledge.
- This curriculum promotes eco-friendly refrigerants, modern RAC and Automobile trends and emphasizes engineering ethics and human values.

3. ACKNOWLEDGEMENTS

The members of the working group sincerely thank Sri Gummala Ganesh Kumar, I.A.S., Director of Technical Education and Chairman of SBTET, Andhra Pradesh, and Sri Kona Sasidhar, I.A.S., Principal Secretary, Skills Development and Training Department, for their valuable guidance and support during the revision of the C-23 Curriculum and the development of the new C-26 Curriculum.

We are also thankful to SBTET, Andhra Pradesh, Mangalagiri, for organizing a series of workshops at different stages. These workshops brought together teachers from polytechnics, experts from reputed national Institutes, universities, engineering colleges and professionals from industry. Their discussions and feedback helped to review the C-23 Curriculum and design the improved C-26 Curriculum.

We express our gratitude to Sri G.V.V. Satyanarayana Murty, Secretary, SBTET, Andhra Pradesh, Sri V. Padma Rao, Joint Director of Technical Education, Sri A. Ravi Kumar, Joint Secretary (Academic), SBTET, Andhra Pradesh and all officers from the Directorate of Technical Education and State Board of Technical Education and Training, Andhra Pradesh, for their encouragement and continuous support.

Finally, we sincerely thank all faculty members from various polytechnics across the state who contributed to this endeavour. Their ideas, teamwork, and commitment played a key role in shaping the C-26 Curriculum successfully.

4. RULES AND REGULATIONS

4.1 Duration and Pattern of Diploma Programmes

All Diploma Programmes approved by AICTE are of three years duration.

- The first year follows a yearly system.
- The remaining period (two years) follows a semester system.
- A run-through system is followed for all Diploma Programmes, as per eligibility rules.

4.2 Procedure for Admission into the Diploma Programmes:

Selection of candidates is governed by the rules and regulations laid down in this regard from time to time.

a. Candidates who wish to seek admission into any of the Diploma Programmes will have to appear for the Common Entrance Test for admissions into polytechnics (POLYCET) conducted by the State Board of Technical Education and Training, Andhra Pradesh, Mangalagiri. Only the candidates satisfying the following requirements will be eligible to appear for the Common Entrance Test for admissions into polytechnics (POLYCET).

The candidates seeking admission should have passed/appeared for S.S.C. examination, conducted by the Board of Secondary Education, Andhra Pradesh, or equivalent examination thereto, by the time of applying for the Common Entrance Test for admission into polytechnics (POLYCET). In case of candidates whose results of their qualifying examinations are pending, their selection shall be subject to production of proof of their passing the qualifying examination in one attempt or compartmentally at the time of admission.

b. Admissions are made based on the merit obtained in the Common Entrance Test (POLYCET) and the reservation rules stipulated by the Government of Andhra Pradesh from time to time.

c. For admission into Diploma in Pharmacy programme for which entry qualification is 10+2 (MPC/BiPC), candidates need not appear for POLYCET. A separate notification will be issued for admission into this Programme.

4.3 Medium of Instruction

The medium of instruction and examination for all Diploma programmes shall be English

4.4 Permanent Identification Number (PIN)

Every student is given a Permanent Identification Number (PIN) at the time of admission.

This number is used to record and maintain the student's academic and examination details throughout the Diploma along with APAAR ID.

4.5 Number of Working Days per Semester/Year:

a) The academic year for all the programmes shall be in accordance with the academic calendar.
b) The working days in a week shall be from Monday to Saturday.
c) There shall be 7 periods of 50 minutes duration each on all working days.
d) The minimum number of working days for each semester/year shall be 90/180 days excluding examination days. If the prescribed minimum is not achieved due to any reason, special arrangements shall be made to conduct classes and complete the syllabus.
e) The timings of the institutions shall be preferably from 9:30 a.m. to 4:30 p.m.

4.6 Eligibility (Attendance to appear for the Summative Assessment)

a) A candidate shall be permitted to appear for the Summative Assessment in all programmes, if he or she has attended a minimum of 75% of working days during the year/semester.
b) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester or first year may be granted on medical grounds.
c) A stipulated fee shall be payable towards condonation for shortage of attendance.
d) Candidates having less than 65% attendance shall be detained.

e) Students whose shortage of attendance is not condoned in any semester / year and who have not paid the condonation fee in time are not eligible to take the Summative Assessment of that semester/year and they will be detained. They may seek readmission for that semester/year (when offered) in the next subsequent academic semester/year.

f) For Industrial Training:

i) During Industrial Training, the candidate shall put in a minimum of 90% attendance.

ii) If the student fails to secure 90% attendance during industrial training, the student shall reappear for industrial training at his own expense.

4.7 Readmission Rules

Readmission shall be granted to eligible candidates by the respective Principal/Regional Joint Director/Director of Technical Education.

a) (i) Within 15 days after commencement of class work in any semester.

(ii) For Industrial Training: before commencement of the Industrial Training.

b) Within 30 days after commencement of class work in any year (including D. Pharmacy Programme or first year course work in Engineering and Non-Engineering Diploma streams). Otherwise, such cases shall not be considered for readmission for that year and they are advised to seek readmission in the next eligible academic year.

c) The percentage of attendance of the readmitted candidates shall be calculated from the first day of beginning of the regular class work for that year/semester, as officially announced by CTE but not from the day on which he/she has actually reported to the class work.

d) A candidate detained in any year or semester shall be allowed readmission to the same year/semester only in the subsequent academic year. This provision shall equally apply to the industrial training also.

4.8 Scheme of Evaluation

a) First Year:

Theory Courses: 70 marks for the Summative Assessment (3 hours) + 30 marks for Formative Assessment.

Laboratory/Drawing Courses: 60 or 30 marks for the Summative Assessment (3 hours) + 40 or 20 marks for Formative Assessment as per the allocated marks to that course.

b) III to V Semesters:

Theory Courses: 70 marks for the Summative Assessment (3 hours) + 30 marks for

Formative Assessment.

Laboratory/Drawing Courses: 60 or 30 marks for the Summative Assessment + 40 or 20 formative assessment as per the allocated marks to the course.

4.9 Formative Assessment Scheme:

Formative Assessment shall be conducted for awarding marks on the dates specified and it consists of two components namely, Assessment through Unit Tests and Continuous Internal Assessment (CIA).

Total Formative Assessment Marks (30) =Unit Test (20) + CIA (10)

a) **Theory Courses:**

Three-unit tests shall be conducted for I year and two Unit Tests for semesters. Unit test shall be of 90 minutes duration and for a maximum of 40 marks for each test.

S. No.	Type of Assessment	Weightage Assigned	Remarks
	Formative Assessment (30 Marks)		
1	Formative Assessment through Unit Tests (UT): 20 Marks		
	Testing of knowledge through Unit Tests for Year - UT1+UT2+UT3 for Semester - UT1 + UT2	20	Each Unit test shall be conducted for 40 marks and scaled down to 20. Average of all the unit tests will be taken as Unit Test marks

2	Formative Assessment through Continuous Internal Assessment (CIA) :10 Marks		
	1. Assignments	05*	All activities shall be recorded. Relevant records are to be filed and secured for further scrutiny of higher authorities
	2. Dynamic Learning Activities: Project Work/ Seminar /Group Discussion, Quizzes etc.	05**	
	T O T A L	30	

**At least one assignment should be completed for each unit which carries 10 marks. The total assignment marks should be scaled down to 5.*

***At least one dynamic learning activity is to be conducted which carries 10 marks. The total marks should be scaled down to 5.*

b) Practical Courses:

Award of marks for Formative Assessment shall be as follows:

i) Drawing Courses:

Distribution of Marks for the Formative Assessment			
First Year (Total: 40 Marks)		Semesters (Total: 40 Marks)	
Max: 20 Marks	Max: 20 Marks	Max: 20 Marks	Max: 20 Marks
From the average of THREE Unit Tests.	From the average of Assessments of Regular Class work Exercises.	From the average of TWO Unit Tests.	From the average of Assessment of Regular Class work Exercises.

- Each Unit Test will be conducted for a duration of 120 minutes with maximum marks of 40 and scaled down to 20 Marks.

ii) Laboratory Courses:

a) Student's performance in Laboratories / Workshop shall be assessed during the year/ semester of study for 40 marks in each Laboratory Course. The procedure for evaluation for Laboratory Courses, other than Drawing courses:

i. Formative Assessment for Laboratory Course shall be done on the basis of tasks performed by the student in the laboratory.

ii. Question paper for Formative Assessment shall be task-based and shall be designed to assess practical skills, procedures, and application of concepts.

b) Formative Assessment in Laboratory courses shall be done during the course of study and marks shall be awarded by the concerned teacher.

Formative Assessment for laboratory courses can be done for 40 marks

Sl. No.	Type of Assessment	Weightage Assigned	Remarks
	Formative Assessment: 40 Marks		
1	Formative Assessment through Unit Tests (UT): 20 Marks		
	Practical & Theory evaluation: Testing of knowledge through Unit Tests for Year - UT1+UT2+UT3 for Semester - UT1 + UT2	20	Each Unit test shall be conducted for 20 Marks. Average of all the Tests will be taken as Unit Test marks
2	Formative Assessment through Continuous Internal Assessment (CIA) :20 Marks		
	Experiment wise observations, individual laboratory performance	20	
	T O T A L	40	

c) For laboratory examinations, there shall be two examiners. External examiner shall be appointed by the Principal in consultation with respective Head of the Section, preferably choosing a qualified person from the list given below in order of preference. Appointment order copy shall be filed and secured.

i) Near by Industries.

ii) Govt./Semi Govt organizations like R & B, PWD, PR, Railways, BSNL, APSRTC, APSEB etc.

iii) Govt./ University Engineering Colleges.

iv) Senior Faculty from nearby Polytechnics.

Internal examiner shall be the person concerned with Formative Assessment as mentioned in (b) above. The Summative Assessment shall be held along with all theory papers in respect of drawing courses. In case of drawing course earmarked as Practicum (practical course) the Summative Assessment shall be held along with practical papers.

d) Question Paper for Practical Examination: Question paper should cover the experiments / exercise prescribed to test various skills like handling, manipulating, testing, troubleshooting, repair, assembling and dismantling etc. from more than one experiment / exercise

e) Records pertaining to Formative Assessment marks of both theory and

practical Courses are to be maintained for official inspection. All the evaluation formats/proformas shall be maintained as per the instructions issued by SBTET, A.P. from time to time

iii) Practicum Theory Courses:

Assessment for Practicum theory courses can be done for 30 marks

Sl. No.	Type of Assessment	Weightage Assigned	Remarks
	Formative Assessment (30 Marks)		
1	Formative Assessment through Unit Tests (UT): 20 Marks		
	Theory & Practical evaluation: Testing of knowledge through Unit Tests for Year - UT1+UT2+UT3 for Semester - UT1 + UT2	20	Each Test shall be conducted for 40 Marks (Theory:30 Marks Practical:10 Marks) and scaled down to 20. Average of all the Tests will be taken as Unit Test marks
2	Formative Assessment through Continuous Internal Assessment (CIA) :10 Marks		
	a) Assignments	05*	All activities shall be recorded. Relevant records are to be filed and secured for further scrutiny of higher authorities
	b) Dynamic Learning Activities: Project Work/ Seminar/Group Discussion, Quizzes etc.	05**	
	TOTAL	30	

**At least one assignment should be completed for each unit which carries 10 marks. The total assignment marks should be scaled down to 5.*

***At least one dynamic learning activity is to be conducted which carries 10 marks. The total marks should be scaled down to 5.*

iv) Practicum Practical Courses:

Assessment for Practicum practical courses can be done for 40 marks

Sl. No.	Type of Assessment	Weightage Assigned	Remarks
	Formative Assessment: 40 Marks		
1	Formative Assessment through Unit Tests (UT): 20 Marks		
	Practical & Theory evaluation: Testing of knowledge through Unit Tests for Year - UT1+UT2+UT3 for Semester - UT1 + UT2	20	Each Test shall be conducted for 40 marks (Theory:10marks Practical:30marks) and scaled down to 20. Average of all the Tests will be taken as Unit Test marks.
2	Formative Assessment through Continuous Internal Assessment (CIA) :10 Marks		

	Experiment wise observations, individual laboratory performance	20	
	T O T A L	40	

v) Activity Periods:

1.	a) Library	All activities shall be duly recorded & the relevant documents shall be filed and securely maintained for scrutiny by higher authorities. 0.5 or 1 Credits shall be awarded to the successful candidates for each semester/year accordingly.
	b) IPSGM/Sports & Games	
	c) Extra-curricular activities (NSS / NCC/ Clean & Green of Campus etc.)	

vi) Industrial Training:

In case of Industrial Training, SOP will be circulated by SBTET, A.P from time to time. The Formative Assessment and Summative Assessment shall be done as illustrated in the following table:

Assessment No	Upon completion of	Conducted by	Based on	Max Marks
Pre-Assessment	15 days to 30 days from the commencement of training	Mentor faculty member visits the industry 15 days to 30 days from the commencement of training and will submit a detailed report to the principal outlining each candidate's details and observed work culture		
1 (Formative Assessment)	Mid Semester Assessment after three months (at industry)	1.The mentor faculty member concerned 2. Industry Training In charge	Learning outcomes as given in the scheme of assessment, for Industrial Training	120
2 (Formative Assessment)	Last month of training (at industry)	1. The mentor faculty member concerned 2. Industry Training In charge	Learning outcomes as given in the scheme of assessment,	120

			for Industrial Training	
3 (Summative Assessment)	After completion of the training (at Institution)	1.The faculty member concerned, 2.HoS concerned 3.An external examiner from Industry	1.Demonstration of any one of the skills listed in learning outcomes	30
			2.Training Report	20
			3. Viva Voce	10
TOTAL				300

Each staff member shall be assigned a batch of students 10 to 15 as a mentor faculty for making assessment during industrial training.

vii) Project Work:

The guidelines to be followed for Project work are as follows:

- ✓ The Project Title and Abstract must be approved by a committee comprising the Principal, Head of the Section (HoS) and the concerned faculty members
- ✓ Students should be encouraged to undertake project work with the potential for publication in academic and professional journals

The Formative Assessment consisting of 40% of the total marks shall be distributed as follows:

Assessment	To be conducted at	Marks (Evaluated for)
Review-1	After the completion of 4 weeks from the start of the semester	10
Review-2	After the completion of 10 weeks from the start of the semester	15
Review-3	After the completion of 14 weeks from the start of the semester	15

The Summative Assessment consisting of 60% of the total marks shall be distributed as follows:

Assessment	To be conducted	Conducted by	Based on	Max Marks

Summative	After completion of the Project work	1.Project Guide 2.HoS concerned 3.An external examiner	1.Demonstration of skill relevant to the Project	30
			2. Project Report	20
			3. Viva Voce	10
TOTAL				60

4.10 Minimum Pass Marks

a) Theory Courses:

To pass a theory course, a candidate must secure a minimum of 35% in the Summative Assessment (i.e., Min 25 Marks) and a combined minimum of 35% from both the Formative and Summative Assessment marks put together.

b) Practical Courses:

For passing a practical Course, a candidate has to secure a minimum of 50% in Summative Assessment and a combined minimum of 50% of both Formative and Summative Assessment marks put together. In case of D.C.C.P., the pass mark for Typewriting and Shorthand is 45% in the Summative Assessment. There are no marks for formative assessment in case of Typewriting and Shorthand courses in D.C.C.P programme.

c) Industrial Training:

The Industrial training shall carry 300 marks and pass marks is 50% in each assessment at industry (Mid semester Assessment and second assessment) i.e 120 marks out of 240 and in final summative assessment 30 marks out of 60 marks at institution level put together i.e. 150 marks out of 300 marks.

d)The courses successfully completed shall be awarded the allotted credits and the corresponding grade shall be assigned based on the percentage of marks secured.

4.11 Provision for Improvement

Improvement is allowed only after he / she has completed all the courses from First Year to Final semester of the Diploma.

a) Improvement is allowed in any 4 (Four) courses of the Diploma Programme.

b) The student can avail the improvement chance only once and it must be

taken within the two examinations immediately following the completion of their Diploma. However, the duration including Improvement examination shall not exceed FIVE years from the year of first admission.

c) No improvement is allowed in Practical / Lab Courses or Project work or Industrial Training assessment. However, improvement in drawing Course(s) is allowed.

d) If improvement is not achieved, the marks obtained in the previous Examinations hold good.

e) Improvement is not allowed in respect of the candidates who are punished under Mal-Practice in any examination.

f) Examination fee for improvement shall be paid as per the notification issued by State Board of Technical Education and Training from time to time.

g) All the candidates who wish to appear for improvement of performance shall deposit the original Marks Memos of all the years / Semesters including Consolidated Marks Memo(CMM) and also original Diploma Certificate to the Board. If there is improvement in performance of the current examination, the revised Memorandum of marks including CMM and Original Diploma Certificate will be issued, else the submitted originals will be returned.

4.12 Rules of Promotion:

i. A candidate shall be permitted to appear for first year examination provided he / she has 75% attendance (which can be condoned on medical grounds up to 10%) i.e. attendance after condonation on medical grounds should not be less than 65% and has to pay the examination fee.

ii. A candidate shall be promoted to 3rd semester if he/she puts in the required percentage of attendance in the first year and pays the examination fee. A candidate who could not pay the first-year examination fee has to pay the promotion fee as prescribed by State Board of Technical Education and Training, AP from time to time before commencement of 3rd semester.

iii. A candidate shall be promoted to 4th semester provided he/she puts the required percentage of attendance in the 3rd semester and paid the examination fee. A candidate, who could not pay the 3rd semester exam fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training AP from time to time before commencement of 4th semester. A candidate is eligible to appear for the 4th semester examination if he/she puts the required percentage of attendance in the 4th semester and pays the examination fee.

iv A candidate shall be promoted to 5th semester provided he / she puts the required percentage of attendance in the 4th semester and pays the examination fee. A candidate, who could not pay the 4th semester examination fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 5th semester. A candidate is eligible to appear for the 5th semester examination if he/she puts the required percentage of attendance in the 5th semester and pays the examination fee.

v A candidate shall be sent to Industrial Training/6th semester provided he/she puts in the required percentage of attendance in the 5th semester and pays the examination fee /promotion fee as prescribed by SBTET. A candidate is eligible to appear for Industrial Training assessment (Seminar/Viva-Voce) only if he/ she puts the required percentage of attendance, i.e., 90% in the 6th semester Industrial Training and pays the examination fee.

vi Industrial Training shall be treated as the 6th semester, irrespective of whether the training is undertaken during the 5th or 6th semester.

For IVC & ITI Lateral Entry students:

i) A candidate shall be permitted to appear for Third semester examination provided he/she puts in 75% attendance (which can be condoned on medical grounds up to 10%) and pays the examination fee for third semester.

ii) A candidate shall be promoted to 4th semester provided he/she puts the required percentage of attendance in the 3rd semester and pays the

examination fee. A candidate who could not pay the 3rd semester exam fee, has to pay the promotion fee as prescribed by SBTET, A.P from time to time before commencement of 4th semester. A candidate is eligible to appear for the 4th semester examination if he/she puts the required percentage of attendance in the 4th semester and pays the examination fee.

iii) A candidate shall be promoted to 5th semester provided he / she put the required percentage of attendance in the 4th semester and pays the examination fee. A candidate, who could not pay the 4th semester examination fee, has to pay the promotion fee as prescribed by State Board of Technical Education and Training from time to time before commencement of 5th semester. A candidate is eligible to appear for the 5th semester examination if he/she puts the required percentage of attendance in the 5th semester and pays the examination fee.

iv) A candidate shall be sent to Industrial Training/VI semester provided he/she puts in the required percentage of attendance in the 5th semester and pays the examination fee /promotion fee as prescribed by SBTET. A candidate is eligible to appear for Industrial Training assessment (Seminar/Viva-Voce) only if he / she puts the required percentage of attendance, i.e., 90% in the 6th semester Industrial Training and pays the examination fee.

4.13 Student Performance Evaluation

Successful candidates shall be awarded the Diploma under the following CGPA.

CGPA secured	Division
CGPA ≥ 7.5	First Class with Distinction (who completed Diploma within 3 years)
7.5 > CGPA ≥ 6	First Class
CGPA < 6	Second Class

Note: Candidate should acquire 120 credits to award diploma**.**

Awarding Grade and Grade Points

Students will be awarded Grades and Grade Points considering their

Percentage of Marks Evaluated in each Theory and Practical Courses and the Conversion of Percentage of Marks obtained in the Examinations to the Grade Points and Awarding Grades for Every Course is tabulated as shown below:

For Theory Courses		
Percentage of Marks	**Grade Points, GP (10)**	**Grade Awarded**
Above 90	10	A+
From 81 to 90	09	A
From 71 to 80	08	B+
From 61 to 70	07	B
From 51 to 60	06	C+
From 41 to 50	05	C
From 35 to 40	04	D
Below 35	0	F (FAIL)

For Practical Courses		
Percentage of Marks	**Grade Points, GP (10)**	**Grade Awarded**
Above 90	10	A+
From 81 to 90	09	A
From 71 to 80	08	B+
From 61 to 70	07	B
From 51 to 60	06	C+
Equal to 50	05	C
Below 50	0	F (FAIL)

The merit level of a student would be indicated by

1. "Semester Grade Point Average (SGPA) " for the Year or for a Semester.
2. "Cumulative Grade Point Average (CGPA)" for awarding Diploma.

Conversion Formula, EP = Equivalent Percentage = [CGPA Obtained] x 10

4.14 Examination Fee Schedule

Examination fees are as per the notifications issued by the State Board of Technical Education and Training (SBTET), Andhra Pradesh, from time to time.

4.15 Structure of Examination Question Paper

I. Formative Assessment:

a) Theory Courses

For First Year: Three Unit Tests.

For semesters: Two Unit Tests.

Each test shall be of 90 minutes duration, carrying a maximum of 40 marks and will consist of Part A and Part B

Part A (16 Marks):

1. Objective Type Questions:

Multiple Choice Questions / True or False / Fill in the Blanks-
4 × 1 marks = 4 marks

2. Short Answer Questions:

Four questions - 4 × 3 marks = 12 marks

Part B (24 Marks):

Essay-Type Questions: (Attempt any 3 out of 4)
3 × 8 marks = 24 marks

Total Marks:4 + 12 + 24 = 40 marks

Computation of Marks

First Year: Average of 3 tests

Semester System: Average of 2 tests

The marks obtained out of 40 shall be scaled down to 20 and treated as the Unit

Test marks for each course.

b) Drawing Courses (both Conventional/Hybrid) :

First Year:

Three-unit tests shall be conducted for 40 marks. The duration of each test is 120 minutes

The question paper pattern is as follows:

Part A: Answer all 4 question, 4 X 5M =20M.

Part B: Answer any 2 questions out of 4, 2 X 10M =20M.

Semesters:

Two-unit tests shall be conducted for 40 marks. The duration of each test is 120 minutes

The question paper pattern is as follows:

Part A: Answer all 4 questions, 4 X 5M =20M.

Part B: Answer one question out of two 1 X 20M =20M.

The marks obtained for 40 shall be scaled down to 20 marks and the average of 3tests/2tests shall be taken as final Unit test marks for the course. Remaining 20 marks are given by the teacher based on the performance of the student during regular class work of that course.

c) Laboratory/Workshops:

Fifty percent of the total marks shall be allotted to continuous assessment

in labs/workshops and the remaining fifty percent shall be derived from two tests

d) Assessment of Practicum Courses:

i)Practicum Theory Course (out of 30 Marks)

Theory and Practical Assessment: 20 Marks

Continuous Internal Assessment: 10 Marks

Total Marks for the course = 20+10= 30 Marks

ii) Practicum Practical Course (out of 40 Marks)

Practical & Theory Assessment: 20 Marks

Continuous Internal Assessment: 20 Marks

Total Marks for the course = 20+20 = 40 Marks

II. Summative Assessment:

The question paper for theory examination is patterned in such a manner that the weightage of periods/marks allotted for each of the topics for a particular course be considered. Summative Assessment paper is of 3 hours duration.

a) Each theory paper has Section A (short answers) and Section B (essay questions).

Section A: Answer 10 out of 12 questions, Total = 10 × 3M = 30M

Section B: Answer 5 out of 8 questions, Total = 5 × 8M = 40M

Total theory marks for Summative Assessment = 70 Marks.

b) Drawing Course:

I year

Section A: 4 questions 4 X 5M = 20 marks (all to be answered).

Section B: answer 4 questions out of 6 questions. 4 × 10M = 40 marks.

Drawing Courses - III Semester to V Semester

As per the weightage of marks given in blueprint of the respective course

c) Practical Examinations:

For practical with total 60 marks: Experiment/exercise = 50 marks; Viva-voce = 10 marks; Total = 60.

For practical with total 30 marks: Experiment/exercise = 25 marks; Viva-voce = 5 marks; Total = 30.

Question papers for practical are drawn by lottery and cover required skills. Changes to the pattern will be notified in advance.

d) Note on Laboratory Evaluation:

Laboratory teaching shall be task/competency based and the Semester-end question papers should follow SBTET norms.

4.16 Issue of Memorandum of Marks

All candidates who appear for the Summative Assessment will be issued memorandum of marks without any payment of fee. However, candidates who lose the original memorandum of marks have to pay the prescribed fee to the Secretary, State Board of Technical Education and Training, A.P. for each duplicate memo. After successful completion of all courses, Consolidated Memorandum of Marks will be issued.

4.17 Maximum Period for Completion of Diploma

The maximum period to complete a Diploma is twice the duration of the course from the date of first admission (this includes any periods of detention or discontinuation). After this period, students will forfeit the right to complete the Diploma and will not be allowed to appear for exams. This applies to all the Diploma Programmes.

4.18 Eligibility for Award of Diploma

A candidate is eligible for the Diploma if:

i) They have pursued the course for not less than 3 years and not more than 6 years.

ii) Students must complete all the required courses. Those who fail to fulfil the requirements within the maximum permissible period shall forfeit their seat and will not be eligible for readmission

For IVC & ITI Lateral Entry students:

i) They must pursue the course for not less than 2 years and not more than 4 years.

ii)They must complete all required courses. Failure to meet the requirements within the maximum permissible period shall result in forfeiture of the seat, and the student will not be eligible for readmission.

Note: As and when a new curriculum is introduced in future, existing curriculum students under C-26 scheme shall write their backlog courses if any in the new curriculum equivalent courses decided by the SBTET, AP.

4.19 Malpractice Cases:

If any candidate resorts to Malpractice during examinations, he / she shall be booked and the punishment shall be awarded as per SBTET,AP rules and regulations in vogue.

4.20. Discrepancies/ Pleas:

Any Discrepancy /Plea regarding results etc., shall be represented to the SBTET, AP within one month from the date of issue of results. Thereafter, no such cases shall be entertained in any manner.

4.21. General

i. The Board may change or amend the academic rules and regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students, for whom it is intended, with effect from the dates notified by the competent authority.

ii. All legal matters pertaining to the State Board of Technical Education and Training, AP are within the jurisdiction of Mangalagiri, Guntur District Andhra Pradesh only.

iii. In case of any ambiguity in the interpretation of the above rules, the decision of the Secretary, SBTET, A.P., Mangalagiri is final.

VISION

To pursue excellence in diploma-level mechanical engineering education by imparting robust knowledge, practical skills and innovative competencies that enhance employability, foster entrepreneurial growth and integrate emerging technologies for the benefit of industry and society.

MISSION

M1	Use of technology enhanced tools and techniques by motivated and qualified faculty for enhancement of knowledge, understanding of principles, concepts and latest trends in mechanical engineering.
M2	Modernization of workshops and laboratories as per the curriculum specified by the State Board of Technical Education, Andhra Pradesh.
M3	Conduct of laboratories, guest lectures, industrial visits and industrial training for better understanding of critical concepts of Mechanical Engineering.
M4	Provide opportunities for developing multidisciplinary skills, communication skills, professional attitude and ethics.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1	Fundamental knowledge of mathematics, Basic sciences and basic interdisciplinary engineering to apply day to day challenges in the field of mechanical engineering.
PEO2	Knowledge in the principles, concepts, and techniques in mechanical engineering area to solve contemporary issues.
PEO3	Applications of the principles, concepts, and techniques in mechanical engineering area to solve contemporary issues and gain on hand experience.
PEO4	Effective Communication on activities regarding planning, designing, manufacturing, and servicing functions with engineering community.

PROGRAMME OUTCOMES (POs)

PO1	**Basic and Discipline Specific Knowledge:** To apply knowledge of mathematics, science and engineering fundamentals and engineering specialization to Engineering Problems.
PO2	**Problem Analysis:** Identify and analyse well-defined engineering problems using codified standard methods mechanical engineering problems for meaningful solutions
PO3	**Design/Development of Solutions:** Design solutions for well defined technical problems and assist with the design of systems components or processes to meet specific needs.
PO4	**Engineering tools, Experimentation and Testing:** Apply modern engineering tools and appropriate techniques to conduct standard tests and measurements.
PO5	**Engineering Practices for Society, Sustainability and Environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.
PO6	**Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well defined engineering activities.
PO7	**Life-long Learning:** Ability to analyse individual needs and engaging updating in the context of technological changes.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1	Ability to employ in fields of engineering such as design, testing, manufacturing, processing, safety, quality control, and other business sectors.
PSO2	Ability to progress through advanced degree or certificate programs or participates in continuing education in engineering, business, and/or other professionally related fields.
PSO3	Achieve positions of increased responsibility within the organizations.

DIPLOMA IN MECHANICAL ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
I YEAR

Course Code	Course Title	No. of Periods / Week		Practicum (Y/N)	Total No. of Periods /Year	Credits	Scheme of Examination			
		Theory	Practical/ Tutorial				Duration (hours)	FA Marks	SA Marks	Total Marks
THEORY COURSES										
26ME101T	English Essentials	3	-	N	90	4	3	30	70	100
26ME102T	Engineering Mathematics-I	6	-	N	180	6	3	30	70	100
26ME103T	Engineering Physics	3	-	N	90	4	3	30	70	100
26ME104T	Engineering Chemistry and Environmental studies	3	-	N	90	4	3	30	70	100
26ME105T	Engineering Mechanics	6	-	N	180	6	3	30	70	100
AUDIT COURSE										
26ME106A	Programming In Python	2	-	N	60					
PRACTICAL COURSES										
26ME107D	Engineering Graphics		6	N	180	3	3	40	60	100
26ME108L	Manufacturing Technology Lab-I (Practicum)		4	Y	120	5	3	40	60	100
26ME109L	Physics Lab		3	N	90	2	1.5	20	30	50
26ME110L	Chemistry Lab			N		2	1.5	20	30	50
26ME111L	Computer and Digital Skills Lab		3	N	90	3	3	40	60	100
26ME112L	Student Centric Activities		3	N	90	1	-	-	-	-
	TOTAL	**23**	**19**		**1260**	**40**		**310**	**590**	**900**
Note 1: One credit will be awarded for student centric activities based on the participation in the extra Curricular activities like NSS/NCC/Clean and Green or Sports/ Games										

* **Note 2**: For the Physics laboratory half of the first-year students of each programme will attend, while the remaining half will attend the chemistry laboratory. Thus, both laboratories will be engaged simultaneously during the three-hour lab session.

Note 3: 26ME101T, 26ME102T, 26ME103T, 26ME104T, 26ME109L, 26ME110L, and 26ME111L are common to all programmes. 26ME106A is common with 26MR106A, 26ME107D is common with 26MR107D, 26ME108L is common with 26MR108L.

DIPLOMA IN MECHANICAL ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
III SEMESTER

Course Code	Course Title	No. of Periods / Week		Practicum (Y/N)	Total No. of Periods /Semester	Credits	Scheme of Examination			
		Theory	Practical/ Tutorial				Duration (hours)	FA Marks	SA Marks	Total Marks
THEORY COURSES										
26ME301T	Strength of Materials	6	-	N	90	4	3	30	70	100
26ME302T	Basic Thermodynamics	6	-	N	90	4	3	30	70	100
26ME303T	Manufacturing Technology I	6	-	N	90	4	3	30	70	100
ELECTIVE COURSES										
26ME304E	Engineering Mathematics-II	3	-	N	45	2	3	30	70	100
26ME305E	Metrology & Instrumentation									
26ME306E	Advanced materials and Nano Technology									
AUDIT COURSE										
26ME307A	Basic Electrical Engineering	2	-	N	30	-	-	-	-	-
PRACTICAL COURSES										
26ME308D	Production drawing		6	N	90	2	3	40	60	100
26ME309L	Material Testing Lab		3	N	45	1.5	3	40	60	100
26ME310L	Manufacturing and Metrology Lab		7	N	105	2	3	40	60	100
26ME311L	Student Centric Activities		3	N	45	0.5	-	-	-	-
	TOTAL	**23**	**19**		**630**	**20**		**240**	**460**	**700**

Note 1: 0.5 credits will be awarded for student centric activities based on the participation in the extra Curricular activities like NSS/NCC/Clean and Green or Sports/ Games

Note 2: 26ME304E is common elective to all programmes. 26ME304E is common elective to all programmes. 26ME302T is common with 26MR302T, 26ME303T is common with 26MR303T, 26ME305E is common with 26MR305E, 26ME306E is common with 26MR306E, 26ME307A is common with 26MR307A, 26ME308D is common with 26MR308D, 26ME309L is common with 26MR309L, 26ME310L is common with 26MR310L.

DIPLOMA IN MECHANICAL ENGINEERING

SCHEME OF INSTRUCTIONS AND EXAMINATIONS
IV SEMESTER

Course Code	Course Title	No. of Periods / Week		Practicum (Y/N)	Total No. of Periods /Semester	Credits	Scheme of Examination			
		Theory	Practical/ Tutorial				Duration (hours)	FA Marks	SA Marks	Total Marks
THEORY COURSES										
26ME401T	Fluid Mechanics & Hydraulic Machinery	6	-	N	90	4	3	30	70	100
26ME402T	Applied Thermodynamics	6	-	N	90	4	3	30	70	100
26ME403T	Manufacturing Technology - II	6	-	N	90	4	3	30	70	100
ELECTIVE COURSES										
26ME404E	Refrigeration and Air Conditioning	3	-	N	45	2	3	30	70	100
26ME405E	Automobile Engineering									
AUDIT COURSE										
26ME406A	Artificial Intelligence & Machine Learning	2	-	N	30	-	-	-	-	-
PRACTICAL COURSES										
26ME407L	Applied Thermodynamics & Hydraulics Lab		6	N	90	2	3	40	60	100
26ME408L	Communication and Employability Skills		4	Y	60	2	3	40	60	100
26ME409L	Machine Tools Lab		6	N	90	1.5	3	40	60	100
26ME410L	Student Centric Activities		3	N	45	0.5	-	-	-	-
	TOTAL	**23**	**19**		**630**	**20**		**240**	**460**	**700**

Note 1: 0.5 credits will be awarded for student centric activities based on the participation in the extra Curricular activities like NSS/NCC/Clean and Green or Sports/ Games

Note 2: 26ME408L is common laboratory to all programmes. 26ME401T is common with 26MR401T, 26ME402T is common with 26MR402T, 26ME403T is common with 26MR403T, 26ME405E is common with 26MR405E, 26ME406A is common with 26MR406A, 26ME407L is common with 26MR407L.

DIPLOMA IN MECHANICAL ENGINEERING

SCHEME OF INSTRUCTIONS AND EXAMINATIONS
V SEMESTER

Course Code	Course Title	No. of Periods / Week		Practicum (Y/N)	Total No. of Periods /Semester	Credits	Scheme of Examination			
		Theory	Practical/ Tutorial				Duration (hours)	FA Marks	SA Marks	Total Marks
THEORY SUBJECTS										
26ME501T	Industrial Engineering & Management	6	-	N	90	4	3	30	70	100
26ME502T	Design of Machine Elements	6	-	N	90	4	3	30	70	100
26ME503T	Industrial Automation	6	-	N	90	4	3	30	70	100
ELECTIVE SUBJECTS										
26ME504E	Mechatronics	3	-	N	45	2	3	30	70	100
26ME505E	Additive Manufacturing									
AUDIT SUBJECT										
26ME506A	Basics of Aerospace Engineering	2	-	N	30	-	-	-	-	-
PRACTICAL SUBJECTS										
26ME507L	CAD/CAM LAB		7	N	105	3	3	40	60	100
26ME508L	Refrigeration & Air Conditioning Lab (Practicum)		6	Y	90	2	3	40	60	100
26ME509P	Project		3	N	45	0.5	3	40	60	100
26ME510L	Student Centric Activities		3	N	45	0.5	-	-	-	-
	TOTAL	**23**	**19**		**630**	**20**		**240**	**460**	**700**
Note 1: 0.5 credits will be awarded for student centric activities based on the participation in the extra Curricular activities like NSS/NCC/Clean and Green or Sports/ Games										

Note 2: 26ME502T is common with 26MR502T, 26ME505E is common with 26MR505E, 26ME506A is common with 26MR506A

DIPLOMA IN MECHANICAL ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS

VI SEMESTER

Course Title	Course Code	Duration	Marks for FA	Marks for SA	Credits
Industrial Training	26ME601I	One Semester	240	60	20

Assessment No	Upon completion of	Conducted by	Based on	Max Marks
Pre-Assessment	15 Days to 30 Days from the commencement of training	Mentor faculty member visits the industry one month after commencement of training and will submit a detailed report to the principal outlining the each candidate's details and observed work culture		
1 (Formative Assessment)	Mid Semester Assessment (after three months - at industry	1.The mentor faculty member concerned 2. Industry Training In charge	Learning outcomes as given in the scheme of assessment, for Industrial Training	120
2 (Formative Assessment)	Last month of training (at industry)	1. The mentor faculty member concerned 2. Industry Training In charge	Learning outcomes as given in the scheme of assessment, for Industrial Training	120
3 (Summative Assessment)	After completion of the training (at Institution)	1.The faculty member concerned, 2.HoS concerned 3.An external examiner from Industry	1.Demonstration of any one of the skills listed in learning outcomes	30
			2.Training Report	20
			3. Viva Voce	10
			TOTAL	300

The Industrial Training shall carry maximum 300 marks. Pass mark is 50% in first and second assessment put together and also 50% in final summative assessment at the institution level.

I YEAR

DIPLOMA IN MECHANICAL ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
I YEAR

Course Code	Course Title	No. of Periods / Week		Practicum (Y/N)	Total No. of Periods /Year	Credits	Scheme of Examination			
		Theory	Practical/ Tutorial				Duration (hours)	FA Marks	SA Marks	Total Marks
THEORY COURSES										
26ME101T	English Essentials	3	-	N	90	4	3	30	70	100
26ME102T	Engineering Mathematics-I	6	-	N	180	6	3	30	70	100
26ME103T	Engineering Physics	3	-	N	90	4	3	30	70	100
26ME104T	Engineering Chemistry and Environmental studies	3	-	N	90	4	3	30	70	100
26ME105T	Engineering Mechanics	6	-	N	180	6	3	30	70	100
AUDIT COURSE										
26ME106A	Programming In Python	2	-	N	60					
PRACTICAL COURSES										
26ME107D	Engineering Graphics		6	N	180	3	3	40	60	100
26ME108L	Manufacturing Technology Lab-I (Practicum)		4	Y	120	5	3	40	60	100
26ME109L	Physics Lab		3	N	90	2	1.5	20	30	50
26ME110L	Chemistry Lab			N		2	1.5	20	30	50
26ME111L	Computer and Digital Skills Lab		3	N	90	3	3	40	60	100
26ME112L	Student Centric Activities		3	N	90	1	-	-	-	-
	TOTAL	**23**	**19**		**1260**	**40**		**310**	**590**	**900**
Note: One credit will be awarded for student centric activities based on the participation in the extra Curricular activities like NSS/NCC/Clean and Green or Sports/ Games										

* **Note 2**: For the Physics laboratory half of the first-year students of each programme will attend, while the remaining half will attend the chemistry laboratory. Thus, both laboratories will be engaged simultaneously during the three-hour lab session.

Note 3: 26ME101T, 26ME102T, 26ME103T, 26ME104T, 26ME109L, 26ME110L, and 26ME111L are common to all programmes. 26ME106A is common with 26MR106A, 26ME107D is common with 26MR107D, 26ME108L is common with 26MR108L.

ENGLISH ESSENTIALS

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME101T	ENGLISH ESSENTIALS	3	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions
1.	Exploring English	10	14	2	1
2.	The Better You!	10	11	3	1
3.	Drive to Destiny	10	14		1
4.	Renew, Rewire & Resolve	10	17	2	1
5.	Brains & Bots	10		1	
6	The Blue Planet: Mend or End	10	11	1	1
7	One World One Dream	10	11	1	1
8	The Net Norms	10	11	1	1
9	Managing Moods & Moments	10	11	1	1
	Total	**90**	**100**	**12**	**8**

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to:	
(i)	To inculcate knowledge of functional English and enrich vocabulary
(ii)	To impart effective listening, speaking, reading, and writing skills

(iii)	To sensitise the students on themes related to personality, technological advancements, sustainability, and human values

COURSE OUTCOMES

CO1	ME101 .1	Learn and apply various English grammatical concepts to communicate in academic, professional, personal, and social contexts.
CO2	ME101 .2	Use appropriate vocabulary in academic, professional and business correspondence, and on social media platforms.
CO3	ME101 .3	Listen/read and comprehend diverse academic, professional, and general listening and reading materials.
CO4	ME101 .4	Communicate effectively and fluently in oral and written forms in various life situations.
CO5	ME101 .5	Display scientific temper and universal human values; adopt technology for holistic development and harmonious living through one's demeanour and communication.

LEARNING OUTCOMES

1.0 Exploring English

1.1 To read and comprehend simple sentences in a short passage.

1.2 To apply rules of spelling, correct the misspelt words and use dictionary to enrich vocabulary

1.3 To identify various parts of speech suitable to the context and use articles & prepositions accurately.

1.4 To describe a given situation/picture using simple sentences.

1.5 To value the importance of English for employability.

2.0 The Better You!

2.1 To read and comprehend formal and informal conversations.

2.2 To use words suitable to the context in spoken and written communication.

2.3 To use the appropriate forms of verbs.

2.4 To engage in conversations in both formal and informal contexts.

2.5 To demonstrate a positive attitude in personal and academic spheres.

3.0 Drive To Destiny

3.1 To read and comprehend paragraphs for specific and general information, and distinguish different types of paragraphs

3.2 To distinguish word pairs and use them contextually.

3. 3 To frame sentences with proper subject-verb agreement.

3.4 To describe actions using appropriate tenses.

3.5 To set and achieve academic and personal goals.

4.0 Renew, Rewire & Resolve

4.1 To read and comprehend the content and structure of e-mails for different purposes.

4.2 To recognise the root words and use appropriate affixes contextually.

4.3 To use various kinds of sentences for different communicative situations.

4.4 To draft E-mails for academic and professional purposes.

4.5 To apply critical thinking and creativity for solving problems.

5.0 Brains & Bots

5.1 To read and comprehend the description of a process and the use of sequence markers.

5.2 To communicate effectively using phrasal verbs.

5.3 To use active and passive voice appropriately.

5.4 To describe processes and procedures using appropriate sentence forms.

5.5 To appraise the importance and use of robotics and artificial intelligence in human life.

6.0 The Blue Planet: Mend Or End!

6.1 To read and comprehend the content, structure and purpose of formal and informal letters.

6.2 To describe using appropriate forms of adjectives

6.3 To substitute phrases or clauses with a single word.

6.4 To draft personal and professional letters.

6.5 To realise the importance of environmental protection and ensure sustainability.

7.0 One World - One Dream

7.1 To read and comprehend an essay and analyse its features

7.2 To identify and create shortened forms of words or phrases.

7.3 To report the expressions of the speaker with necessary grammatical changes.

7.4 To draft well-organised essays for academic and professional purposes.

7.5 To appraise the importance of inclusivity in society.

8.0 The Net Norms

8.1 To comprehend and analyse the given text for making notes and summarising.

8.2 To use contemporary language in informal communication.

8.3 To split or combine ideas using conjunctions for effective communication.

8.4 To make notes of textual information and summarise the information.

8.5 To demonstrate ideal behaviour on the internet.

9.0 Managing Moods & Moments

9.1 To read and comprehend different types of reports.

9.2 To analyse and evaluate grammatical errors.

9.3 To use words and phrases in sentences of your own.

9.4 To draft organised and comprehensive reports on experiments, events, visits and incidents.

9.5 To assess the reasons and manage stress and time effectively.

CO-PO/PSO MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PS02	PS03
CO1	POs 1 to 4 are not directly applicable to the English course. However, activities that use content from science and technology relevant to the Programme taken up by the student shall be exploited for communication in the Course.					3	2	Programme Specific Outcomes are branch-specific with technical aspects that are not directly applicable to the English Language course.		
CO2						3	2			
CO3						3	2			
CO4						3	2			
CO5					2		2			
Average					2	3	2			

COURSE CONTENT

1.0 Exploring English

Reading – Role play – Picture Interpretation – Sounds and Spellings – Parts of Speech – Articles and Prepositions

2.0 The Better You!

Reading – Dialogue Writing – Synonyms and Antonyms – Word order – Verbs

3.0 Drive to Destiny

Reading – Paragraph Writing – Homophones, Homonyms, Homographs – Concord – Tenses

4.0 Renew, Rewire & Resolve

Reading – E-mail Writing – Roots, Affixes – Kinds of Sentences

5.0 Brains & Bots

Reading – Describing Process – Phrasal Verbs – Voice

6.0 The Blue Planet: Mend or End!

Reading – Letter Writing – One-word Substitutes – Degrees of Comparison

7.0 One World - One Dream

Reading – Essay Writing – Abbreviations & Acronyms – Reported Speech

8.0 The Net Norms

Reading – Note making & Summarising – Gen-Z Vocabulary – Synthesis of Sentences

9.0 Managing Moods & Moments

Reading – Report Writing – Usage – Error Analysis

Note: The textbook "English Essentials" (A Textbook of English for I Year Engineering Diploma Courses - by SBTET, AP) is the prescribed text for this course. It comprises various language inputs and activities addressing the Learning outcomes specified in each unit. Every unit will have six major components: Listening, Speaking, Reading, Writing, Vocabulary, and Grammar. The activities will be designed as Individual, Pair and Group activities to facilitate self and peer learning.

REFERENCE BOOKS

1. Martin Hewings, "*Advanced Grammar in Use",* Cambridge University Press (2007)
2. Murphy, Raymond, "*English Grammar in Use",* Cambridge University Press (2019)
3. Sidney Greenbaum, "*Oxford English Grammar"*, Oxford University Press (1996)
4. Wren and Martin (Revised by N.D.V. Prasad Rao) "*English Grammar and Composition*, Blackie ELT Books", S. Chand and Co. (2023)
5. Sarah Freeman, "*Strengthen Your Writing"*, Macmillan

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.5
Unit Test-II	From 4.1 to 6.5
Unit Test-II	From 7.1 to 9.5

ENGINEERING MATHEMATICS - I

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME102T	Engineering Mathematics-I	6	180	30	70	6

S.No.	Unit Title	No. of periods	COs mapped
1	Algebra	31	CO1
2	Trigonometry	63	CO2
3	Co-ordinate Geometry	26	CO3
4	Differential Calculus	34	CO4
5	Integral Calculus	26	CO5
Total Periods		**180**	

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
Unit - I: Algebra						
1	Partial Fractions	6	4	0	1/2	CO1
2	Matrices and Determinants	25	18	2	1&1/2	CO1
Unit - II: Trigonometry						
3	Trigonometric Ratios	4	0	0	0	CO2
4	Compound Angles	8	3	1	0	CO2
5	Multiple and Sub-multiple angles	8	3	1	0	CO2
6	Transformations	9	4	0	1/2	CO2
7	Inverse Trigonometric Functions	8	4	0	1/2	CO2
8	Trigonometric Equations	8	4	0	1/2	CO2
9	Properties of triangles	8	4	0	1/2	CO2
10	Complex Numbers	8	3	1	0	CO2
11	Hyperbolic functions	2	0	0	0	CO2
Unit III: Co-ordinate Geometry						
12	Straight Lines	8	3	1	0	CO3
13	Circles	8	4	0	1/2	CO3
14	Conic Sections	10	4	0	1/2	CO3
Unit – IV: Differential Calculus						
15	Limits and Continuity	6	3	1	0	CO4
16	Differentiation	28	17	3	1	CO4

Unit – V: Integral Calculus						
17	Indefinite integration	18	11	1	1	CO5
18	Definite integration	8	11	1	1	CO5
	Total	180	100	12	8	
			Marks	36	64	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
(i)	Apply the principles of Algebra, Trigonometry and Co-ordinate Geometry to real-time problems in engineering.
(ii)	Build the concepts of indefinite integrals and definite integrals.

COURSE OUTCOMES

CO1	ME102.1	Resolve partial fractions and solve problems on matrices and determinants.
CO2	ME102.2	Use the concept of trigonometric functions, their inverses and complex numbers.
CO3	ME102.3	Find the equations and properties of straight lines, circles and conic sections in coordinate system.
CO4	ME102.4	Evaluate the limits and derivatives of various functions and apply to engineering problems.
CO5	ME102.5	Integrate various functions using different methods and evaluate definite integrals.

LEARNING OUTCOMES

C.O. 1 Resolve partial fractions and solve problems on matrices and determinants.

L.O. 1.1 Define rational, proper and improper fractions of polynomials.

1.2 Explain the procedure of resolving proper fractions of the type $\frac{f(x)}{(ax+b)(cx+d)}$

1.3 Define a matrix and order of a matrix.

1.4 State various types of matrices with examples (emphasis on 3rd order square matrices).

1.5 Compute sum, difference, scalar multiplication and product of matrices. Illustrate the properties of these operations such as commutative, associative and distributive properties with examples and counter examples.

1.6 Define the transpose of a matrix and state its properties – examples.

1.7 Define symmetric and skew-symmetric matrices with examples. Resolve a square matrix into a sum of symmetric and skew-symmetric matrices with examples.

1.8 Define determinant of a square matrix; minor, co-factor of an element of a 3x3 square matrix with examples. Expand the determinant of a 3x3 matrix using Laplace expansion formula. State and apply the properties of determinants to solve simple problems.

1.9 Distinguish singular and non-singular matrices. Define multiplicative inverse of a matrix and list properties of adjoint and inverse. Compute adjoint and multiplicative inverse of a square matrix.

1.10 Solve a system of three linear equations in three unknowns using Cramer's rule.

C.O. 2 Solve problems using the concept of trigonometric functions, their inverses and complex numbers.

L.O. 2.1 Recall the trigonometric ratios and their values at specified angles.

2.2 Draw graphs of trigonometric functions - Explain periodicity of trigonometric functions.

2.3 Define compound angles and state the formulae of $\sin(A \pm B)$, $\cos(A \pm B)$, $\tan(A \pm B)$ and $\cot(A \pm B)$.

2.4 Give simple examples on compound angles to derive the values of $\sin 15^0$, $\cos 15^0$, $\sin 75^0$, $\cos 75^0$, $\tan 15^0$, $\tan 75^0$ etc.

2.5 Derive identities like $\sin(A+B)\sin(A-B) = \sin^2 A - \sin^2 B$ etc.

2.6 Solve simple problems using the identities on compound angles.

2.7 Derive the formulae of multiple angles 2A, 3A etc., and sub-multiple angle A/2 in terms of angle A of trigonometric functions.

2.8 Derive useful allied formulae like $\sin^2 A = \frac{1-\cos 2A}{2}$ etc.

2.9 Solve simple problems using the multiple and sub-multiple formulae.

2.10 Derive the formulae on transforming sum or difference of two trigonometric ratios intoa product and vice versa - examples on these formulae.

2.11 Solve problems by applying these formulae to sum or difference or product of two terms.

2.12 Explain the concept of inverse of a trigonometric function by selecting an appropriate domain and range.

2.13 Define inverses of six trigonometric functions along with their domains and ranges.

2.14 Derive relations between inverse trigonometric functions so that the given inverse trigonometric function can be expressed in terms of other inverse trigonometric functions with examples.

2.15 State various properties of inverse trigonometric functions and identities like $\sin^{-1} x + \cos^{-1} x = \frac{\pi}{2}$ etc.

2.16 Apply formulae like $\tan^{-1} x + \tan^{-1} y = \tan^{-1}\left(\frac{x+y}{1-xy}\right)$, *where* $x \geq 0, y \geq 0, xy < 1$ etc., to solve simple problems.

2.17 Explain what is meant by solution of trigonometric equations and find the general solutions of $\sin x = k$, $\cos x = k$ and $\tan x = k$ with appropriate examples.

2.18 Solve models of the type $a\sin^2 x + b\sin x + c = 0$ and $a\sin x + b\cos x + c = 0$.

2.19 State sine rule, cosine rule, tangent rule and projection rule and solve a triangle using these formulae.

2.20 List various formulae for area of a triangle with examples.

2.21 Define a complex number, its modulus, conjugate, amplitude and list their properties.

2.22 Define arithmetic operations on complex numbers with examples.

2.23 Represent the complex number in various forms like modulus-amplitude (polar) form and Exponential (Euler) form with examples.

2.24 Explain the concept of hyperbolic trigonometric functions and list appropriate formulae.

C.O. 3 Find the equations and properties of straight lines, circles and conic sections in coordinate system.

L.O. 3.1 Write different forms of a straight line – general form, point-slope form, slope-intercept form, two-point form, intercept form and normal form or perpendicular form.

3.2 Find distance of a point from a line, acute angle between two lines, intersectionof two non-parallel lines and distance between two parallel lines.

3.3 Define locus of a point and circle.

3.4 Write the general equation of a circle and find its centre and radius.

3.5 Find the equation of a circle, given (i) centre and radius, (ii)two ends of the diameter(iii) three non collinear points of type $(0,0),(a,0),(0,b)$.

3.6 Define a conic - Explain the terms focus, directrix, eccentricity, axes and latus-rectum of a conic.

3.7 Find the equation of a conic when focus, directrix and eccentricity are given.

3.8 Describe the properties of Parabola $y^2 = 4ax$.

C.O.4 Evaluate the limits and derivatives of various functions.

L.O. 4.1 Explain the concept of limit and meaning of $\lim_{x\to a} f(x)=l$ and state the properties of limits.

4.2 Evaluate the limits of the type $\lim_{x\to a}\frac{f(x)}{g(x)}$

4.3 State the Standard limits $\lim_{x\to a}\frac{x^n-a^n}{x-a}$, $\lim_{x\to 0}\frac{\sin x}{x}$, $\lim_{x\to 0}\frac{\tan x}{x}$, $\lim_{x\to 0}\frac{a^x-1}{x}$, $\lim_{x\to 0}\frac{e^x-1}{x}$, **(**without proof) and solve simple problems using these standard limits.

4.4 Explain the concept of continuity of a function at a point and on an interval

4.5 State the concept of derivative of a function $y=f(x)$– definition, first principle as $\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$ and also write standard notations to denote the derivative of a function.

4.6 Explain the significance of derivative in scientific and engineering applications.

4.7 Find the derivatives of standard algebraic, logarithmic, exponential and trigonometric functions using the first principle.

4.8 Find the derivatives of hyperbolic and inverse hyperbolic functions.

4.9 State the rules of differentiation of sum, difference, scalar multiplication, product and quotient of functions with simple illustrative examples.

4.10 Explain the method of differentiation of a function of a function (Chain rule) with illustrative examples.

4.11 Explain the method of differentiation of parametric functions with examples.

4.12 Explain the procedure for finding the derivatives of implicit functions with examples.

4.13 Explain the need of taking logarithms for differentiating some functions of $[f(x)]^{g(x)}$ type – examples on logarithmic differentiation.

4.14 Explain the concept of finding the second order derivatives with examples.

4.15 Define maximum and minimum values of a function and find the maximum and minimum values for quadratic polynomials.

4.16 Explain the concept of functions of several variables, finding partial derivatives and difference between the ordinary and partial derivatives with simple examples.

C.O. 5 Integrate various functions using different methods and evaluate definite integrals.

L.O. 5.1 Explain the concept of Indefinite integral as an anti-derivative.

5.2. State the indefinite integral of standard functions and properties of $\int (u+v)\,dx$ and $\int k\,u\,dx$, where *u, v* are functions of x and k is constant.

5.3. Solve problems involving standard functions using these properties.

5.4. Evaluate integrals involving simple functions of the following type by the method of substitution.

i) $\int f(x)\,dx$, *where* $f(x)$ is in standard form.

ii) $\int [f(x)]^n f'(x)dx, n \neq -1.$

iii) $\int \frac{f'(x)}{f(x)}dx.$

5.5. Find the integrals of *tan x, cot x, sec x* and *cosec x* w.r.t. x.

5.6. Evaluate the Standard integrals of the functions of the type :

i) $\frac{1}{a^2+x^2}, \frac{1}{a^2-x^2}, \frac{1}{x^2-a^2}$

ii) $\frac{1}{\sqrt{a^2+x^2}}, \frac{1}{\sqrt{a^2-x^2}}, \frac{1}{\sqrt{x^2-a^2}}$

iii) $\sqrt{a^2+x^2}, \sqrt{a^2-x^2}, \sqrt{x^2-a^2}$

5.7. Evaluate integrals using decomposition method for integrand of the type $\frac{px+q}{(ax+b)(cx+d)}$.

5.8. Solve problems using integration by parts.

5.9 Use Bernoulli's rule to evaluate the integrals of the form $\int u.vdx$.

5.10. State the fundamental theorem of integral calculus.

5.11. Explain the concept of definite integral.

5.12. Solve simple problems on definite integrals.

5.13. State various properties of definite integrals.

5.14. Evaluate simple problems on definite integrals using these properties.

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	3				3	2	2
CO2	3	3	2	2				3	2	2
CO3	3	3	2	2				3	2	2
CO4	3	3	3	3				3	3	3
CO5	3	3	3	3				3	3	3
Avg.	3	2.8	2.4	2.6				3	2.4	2.4

COURSE CONTENT

Unit-I: Algebra

1. **Partial Fractions:** Definitions of rational, proper and improper fractions of polynomials. Resolve rational fractions (proper fractions) of type $\frac{f(x)}{(ax+b)(cx+d)}$ into partial fractions.

2. **Matrices:** Definition of a matrix, types of matrices - Algebra of matrices, equality of two matrices, sum, difference, scalar multiplication and product of matrices. Transpose of a matrix, Symmetric, skew-symmetric matrices - Determinant of a square matrix, minor and cofactor of an element, Laplace's expansion, properties of determinants - Singular and non-singular matrices, Adjoint and multiplicative inverse of a square matrix - System of linear equations in 3 variables-Solutions by Cramer's rule.

Unit-II: Trigonometry

3. **Trigonometric ratios:** Definition of trigonometric ratios of any angle, values of trigonometric ratios at specified values, draw graphs of trigonometric functions, periodicity of trigonometric functions.
4. **Compound angles:** Formulas of $\sin(A \pm B)$, $\cos(A \pm B)$, $\tan(A \pm B)$, $\cot(A \pm B)$ and related identities.
5. **Multiple and sub-multiple angles:** Formulae for trigonometric ratios of multiple angles 2A, 3A and sub multiple angle A/2.
6. **Transformations:** of products into sums or differences and vice versa.
7. **Inverse trigonometric functions:** Definition, domains and ranges-basic properties.
8. **Trigonometric equations:** Concept of a solution, principal value and general solution of trigonometric equations: $\sin x = k$, $\cos x = k$ and $\tan x = k$, where k is a constant. Solutions of simple quadratic equations and equations of type $a\sin^2 x + b\sin x + c = 0$ and $a\sin x + b\cos x + c = 0.$
9. **Properties of triangles:** Relations between sides and angles of a triangle- sine rule, cosine rule, tangent rule and projection rule-area of a triangle.
10. **Complex Numbers:** Definition of a complex number, modulus, conjugate and amplitude of a complex number- Arithmetic operations on complex numbers - Modulus-Amplitude(polar) form, form (Euler form) of a complex number.
11. **Hyperbolic functions:** Definition of hyperbolic and inverse hyperbolic trigonometric functions- and list formulae.

UNIT-III: Coordinate geometry

12 Straight lines: Various forms of a straight line - Angle between two lines, perpendicular distance from a point to the straight line, point of intersection of non-parallel lines and distance between parallel lines.

13. Circle: Locus of a point, Circle definition-Circle equation given (i) centre and radius,(ii) two ends of a diameter (iii) three non-collinear points of type $(0,0),(a,0),(0,b)$ - General equation of a circle –its centre and radius.

14. Conic sections: Definition of a conic - Equation of a conic when focus, directrix and eccentricity are given - Properties of parabola in the standard form $y^2 = 4ax.$

UNIT-IV: Differential Calculus

15. Concept of Limit: Definition and Properties of Limits and Standard Limits - Continuity of a function at a point.

16. Concept of derivative: Definition (first principle)- different notations- Derivatives of standard algebraic, logarithmic, exponential, trigonometric, inverse trigonometric, hyperbolic and inverse hyperbolic functions - Derivatives of sum, difference, scalar multiplication, product, quotient of functions - Chain rule, derivatives of parametric functions, derivatives of implicit functions, logarithmic differentiation - Second order derivatives – Define maximum and minimum values of a function and find the maximum or minimum values for quadratic polynomial. Functions of several variables, first order partial derivatives.

UNIT-V: Integral Calculus

17. Indefinite Integration: Integration regarded as an anti-derivative – Indefinite integrals of standard functions. Properties of indefinite integrals. Integration by substitution or change of variable. Integrals of tan x, cot x, sec x and cosec x.

Evaluation of integrals which are of the following forms:

$i) \frac{1}{a^2+x^2}, \frac{1}{a^2-x^2}, \frac{1}{x^2-a^2}$

$ii) \frac{1}{\sqrt{a^2+x^2}}, \frac{1}{\sqrt{a^2-x^2}}, \frac{1}{\sqrt{x^2-a^2}}$

$iii) \sqrt{a^2+x^2}, \sqrt{a^2-x^2}, \sqrt{x^2-a^2}$

Integration by decomposition of the integrand into simple rational, algebraic functions - Integration by parts, Bernoulli's rule.

18. Definite Integration: Definite integral, fundamental theorem of integral calculus, properties of definite integrals, evaluation of simple definite integrals.

TEXT BOOK

Engineering Mathematics-I, a textbook for first year diploma courses, prepared & prescribed by SBTET, AP.

REFERENCE BOOKS

1. Shanti Narayan, A Textbook of matrices, S.Chand & Co.
2. Robert E. Moyer & Frank Ayers Jr., Schaum's Outline of Trigonometry, 4th Edition, Schaum's Series.
3. G.B.Thomas, R.L.Finney, Calculus and Analytic Geometry, Addison Wesley, 9th Edition, 1995.
4. Frank Ayers & Elliott Mendelson, Schaum's Outline of Calculus, Schaum's Series.

5. M.Vygodsky, Mathematical Handbook, Mir Publishers, Moscow.

SUGGESTED E-LEARNING REFERENCES

1. https://www.khanacademy.org/
2. https://www.wolframalpha.com/
3. https://onlinecourses.nptel.ac.in/
4. http://tutorial.math.lamar.edu/

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 2.11
Unit Test-II	From 2.12 to 3.8
Unit Test-II	From 4.1 to 5.14

ENGINEERING PHYSICS

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME103T	Engineering Physics	3	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1.	Units and Measurements	09	06	02	-	CO1
2.	Elements of Vectors	11	14	02	01	
3.	Mechanics	10	11	01	01	CO2
4.	Fundamentals of Astrodynamics	13	19	01	02	
5.	Energy and Thermal Physics	12	11	01	01	CO3
6.	Concepts of Acoustics	12	14	02	01	
7.	Electricity and Magnetism	13	14	02	01	CO4
8.	Modern Physics	10	11	01	01	
	Total	**90**	**100**	**12**	**08**	

COURSE OBJECTIVES

Upon completion of the course the student shall be able to

(1)	Understand the basic concepts of physics for various Engineering applications as required for industries.
(2)	Equip the students with the scientific advances in technology and make the student suitable for any industrial organization.

COURSE OUTCOMES

CO1	ME103.1	Familiarize with various physical quantities, their SI units and errors in measurements; Understand the concepts of vectors for solving engineering problems.
CO2	ME103.2	Solve problems in engineering using appropriate equations and formulae related to Mechanics; Understand the concepts of gravitation, planetary motion with reference to applications in satellites
CO3	ME103.3	Familiarize with the knowledge of various forms of energy, thermal physics and concepts of acoustics in relevance to the societal requirements.
CO4	ME103.4	Familiarize with the basic knowledge of electricity, magnetism and advances in Modern Physics such as photoelectric cell, optical fibers, superconductors and nanotechnology.

LEARNING OUTCOMES

Upon completion of the course the student shall be able to

1 Units and Measurements

1.1 Introduction to Units and Measurements
1.2 Define the terms: a) Physical quantity b) Fundamental physical quantities and c) Derived physical quantities.
1.3 Explain the concept of units in measurement.
1.4 Define the term 'unit'.
1.5 Define fundamental units and derived units.
1.6 State the SI units of fundamental quantities along with their symbols.
1.7 State the common multiples and submultiples used in the SI system.
1.8 State the rules for writing SI units.
1.9 State the advantages of using SI units.
1.10 Differentiate between direct and indirect measurements.
1.11 Define accuracy and least count in the context of measurement.
1.12 Define error in measurement.
1.13 Define absolute, relative and percentage errors and state their respective formulae.
1.14 Solve numerical problems on errors in measurements.

2 Elements of Vectors

2.1 Explain the concept of vectors.
2.2 Define scalar and vector quantities with relevant examples for each.
2.3 Represent a vector geometrically.
2.4 Define equal vectors, negative vector, unit vector, position vector, co-initial vectors, co-planar vectors.
2.5 Resolve a given vector into its rectangular components.
2.6 State and explain the triangle law of addition of vectors.
2.7 State the parallelogram law of addition of vectors.
2.8 Derive the expressions for the magnitude and direction of the resultant vector using the parallelogram law.

2.9 Illustrate applications of the parallelogram law of vectors using examples (i) Bow and arrow (ii) working of a sling (iii) Flying of a bird.
2.10 Define dot product (scalar product) of two vectors.
2.11 Explain (i) work done (ii) power as examples of dot product.
2.12 Define cross product (vector product) of two vectors.
2.13 Explain (i) linear velocity (ii) torque as examples of cross product.
2.14 Solve numerical problems on (i) resolution of vectors (ii) the parallelogram law of vectors iii) dot product.

3 Mechanics

3.1 Define linear momentum; Mention its SI unit.
3.2 Define force. Mention its SI unit.
3.3 Define torque. Mention its SI unit.
3.4 Define concurrent forces, co-planar forces.
3.5 State and explain Lami's theorem.
3.6 State equations of motion of a body moving in a straight line with uniform acceleration.
3.7 Define projectile. Give examples.
3.8 Derive the equation for the path of an oblique projectile.
3.9 Define periodic motion.
3.10 Define Ideal Simple pendulum.
3.11 Write formula for the time period of a simple pendulum.
3.12 Solve numerical problems on equations of motion and simple pendulum.

4 Fundamentals of Astrodynamics

4.1 Define acceleration due to gravity (g); Mention its SI unit.
4.2 State and explain Newton's universal law of gravitation.
4.3 Define universal gravitational constant (G) and mention its value in SI unit.
4.4 Derive the relationship between acceleration due to gravity (g) and the universal gravitational constant (G).
4.5 State and explain Kepler's laws of planetary motion.
4.6 Define orbital velocity and state its formula.
4.7 Define escape velocity and state its formula.
4.8 Derive the relationship between escape velocity and orbital velocity.
4.9 Define the term 'satellite'.
4.10 Define natural and artificial satellites. Give examples for each.
4.11 Mention the applications of artificial satellites.
4.12 Solve numerical problems on (i) Newton's law of gravitation (ii) orbital velocity (iii) escape velocity.

5 Energy and thermal Physics

5.1 Define work done; Mention its SI unit.
5.2 Define power; Mention its SI unit.
5.3 Define energy; Mention its SI unit.
5.4 List various forms of energy.
5.5 Define potential energy; Give examples and derive its equation.
5.6 Define kinetic energy; Give examples and derive its equation.
5.7 Derive the relationship between kinetic energy and linear momentum.
5.8 State the law of conservation of energy; Give any two examples.
5.9 State Boyle's law; Write its equation.
5.10 State Charles's volume law; Write its equation.
5.11 State Charles's pressure law; Write its equation.
5.12 Define an Ideal gas.

5.13 Derive the ideal gas equation (PV = nRT).
5.14 Solve numerical problems on (i) Work done (ii) Potential energy (iii) Kinetic energy (iv) Relation between K.E. and momentum (v) Gas laws

6 Concepts of Acoustics

6.1 Define longitudinal waves. Give examples.
6.2 Define transverse waves. Give examples.
6.3 Define sound. Mention SI unit for intensity of sound.
6.4 Define musical sound.
6.5 Define noise.
6.6 Distinguish between musical sound and noise.
6.7 Define noise pollution.
6.8 Explain the sources of noise pollution.
6.9 Explain the effects of noise pollution.
6.10 Explain methods of minimizing noise pollution.
6.11 Define Beats. Write formula for beat frequency.
6.12 State Doppler's Effect. Mention its applications.
6.13 Explain the concept of echo.
6.14 Mention the applications of echo.
6.15 Define reverberation and reverberation time.
6.16 Write Sabine's formula and name the parameters in it.
6.17 Solve numerical problems on echo.

7 Electricity and Magnetism

7.1 State and explain Ohm's law.
7.2 Define electrical resistance; Mention its SI unit.
7.3 Define specific resistance (resistivity);Mention its SI unit.
7.4 State and explain Kirchhoff's Current Law.
7.5 State and explain Kirchhoff's Voltage Law.
7.6 Derive an expression for the balancing condition of Wheatstone's bridge with neat diagram.
7.7 Describe Meter bridge with necessary circuit diagram.
7.8 Write formula to find unknown resistance using meter bridge.
7.9 Explain the concept of magnetic field.
7.10 Define uniform and non-uniform magnetic fields.
7.11 Define magnetic pole strength; Mention its SI unit.
7.12 Define magnetic moment; Mention its SI unit.
7.13 Define magnetic lines of force.
7.14 Write the properties of magnetic lines of force.
7.15 State Coulomb's inverse square law of magnetism. Write its equation.
7.16 Derive the expression for the moment of couple acting on a bar magnet placed in a uniform magnetic field.
7.17 Solve numerical problems on (i) Ohm's law (ii) Kirchhoff's first law (iii) Wheatstone bridge and Meter bridge (iv) Coulomb's inverse square law of magnetism.

8 Modern Physics

8.1 State and explain photoelectric effect.
8.2 Write Einstein's photoelectric equation and name the terms in it.
8.3 Explain the working of a photoelectric cell.
8.4 List the applications of the photoelectric cell.
8.5 Define critical angle.
8.6 Explain the phenomenon of total internal reflection.

8.7 Define optical fiber; Explain the principle and working of an optical fiber.
8.8 List the applications of optical fiber.
8.9 Define Superconductor and superconductivity.
8.10 List the applications of superconductors.
8.11 Define Nanotechnology and Nano materials.
8.12 Write applications of Nano materials.

CO-PO/PSO MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	1	1	1		1
CO2	3	2	1	1	1		2
CO3	3	2	1	1	1		2
CO4	3	2	1	1	3		2
Average	3	2	1	1	1.5		1.75

COURSE CONTENT

1. **Units and measurements:**

   Introduction – Physical quantity – Fundamental and Derived quantities –Unit- Fundamental and derived units - SI system of units –Multiples and Sub multiples – Rules for writing S.I. units-Advantages of SI units – Direct and indirect measurements – Accuracy and least count – Errors: Absolute, relative and percentage errors – Problems.

2. **Elements of Vectors:**

   Introduction of Scalars and Vectors – Representation of a vector –Types of vectors - Resolution of vector into rectangular components – Triangle law of vectors - Parallelogram law of vectors- examples- derivation of magnitude and direction of resultant vector- Dot product- Cross product - Problems.

3. **Mechanics:**

   Introduction to Mechanics – Momentum –force-torque. Concurrent and coplanar forces - Lami's theorem – equations of motion of a body moving in a straight line – projectile - path of projectile in oblique projection – periodic motion -Ideal simple pendulum- Time period of simple pendulum- Problems.

4. **Fundamentals of Astrodynamics:**

   Concept of acceleration due to gravity (g) -Newton's law of gravitation- Universal Gravitational constant G – Relation between g and G- Kepler's laws of planetary motion – Orbital velocity and escape velocity – Satellites: Natural and artificial - Applications of artificial satellites – Problems.

5. **Energy and thermal Physics**

   Work done, Power and Energy - forms of energy - Potential energy - Kinetic energy- Momentum- K.E and Momentum relation – Law of Conservation of energy- Boyle's law - Charle's volume law -Charle's pressure law- Ideal Gas equation- Problems.

6. **Concepts of Acoustics**

   Longitudinal wave- transverse wave- musical sound - noise - Noise pollution – Causes, effects, Methods of minimizing noise pollution- Beats - Doppler's Effect - applications - Echo- Reverberation - Reverberation time-Sabine 's formula - Problems.

7. Electricity and Magnetism

Ohm's law- Resistance - Specific resistance - Kirchoff's laws - Wheatstone's bridge- Meter Bridge. Concept of magnetic field- magnetic pole strength – Magnetic Moment- magnetic lines of force - Coulomb's inverse square law of magnetism– Torque acting on a bar magnet- Problems.

8. Modern Physics

Photoelectric effect – Einstein photo electric equation – photoelectric cell – Applications of photoelectric cell – critical angle, Total internal reflection- Optical Fiber - Principle – working-Applications of optical fibers - Superconductivity–applications – Nanotechnology – applications.

REFERENCES

1. Intermediate physics - Volume - I & 2
2. Telugu Academy (English version)
3. Unified physics Volume 1, 2, 3 and 4 -Dr. S.L Guptha and Sanjeev Guptha
4. Concepts of Physics, Vol 1 & 2 -H.C. Verma
5. Text book of physics Volume I & II -Resnick & Holiday
6. Fundamentals of physics -Brijlal & Subramanyam
7. Text book of applied physics -Dhanpath Roy
8. NCERT Text Books of physics -Class XI & XII Standard
9. e-books/e-tools/websites/Learning Physics software/PhET Interactive Simulations

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.12
Unit Test-II	From 4.1 to 6.17
Unit Test-II	From 7.1 to 8.12

ENGINEERING CHEMISTRY AND ENVIRONMENTAL STUDIES

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME104T	Engineering Chemistry and Environmental Studies	3	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1	Basic Concepts of Chemistry	14	18	2	1.5	CO1
2	Solutions, Acids and Bases	14	18	2	1.5	CO1
3	Electrochemistry	12	11	1	1	CO2
4	Corrosion	8	11	1	1	CO2
5	Water Treatment	8	11	1	1	CO3
6	Polymers and Engineering Materials	10	11	1	1	CO4
7	Fuels and Alternative Energy Sources	6	3	1	0	CO4
8	Environmental Studies	18	17	3	1	CO5
TOTAL		**90**	**100**	**12**	**8**	

COURSE OBJECTIVES

1	To develop a fundamental understanding of core chemical principles and their relevance to a wide range of engineering applications.
2	To explore and analyze natural and anthropogenic environmental challenges through an interdisciplinary lens, incorporating physical, chemical and socio - cultural perspectives.
3	To reinforce theoretical concepts by conducting relevant experiments/exercises

COURSE OUTCOMES

CO1	ME104.1	Explain the basics of atomic structure, chemical bonding, oxidation-reduction, mole concept, concentration expressing methods of solutions, acids-bases, pH and buffer solutions.
CO2	ME104.2	Explain electrolysis, Galvanic cell, batteries and corrosion.
CO3	ME104.3	Explain the chemistry involved in the treatment of hardness in water.
CO4	ME104.4	Explain the preparation and applications of polymers, and understand the composition and uses of alloys, nanomaterials and green fuels.
CO5	ME104.5	Explain environmental concepts, pollution types, global issues, green chemistry principles and sustainable development goals.

CO-PO/PSO MATRIX

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PSO1**	**PSO2**	**PSO3**
CO1	3									
CO2	3	1	1	1	1		1			
CO3	3	1	1	1	1		1			
CO4	3	1	1		1		1			
CO5	3	1			1	1	1			
Average	**3**	**1**	**1**	**1**	**1**	**1**	**1**			

LEARNING OUTCOMES

At the end of the course student will be able to

1.0 **Basic Concepts of Chemistry**

1.1 Explain the charge, mass of fundamental particles of an atom (electron, proton and neutron).

1.2 Understand the concept of Atomic number and Mass number.

1.3 Calculate the number of electrons, number of protons and number of neutrons in atoms, if Atomic number and Mass number are given.

1.4 Explain the Postulates of Bohr's atomic theory and its limitations.

1.5 Explain the values and significance of four Quantum numbers.

1.6 Define Orbital of an atom and draw the shapes of s, p orbitals.

1.7 Distinguish between orbit and orbital.

1.8 Explain (i). Aufbau principle (ii). Hund's rule and (iii). Pauli's exclusion principle.

1.9 Write the Electronic configuration of elements up to Atomic number 20.

1.10 Explain the significance of chemical bonding.

1.11 Understand the concept of Octet rule.

1.12 Define Ionic bond and explain it in the formation of NaCl.

1.13 Define Covalent bond and explain it in the formation of H_2, O_2 & N_2 molecules (Lewis Dot Method).

1.14 List out the Properties of Ionic compounds and Covalent compounds and distinguish between their properties.

1.15 Understand the electronic concept of oxidation, reduction and redox reactions.

2.0 **Solutions, Acids and Bases**

2.1 Define the terms: (i). Solution (ii). Solute and (iii). Solvent with examples.

2.2 Classify solutions based on physical state of solvent with examples.

2.3 Define the terms: (i). Atomic weight, (ii). Molecular weight, and (iii). Equivalent weight.

2.4 Calculate Molecular weight and Equivalent weight of the given Acids (HCl, H_2SO_4, H_3PO_4),Bases (NaOH, $Ca(OH)_2$, $Al(OH)_3$ and Salts (NaCl, Na_2CO_3, $AlCl_3$).

2.5 Define Mole and solve numerical problems on Mole concept.

2.6 Define Molarity, Normality and solve numerical problems on Molarity and Normality.

(a). Calculate the Molarity & Normality, if Weight of solute and Volume of solution are given.

(b). Calculate the weight of solute, if Molarity or Normality with volume of solution are given.

2.7 Explain Arrhenius theory of Acids and Bases and give its limitations.

2.8 Define pH and mention its Significance.

2.9 Define buffer solution and classify buffer solutions with examples. Give its applications.

3.0 **Electrochemistry**

3.1 Define the terms (i). Conductor (ii). Semiconductor (iii). Insulator. (iv). Electrolyte (Strong and Weak) and (v). Non-electrolyte. Give two examples for each.

3.2 Define Electrolysis and Explain electrolysis by taking an example of molten NaCl.

3.3 State the applications of electrolysis.

3.4 Understand Electrode potential and Standard reduction

potential (SRP).
3.5 Define electrochemical series and state its significance.
3.6 Define Galvanic cell. Explain the construction and working of Galvanic cell.
3.7 Distinguish between electrolytic cell and galvanic cell.
3.8 Define battery and list the types of batteries with examples.
3.9 Explain the construction, working and applications of (i). Dry cell (Leclanché cell) and (ii). Lithium-ion battery.

4.0 **Corrosion**
4.1 Define the term corrosion.
4.2 State the factors which influencing the rate of corrosion.
4.3 Describe the formation of (a). Composition cell (b). Stress cell and (c). Concentration cell during corrosion.
4.4 Define rusting of iron and explain the mechanism of rusting of iron.
4.5 Explain the methods of prevention of corrosion by:
(a). Protective Coatings (through flow chart with examples) and (b). Cathodic Protection Methods. ((i). Sacrificial Anode Process and (ii). Impressed Voltage Process)

5.0 **Water Treatment**
5.1 Define soft water and hard water.
5.2 Define hardness of water and classify its types.
5.3 List out the salts that causing hardness of water (with Formulae).
5.4 State the disadvantages of using hard water in industries.
5.5 Define Degree of hardness and units of hardness (mg/L and ppm).
5.6 Explain the method of softening of hard water by Ion exchange method (By indicative reactions).
5.7 Explain the concept of Reverse Osmosis in removing hardness of water.
5.8 List out the applications and advantages of reverse osmosis technique.
5.9 List out the essential qualities of drinking water/potable water.
5.10 Explain Municipal treatment of water for drinking purpose (only flow chart).

6.0 **Polymers and Engineering Materials.**
6.1 Explain monomers, polymers and the concept of polymerization.
6.2 Describe the methods of polymerization (a). Addition Polymerization of Polythene and (b). Condensation Polymerization of Bakelite (Only flow chart).
6.3 Define plastic. Write the monomers and uses of plastics: (i). PVC and (ii) Nylon (6,6).
6.4 Define Biodegradable polymers. State applications of (i). PHBV and (ii). PBAT.
6.5 Define an alloy. Write the composition and applications of the following alloys: (i). Stainless Steel and (ii). Nitinol.
6.6 Define Nano Materials and State applications of (i). Graphene and (ii). Nanotubes.

7.0 **Fuels and Alternative Energy Sources**
7.1 Define the term fuel.
7.2 Classification of fuels as Natural fuels and Synthetic fuels.
7.3 Write the composition and uses of the following:
(i) LPG (ii) CNG and (iii). Power alcohol.
7.4 State the Renewable and Non- renewable energy sources with examples.
7.5 Define Green fuel. State the advantages and disadvantages of hydrogen as a green fuel.

8.0 **Environmental Studies**

8.1 Importance of environmental studies.

8.2 Define the following terms:
(i). Pollution, (ii). Pollutant, (iii). Sink, (iv). Receptor, (v). Particulate Matter, (vi). Dissolved Oxygen (DO) and (vii). Threshold Limit Value (TLV).

8.3 State the uses of forest resources.

8.4 Define deforestation. Explain the causes, effects and controlling methods of deforestation.

8.5 Define Air pollution. Explain the causes, effects and controlling methods of Air pollution.

8.6 Explain the global impacts of Air pollution: (i). Global Warming, (ii). Ozone Layer Depletion and (iii). Acid Rain.

8.7 Define Water pollution. Explain the causes, effects and controlling methods of Water pollution.

8.8 Define e – pollution. State the sources of e – pollution. Explain its health effects and its management.

8.9 Define Green Chemistry. List the Green Chemistry Principles.

8.10 Define Sustainable Development and List the Sustainable Development Goals.

COURSE CONTENT

1. Basic Concepts of Chemistry

Atomic Structure:

Introduction - Fundamental particles – their mass and charge – Atomic number and Mass number - definition with examples – calculation of electrons, protons and neutrons in atoms – Bohr's atomic theory and limitations - Quantum numbers – Orbital concept, shapes of s, p Orbitals – Distinguish between Orbit and Orbital - Aufbau principle - Hund's rule - Pauli's exclusion Principle - Electronic configuration of elements (Atomic number(Z) from 1 to 20).

Chemical Bonding:

Introduction – Octet rule - Types of chemical bonds – Ionic bond (NaCl) and Covalent bond (H_2, O_2 & N_2 molecules) as examples – Properties of Ionic and Covalent compounds. Electronic concept of oxidation, reduction and redox reactions.

2. Solutions, Acids and Bases

Solutions:

Introduction – Idea of solute, solvent and solution - Types of solutions based on physical state of solvent – Atomic weight – Molecular weight, Equivalent Weight (Acids, Bases and Salts) - Mole concept – Numerical problems on Mole concept - Methods of expressing concentration of a solution – Molarity - Normality – Numerical problems on Molarity and Normality.

Acids and Bases:

Introduction - Arrhenius theory of acids and bases – pH Scale – its significance – Buffer solution – Definition – Types of buffer solutions with examples – its applications.

3. Electrochemistry

Introduction - Conductors, Semiconductors, Insulators with examples - Electrolytes (Strong and Weak) and Non-electrolytes – Definition – Examples – Electrolysis – Definition – Electrolysis of molten NaCl – Applications of electrolysis – Electrode potential - Standard reduction potential – Definition – Electrochemical series – Significance – Construction and working of Galvanic cell – Differences between Electrolytic cell and Galvanic cell - Batteries - Types of batteries – Definition and examples – construction, working and applications of: (i). Dry Cell (Leclanché Cell) and (ii). Lithium-ion battery.

4. Corrosion

Introduction – Definition - Factors influencing the rate of corrosion – Composition cell, Stress cell and Concentration cell during corrosion – Rusting of iron and its mechanism – Prevention of corrosion - Protective Coating methods (flow chart with examples) - Cathodic Protection methods.

5. Water Treatment

Introduction – Soft and Hard water – Hardness of water – Types of hardness – salts responsible for hardness - Degree of hardness – Methods of expressing hardness (mg/L and ppm) – Disadvantages of using hard water in industries - Softening of hard water by Ion exchange method – Concept of Reverse Osmosis process – Applications and Advantages of Reverse Osmosis - Essential qualities of drinking water/potable water – Municipal treatment of water for drinking purpose (only flow chart).

6. Polymers and Engineering Materials

Polymers:

Introduction- Monomers - Polymers - Polymerization – Types of Polymerization – Addition polymerization (Polythene) and Condensation polymerization (only flow chart of Bakelite) - Plastics – monomers and uses of PVC and Nylon (6,6) - Biodegradable Polymers: (i). PHBV and (ii). PBAT (Composition and Uses).

Engineering Materials:

Alloys - Definition - Composition and applications of (i). Stainless Steel and (ii). Nitinol, Nano Materials – Definition - Applications of (i) Graphene and (ii). Nanotubes.

7. Fuels and Alternative Energy Sources

Introduction – Definition - Classification of fuels – Composition and uses of (i). LPG (ii). CNG and (iii). Power alcohol - Renewable and Non-renewable energy sources – Advantages and disadvantages of Hydrogen as a green fuel.

8. Environmental Studies

Introduction - Importance of environmental studies – Important terms related to environment – Pollution, Pollutant, Sink, Receptor, Particulate Matter, Dissolved

Oxygen (DO), Threshold Limit Value (TLV) - Uses of forest resources – Deforestation - Definition – causes, effects, controlling methods –Air pollution – Definition, causes, effects, controlling methods - Global impacts of Air pollution – Global warming, Ozone layer depletion, Acid rain – Water pollution – Definition, causes, effects, controlling methods – e - pollution, Definition, sources, effects, management - Green Chemistry – Definition – Principles of Green Chemistry – Sustainable Development – Definition – Goals.

REFERENCE BOOKS:

1. Jain & Jain : Engineering Chemistry
2. O.P. Agarwal, Hi-Tech. : Engineering Chemistry
3. B. K. Sharma : Engineering Chemistry
4. A. K. De : Engineering Chemistry
5. Mahua Basu & S. Xavier : Fundamentals of Environmental Studies
6. Anubha Kaushik & C.P Kaushik : Environmental Studies

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 2.9
Unit Test-II	From 3.1 to 5.10
Unit Test-II	From 6.1 to 8.10

ENGINEERING MECHANICS

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME105T	Engineering Mechanics	06	180	30	70	6

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1	Statics	30	21	3	1.5	CO1
2	Friction	30	14	2	1	CO2
3	Geometrical Properties of Sections	30	18	2	1.5	CO3
4	Dynamics	45	22	2	2	CO4
5	Simple Mechanisms & Machines	45	25	3	2	CO5
	Total	**180**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Understand the basic principles of statics and dynamics of rigid bodies.
2	Calculate the reactive forces and motion characteristics for given conditions.
3	Understand the working of simple mechanisms and machines.

COURSE OUTCOMES

CO1	ME105.1	Explain the basic concepts of force, moment, composition and resolution of forces, equilibrium, resultant of forces and moments in coplanar force systems and applying them to analyze the real time problems. Construct free body diagram and calculate the reactions necessary to ensure static equilibrium.
CO2	ME105.2	Understand the effect of friction in static and dynamic conditions.
CO3	ME105.3	Calculate Centroid and Moment of Inertia of various sections used in engineering applications
CO4	ME105.4	Apply the various principles like, Work-Energy principle and Impulse– Momentum principle to solve the kinetic problems of particles Analyse and solve different problems of kinematics and kinetics.
CO5	ME105.5	Illustrate working principles of simple machines and functioning of simple mechanisms in different applications.

LEARNING OUT COMES

Upon completion of the course the student shall be able to

1.0 **Statics**

1.1 Explain the importance of Engineering Mechanics in real world

1.2 Explain the concept of force

1.3 Classify the system of forces.

1.4 Explain the system of forces a) Co-planar and Non-coplanar, b) Parallel and Non-Parallel,

c) Like and Unlike d) Concurrent and Non-concurrent.

1.5 ExplainCompositionandResolutionofforcesandresultantofconcurrentcoplanarforces.

1.6 State(a)parallelogram law(b)triangle law (c)polygon law of forces(d)Lami's theorem.

1.7 Problems on parallelogram law and Lami's theorem.

1.8 Explain the concept of equilibrium.

1.9 State the conditions of equilibrium of a body acted upon by a number of co-planar forces.

1.10 Solve the problems on equilibrium of a body subjected to number of concurrent coplanar forces using Lami's theorem and equilibrium equations.

1.11 Explain moment of force and couple.

1.12 State Varignon's theorem.

2.0 **Friction**

2.1 Explain the concept of friction

2.2 State the laws of friction

2.3 Define i) angle of friction ii) angle of repose

2.4 Identify the machine members in which friction is desirable.

2.5 Resolve the forces acting on bodies moving on horizontal plane.
2.6 Resolve the forces acting on bodies moving up on an inclined plane when the force applied is (a) parallel to the plane(b) Parallel to the base.
2.7 Resolve the forces acting on bodies moving down on an inclined plane when the force applied is (a) parallel to the plane(b) Parallel to the base.
2.8 Solve the related numerical problems of the above cases.
2.9 Solve problems on friction in screw jack.

3.0 **Geometrical Properties of Sections**
3.1 Define the terms i) centre of gravity ii) centre of mass and (iii) centroid.
3.2 Write the differences among centre of gravity and centroid.
3.3 State the need for finding the centroid and centre of gravity for various engineering applications.
3.4 Explain the method of determining the centroid by 'Method of moments'
3.5 Determine the position of centroid of standard sections like -T, L, I, Z and Channel section.
3.6 Explain the meaning of the terms i) Moment of Inertia ii) Polar Moment of Inertia iii) Radius of gyration.
3.7 State the necessity of finding Moment of Inertia for various engineering applications.
3.8 Statements of (a)Parallel axes theorem and (b)Perpendicular axes theorem
3.9. Determine Moment of Inertia and Radius of gyration for standard sections like - T, L, I, Z and Channel section.

4.0 **Dynamics**
4.1 Define the terms Kinematics and Kinetics
4.2 Classify the types of motion
4.3 Define the terms displacement, velocity and acceleration
4.4 Write equations of motion (without derivation)
4.5 Solve the problems related to the rectilinear motion of a particle.
4.6 Define energy and momentum
4.7 State Newton's laws of motion with expressions.
4.8 State the law of conservation of energy
4.9 Explain the Work- Energy principle.
4.10 State law of conservation of momentum.
4.11 Explain the Impulse–Momentum equation
4.12 Solve problems using the above principles.
4.13 Explain rotary motion and terms involved in rotary motion of a particle.
4.14 Write the equations of rotary motion of a particle.
4.15 Differentiate centripetal force and centrifugal force.
4.16 Solve simple problems on rotary motion.
4.17 Describe simple harmonic motion with engineering applications.
4.18 Define the terms related to SHM.
4.19 Solve simple problems on simple harmonic motion.

5.0 **Simple Mechanisms and Simple Machines**
A) Simple Mechanisms:

5.1 Define the terms i) kinematic link ii) kinematic pair iii) Kinematic chain iv) Mechanism
v)Machine vi) Structure vii) inversion of mechanism.
5.2 Write classification of kinematic pairs on different criteria.
5.3 Explain the working principle of Quadratic cycle chain.
5.4 Explain the important inversions of Quadric cycle chain with legible sketches.
5.5 Explain the working principle of Slider Crank mechanism.
5.6 Explain the important inversions of Slider Crank mechanism with legible sketches.

B) Simple Machines:

5.7 Define the important terms related to Simple Machines
5.8 Illustrate the use of three classes of simple lever.
5.9 Explain the working and write mathematical expressions for the velocity ratio of i) Wheel & Axle, Differential Wheel and Axle ii) Pulleys iii) Worm & Worm wheel iv) Winch crabs v) Screw jack vi) Rack & Pinion.
5.10 Calculate the efficiency of the given machine.
5.11 Calculate the effort required to raise and lower the load on screw jack under given conditions.
5.12 Explain Law of simple machine.
5.13 Explain the conditions for self-locking.
5.14 State the conditions for reversibility.
5.15 Numerical problems on the above simple machines

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
C01	3	3	1				1	1	3	1
C02	3	3	1				1	1	3	1
C03	3	3	1				1	1	3	1
C04	3	3	1				1	1	3	1
C05	3	3	1				1	1	3	1
AVG	3	3	1				1	1	3	1

COURSE CONTENTS

1.0 Statics

Importance of engineering mechanics in engineering - Definition of force and its specifications-System of forces –Principle of transmissibility-Composition and Resolution of force - Resultant -Equilibrant, Statement of parallelogram law of forces, triangle law of forces, polygon law of forces - Numerical problems related to the above. Equilibrium - Condition for equilibrium of a rigid body subjected to number of coplanar concurrent forces –Surface and Support reactions, Free body diagrams Lami's theorem -Numerical Problems. Moment of force and moment of couple – Statement of Varignon's Principle.

2.0 Friction

Concept of Friction – Advantages and Disadvantages of friction – Friction in Engineering applications – Types of friction - Definition of static friction, dynamic

friction - Laws of solid and dynamic friction – Terminology of friction: Coefficient of friction, Angle of friction and Angle of repose. Derivation of the expression for the force to be applied on a body moving on (i)Horizontal Plane (i)inclined plane moving upward and downwards. Screw friction; Numerical problems on the above cases.

3.0 Geometrical Properties of Sections

Geometric Properties of Sections – Definition of the terms centre of gravity, Centre of mass and centroid– Position of centroids of the plane geometrical figures such as square, rectangle, triangle, semi-circle (**formulae only without derivations**) – Problems to determine the Centroid of T-Section, L-Section I-section, Z-section and Channel sections only. Definitions of Centroidal Axes and Axis of symmetry - Moment of Inertia and Radius of Gyration –Statements only for (i) Parallel axes theorem and (i) Perpendicular axes theorem - Moment of Inertia of lamina of rectangle, circle, triangle sections- Calculation of Moment of Inertia of T-Section, L-Section (Equal& unequal lengths), I-section, Z-section and Channel sections only.

4.0 Dynamics

Definition and classification of Dynamics.

Kinematics: Definition – Classification of motion - definition of displacement, time, velocity and acceleration – Equations of motion (**without derivation**)-Problems related to the rectilinear motion of a particle.

Kinetics: Definition – Momentum – Newton's Laws of motion- Statements and applications- Law of conservation of energy - Work-Energy principle – Law of conservation of momentum-Impulse–momentum equation-Problems on the above principles.

Rotary motion of particle - laws of rotary motion – Terms involved in rotary motion – Differentiate centripetal and centrifugal forces- Simple problems.

Simple Harmonic Motion: Definition – Characteristics - Terms of SHM such as frequency, time period, amplitude - Simple problems on SHM.

5.0 Simple Mechanisms And Simple Machines

5.1 Simple Mechanisms

Define the terms kinematic link, kinematic pair, Kinematic Chain, Mechanism, Machine, Structure and inversion - classification of kinematic pairs on different criteria – nature of contact, relative motion and type of closure – Quadric cycle chain - Inversions of Quadric cycle chain: Beam engine, Coupling rod of a locomotive and Watt's straight-line mechanism-Slider Crank Mechanism- Inversions of Slider Crank Chain.

5.2 Simple Machines

Definition of Simple Machine and uses of simple machines – Terminology such as Load, effort, Mechanical advantage, Velocity Ratio and Efficiency – Expressions for Velocity Ratio in case of levers, three systems of pulleys, Wheel and Axle, Differential wheel and axle, Worm and Worm wheel, Rack and Pinion, Winch Crabs, & Screw jack (**Derivations omitted**) - Simple problems on the above simple machines - Importance of Law of Simple Machine – Conditions for reversibility and self-locking of a machine.

REFERENCE BOOKS

1	Engineering Mechanics	Singer	B.S. Publications
2	Engineering Mechanics	K.L. Kumar	TMH
3	Engineering Mechanics	Timoshenko	MGH
4	Mechanics of Solids	S.S.BHAVIKATTI	New Age
5	Engineering Mechanics		SBTET

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 2.9
Unit Test-II	From 3.1 to 4.12
Unit Test-II	From 4.13 to 5.15

PROGRAMMING IN PYTHON

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME106A	PROGRAMMING IN PYTHON	2	60	--	--	-

TIME SCHEDULE

S.No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1	Introduction to Python Programming	3	-	-	-	CO1
2	Python Fundamentals	15	-	-	-	CO2
3	Control Flow	10	-	-	-	CO3
4	Loops	12	-	-	-	CO4
5	Practice the Simple Programs using the Control Flow and Loops	20	-	-	-	CO5
	Total	60	-	-	-	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Understand Basic Fundamental of Python Programming to solve the engineering problems.

COURSE OUTCOMES

CO1	ME106.1	Understand fundamental Python programming concepts.
CO2	ME106.2	Understand Basics like operators, expressions
CO3	ME106.3	Write Python programs using Control statements
CO4	ME106.4	Write Python programs using Loops
C05	ME106.5	Write python programs using the Control Flow and Loops

LEARNING OUTCOMES

Upon completion of the course the student shall be able to

1.0 Introduction To Python Programming

1.1 Understand the evolution, versatility and popularity of Python language.
1.2 List Python features
1.3 Describe Python Integrated Development and Learning Environment (IDLE)
1.4 Explain Applications of Python
1.5 Compare with other programming languages

2.0 Python Fundamentals

2.1 Explain Identifiers, Keywords, Indentation and Variables
2.2 Explain various datatypes (Int, float, Boolean, string, and list)
2.3 Explain declaration, initialization of variables.
2.4 Explain Input and Output statements.
2.5 Explain formatted input output.
2.6 Explain the usage of comments
2.7 Explain various Operators.
2.8 Explain Boolean values.
2.9 Give the Steps in developing a simple python program and execution.

3.0 Control Flow

3.1 Explain various Control Flow constructs (a)If (b)If-Else (c)If-Elif-Else

4.0 Loops

4.1 Explain various Loop Statements.
a) for Loop
b) while loop
c) Break
d) Continue
e) Pass

5.0 Practice Simple Programmes

5.1 Practice simple programs using the above Control Flow and Loops

CO-PO/PSO MATRIX

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			2			1	2	2	1
CO2	3			2			1	2	2	1
CO3	3			2			1	2	2	1
CO4	3			2			1	2	2	1
CO5	3	1	1	2			1	2	2	1
AVG	3	1	1	2			1	2	2	1

COURSE CONTENTS

1.0 Introduction To Python Programming

History of Python, Introduction to Python and installation, Explain Applications of Python. Comparison with other programming languages (e.g., MATLAB, C++ - Brief overview of why Python is suitable for beginners and engineering tasks). Motivation for Computing.

2.0 Python Fundamentals

Basic syntax: comments, variables. Data types (integers, floats, strings, booleans). Operators: Arithmetic, Assignment, Comparison. Logical-Input and Output functions (print(), input())

3.0 Control Flow

If...Else Statements - Conditions and logic, Comparison Operators - >, <, ==, !=, etc., Logical Operators - and, or, not ,Nested Conditions & Elif - More complex decision trees.

4.0 Loops

While Loops - Repeat until something stops, For Loops - Loop through numbers or items,
Break, continue and pass.

5.0 Python Programming

Write a Program to Find the Largest Among Three Numbers, Write a Program to Temperature conversion from Celsius to Fahrenheit, Write a Program to check a number is prime or not, Write a Program to Convert Kilometer to Miles, Write a Program to display multiplication table of a given number, Write a Program to sum of square of first "n" natural numbers, Write a Python Program to Convert Decimal to Binary, Octal and Hexadecimal, Write a Program for creating a Hotel bill, Write a Program to calculate unknowns of Ideal gas equations.

REFERENCE BOOKS

1. Python Programing by K. Nageswara Rao, Shaikh Akbar - Scitech Publications (India) Pvt. Ltd.
2. Python Programming: A Modern Approach, Vamsi Kurama, Pearson

ENGINEERING GRAPHICS

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME107D	ENGINEERING GRAPHICS	06	180	40	60	3

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1	Importance of Engineering Drawing	--	01	-	-	-
2	Engineering Drawing Instruments	01	05	-	-	-
3	Free hand lettering & Numbering	01	06	05	01	-
4	Dimensioning Practice	01	09	05	01	-
5	Geometrical constructions	03	24	15	01	01
6	Projections of Points, Lines, Planes& Auxiliary Planes	03	21	05	01	
7	Projections of Solids	01	12	10		01
8	Sections of Solids	01	21	10	-	01
9	Orthographic Projections	01	30	10	-	01
10	Isometric Views	01	30	10	-	01
11	Development of surfaces	01	21	10	-	01
Total		**14**	**180**	**80**	**04**	**06**

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Perform basic graphic skills and use them in preparation of engineering drawings.

COURSE OUTCOMES

CO1	ME107.1	Describe the use of engineering drawing instruments
CO2	ME107.2	Practice the conventions to be followed in engineering drawing as per BIS
CO3	ME107.3	Draw i) basic geometrical constructions ii) engineering curves
CO4	ME107.4	Draw the orthographic projections of i) Points ii) Lines iii)Regular Planes iv) Regular Solids V) Sections of Regular Solids
CO5	ME107.5	Practice isometric views of machine components
CO6	ME107.6	Draw the developments of surfaces of regular solids and use them tomake the components used in daily life

LEARNING OUTCOMES

Upon completion of the course the student shall able to

1.0. Understand the Basic Concepts of Engineering Drawing

1.1 State the importance of drawing as an engineering communication Medium State the necessity of B.I.S. Code of practice for Engineering Drawing.
1.2 Explain the linkages between Engineering drawing and other subjects of Mechanical Engineering

2.0. Use of Engineering Drawing Instruments

2.1 Select the correct instruments to draw the different lines /curves
2.2 Use correct grade of pencil to draw different types of lines and for different purposes
2.3 Select and use appropriate scales for a given application.
2.4 Identify different drawing sheet sizes as per I.S. and Standard Lay-outs.
2.5 Prepare Title block as per B.I.S. Specifications.
2.6 Identify the steps to be taken to keep the drawing clean and tidy.
DrawingPlate1: Use of engineering Drawing Instruments

1.0. Write the Free Hand Lettering and Numbers

3.1 Write titles using vertical lettering and numerals of 7mm, 10mm and14mm height
3.2 Write titles using sloping lettering and numerals of7mm, 10mm and14mm height
3.3 Select suitable sizes of lettering for different layouts and applications
Drawing plate 2: Exercises on Free hand lettering and numbering

4.0. Understand Dimensioning Practice

4.1 Acquaint with the conventions, notations, rules and methods of dimensioning in engineering drawing as per the B.I.S.
4.2 Dimension a given drawing using standard notations and desired system of dimensioning.
Drawing Plate 3: Exercises on Dimensioning Practice

5.0. Apply Principles of Geometric Constructions

5.1 Practice the basic geometric constructions like i) dividing a line into equal parts ii) exterior and interior tangents to the given two circles iii) tangent arcs to two

given lines and arcs

5.2 Draw any regular polygon using general method when i) side length is given ii) inscribing circle radius is given iii) describing circle radius is given

5.3 Draw the conics using general and special methods,

5.4. Draw the engineering curves like i) involute ii) cycloid iii) helix

DrawingPlate-4: Having problems up to construction of polygon

DrawingPlate-5: Having problems of construction of conics

DrawingPlate-6: Having problems of construction of involute, cycloid and helix

6.0. Projections of Points, Lines, Planes & Auxiliary Planes

6.1 Explain the basic principles of the orthographic projections

6.2 Visualise and draw the projection of a point with respect to reference planes (HP&VP)

6.3 Visualise and draw the projections of straight lines with respect to two references Planes (upto lines parallel to one plane and inclined to other plane)

6.4 Visualise and draw the projections of planes (up to planes perpendicular to one plane and inclined to other plane

DrawingPlate-7: problems on projection of points and Lines

Drawing Plate -8: problems on projection of planes

DrawingPlate-9: problems on auxiliary planes

7.0. Draw the Projections of Solids

7.1. Visualise and draw the projections of regular solids like Prisms, Pyramids, Cylinder, Cone (upto axis of solids parallel to one plane and inclined to other plane)

Drawing plateNo.10: Problems on projection of solids

8.0. Appreciate The Need of Sectional Views

8.1 Identify the need to draw sectional views.

8.2 Differentiate between true shape and apparent shape of section

8.3 Draw sectional views and true sections of regular solids by applying the principles of hatching.

Drawing Plate–11: Problems on section of solid

9.0. Apply Principles of Orthographic Projections

9.1 Draw the orthographic views of an object from its pictorial drawing.

9.2 Draw the minimum number of views needed to represent a given object fully.

DrawingPlate12: Problems on orthographic projections

10.0 Prepare Pictorial Drawings

10.1. Identify the need of pictorial drawings.

10.2. Differentiate between isometric scale and true scale.

10.3 Prepare Isometric views from the given orthographic drawings.

Drawing plate13: Exercise on Isometric drawings only.

11.0 Interpret Development of Surfaces of Different Solids.

11.1 State the need for preparing development drawing.

11.2 Draw the development of simple engineering objects and their truncations (cubes, prisms, cylinders, cones, pyramid)

11.3 Prepare development of surface of engineering components like i) funnel ii) 90^0 elbow iii) Tray

Drawing plate No. 14: Problems on Development of surfaces

Competencies and Key competencies to be achieved by the student

S.No	Major topic	Key Competency
1.	Importance of Engineering Drawing	➢ Explain the linkages between Engineering drawing and other subjects of study in Diploma in Mechanical Engineering.
2.	Engineering Drawing Instruments	➢ Select the correct instruments to draw various entities in different orientation
3.	Free hand lettering & Numbering	➢ Write titles using sloping and vertical lettering and numerals as per B.I.S (Bureau of Indian standards)
4.	Dimensioning Practice	➢ Dimension a given drawing using standard notations and desired system of dimensioning
5.	Geometrical construction	➢ Construct ellipse, parabola, rectangular hyperbola, involute, cycloid and helix from the given data.
6.	Projection of points, Lines, Planes &Solids	➢ Draw the projections of points, straight lines, plane s& solids with respect to reference planes ➢ (HP&VP)
7.	Auxiliary views	➢ Draw the auxiliary views of a given Engineering component ➢ Differentiate between Auxiliary view and apparent view
8.	Sections of Solids	➢ Differentiate between true shape and apparent shape of section ➢ Apply principles of hatching. ➢ Draw simple sections of regular solids
9.	Orthographic Projection	➢ Draw the minimum number of views needed to represent a given object fully.
10.	Isometric Views	➢ Differentiate between isometric scale and true scale. ➢ Draw the isometric views of given objects.
11.	Development of surfaces	➢ Prepare development of Surface of regular solids and other components like i) funnel ii) 90^0 elbow iii) Tray

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1				1	2	3	1
CO2	3	2	1				1	2	3	1
CO3	3	2	1				1	2	3	1
CO4	3	2	1				1	2	3	1
CO5	3	2	1				1	2	3	1
CO6	3	2	1			1	1	2	3	1
AVG	3	2	1			1	1	2	3	1

COURSE CONTENTS

1.0 B.I.S Specifications should Invariably be Followed in all the Topics

A-3 Size Drawing Sheets are to be used for all Drawing Practice Exercises.

The importance of Engineering Drawing

Explanation of the scope and objectives of the subject of Engineering Drawing Its importance as a graphic communication -Need for preparing drawing as per standards – SP-46 –1988 –Mention B.I.S – Role of drawing in-engineering education– Link between Engineering drawing and other subjects of study.

2.0 Engineering Drawing Instruments

Classifications: Basic Tools, tools for drawing straight lines, tools for curved lines, tools for measuring distances and special tools like mini drafter & drafting machine – Mentioning of names under each classification and their brief description -Scales: Recommended scales reduced & enlarged -Lines: Types of lines, selection of line thickness - Selection of Pencils -Sheet Sizes: A0, A1, A2, A3, A4, A5, Layout of drawing sheets in respect of A0, A1, A3 sizes, Sizes of the Title block and its contents -Care and maintenance of Drawing Sheet,

3.0 Free Hand Lettering and Numbering

Importance of lettering – Types of lettering -Guide Lines for Lettering Practicing of letters & numbers of given sizes (7 mm, 10 mm and 14 mm)

Advantages of single stroke or simple style of lettering-Use of lettering stencils

4.0 Dimensioning Practice

Purpose of engineering Drawing, Need of B.I.S code in dimensioning -Shape description of an Engineering object -Definition of Dimensioning size description -Location of features, surface finish, fully dimensioned Drawing -Notations or tools of dimensioning, dimension line extension line, leader line, arrows, symbols, number and notes, rules to be observed in the use of above tools -Placing dimensions: Aligned system and uni-directional system (SP-46-1988)-Arrangement of dimensions Chain, parallel, combined progressive, and dimensioning by co-ordinate methods-The rules for dimensioning standard, features “Circles(holes)arcs, angles, tapers, chamfers, and dimension of narrow spaces.

5.0 Geometric Constructions

Division of a line: to divide a straight line into given number of equal parts

Construction of tangent lines: to draw interior and exterior tangents to two circles of given radii and centre distance

Construction of tangent arcs:

I. To draw tangent arc of given radius to touch two lines inclined at given angle (acute, right and obtuse angles).

II. Tangent arc of given radius touching a circle or an arc and a given line.
Tangent arcs of radius R, touching two given circles internally and externally.

Construction of polygon: construction of any regular polygon by general method for given side length, inscribing circle radius and describing /superscribing circle radius

Conics: Explanation of Ellipse, Parabola, Hyperbola, as sections of a double cone and a loci of a moving point, Eccentricity of above curves–Their Engg. Applications viz., Projectiles,

General Curves: Involute, Cycloid and Helix, explanations as locus of a moving point, their engineering application, viz., Gear tooth profile, screw threads, springs etc.–their construction

6.0. Projections of Points, Lines And Planes & Auxilary Views

Classification of projections, Observer, Object, Projectors, Projection, Reference Planes, Reference Line, Various angles of projections –Differences between first angle and third angle projections

Projections of points in different quadrants Projections of straight line-

(A) Parallel to both the planes.
(B) Perpendicular to one of the planes.
(C) Inclined to one plane and parallel to other planes

Projections of regular planes

(A) Plane parallel to one of the reference planes
(B) Plane perpendicular to HP and inclined to VP and vice versa.

Auxiliary views: Need for drawing auxiliary views -Explanation of the basic principles of drawing an auxiliary views explanation of reference plane and auxiliary plane- Partial auxiliary view.

7.0 Projection of Regular Solids

a). Axis perpendicular to one of the planes
b). Axis parallel to VP and inclined to HP and vice versa.

8.0 Sections of Solids

Need for drawing sectional views– what is a sectional view- Hatching– Section of regular solids section planes inclined to one plane and perpendicular to other plane

9.0 Orthographic Projections

Meaning of orthographic projection - Using a viewing box and a model – Number of views obtained on the six faces of the box, - Legible sketches of only 3 views for describing object -Concept of front view, top view, and side view sketching these views for a number of engg objects - Explanation of first angle projection. – Positioning of three views in First angle projection -Projection of points as a means of locating the corners of the surfaces of an object – Use of mitre line in drawing a third view when other two views are given -Method of representing hidden lines -Selection of minimum number of views to describe an object fully.

10.0 Pictorial Drawings

Brief description of different types of pictorial drawing viz., Isometric, oblique, and perspective and their use-Isometric drawings: Isometric axes, angle between them, meaning of visual distortion in dimensions - Need for an isometric scale, difference between Isometric scale, and true scale-difference between Isometric view and Isometric projection - Isometric and non-Isometric lines -Isometric drawing of

common features like rectangles, circular - shapes, non-isometric lines – Drawing the isometric views for the given orthographic projections-Use of box/off set method

11.0 Development of Surfaces

Need for preparing development of surface with reference to sheet metal work-Concept of true length of a line with reference to its orthographic projection when the line is (i) parallel to the plane of projection (ii) inclined to one principal and parallel to the other - Development of simple solids like cubes, prisms, cylinders, cones, pyramid and truncation of these solids-Types of development: Parallel line and radial line development -Procedure of drawing development of funnels, 90^0 elbow pipes, Tray.

REFERENCE BOOKS

1 Engineering Graphics by PI Varghese– (Mc Graw-hill)
2 Engineering Drawing by Basant Agarwal & C.M Agarwal - (Mc Graw-hill)
3 Engineering Drawing by N.D.Bhatt.
4 T.S.M. & S.S.M on " Technical Drawing" prepared by T.T.T.I., Madras.SP-46-1998 –Bureau of Indian Standards.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 5.4
Unit Test-II	From 6.1 to 8.3
Unit Test-II	From 9.1 to 11.3

MANUFACTURING TECHNOLOGY LAB-I
(PRACTICUM - PARCTICAL)

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME108L	MANUFACTURING TECHNOLOGY LAB – I	04	120	40	60	5

TIMES CHEDULE

S.No	Major Title	No of Periods		Total
		Theory	Practical	
1	Carpentry shop	06	24	**30**
2	Fitting shop	06	24	**30**
3	Forging shop	06	24	**30**
4	Sheet metal work	06	24	**30**
Total		24	96	120

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Familiarize with usage of tools used in Basic workshop processes
2	Handle the tools appropriately and safely
3	Reinforce theoretical concepts by practising relevant exercises of basic workshop processes

COURSE OUTCOMES

CO1	ME108.1	Explain the use of basic workshop marking, measuring and cutting tools and its operations used in carpentry, fitting, forging and sheet metal.
CO2	ME108.2	Perform the operations in Carpentry Shop
CO3	ME108.3	Perform the operations in Fitting Shop
CO4	ME108.4	Perform the operations in Forging Shop
CO5	ME108.5	perform the operations in Sheet metal Shop

LEARNING OUTCOMES

1.0. Introduction to Carpentry
Upon successful completion of this unit, students will be able to

Theory (The equipment will be demonstrated and explained in the lab.):
State the importance of workshop processes.
List the various workshop processes and explain briefly about each.

Carpentry Shop
1.1 Identify various carpentry tools.
1.2 Distinguish between marking tools, measuring tools and cutting tools.
1.3 List work holding devices.
1.4 Explain wood working processes viz., sawing, chiselling and planning.
1.5 Explain the use of carpentry joints such as lap joint, dovetail joint, mortise and tenon joint with legible sketch.
1.6 Explain the working of wood working machines.

Practical:
1.7. Cutting of Wood with Hand Saw
1.7.1 Identify the orientation of grains
1.7.2 Select appropriate saw for cutting in each of the directions viz. across and along the grains
1.7.3 Select appropriate work holding device
1.7.4 Handle appropriate measuring and marking tools (Steel rule, Try square, Marking gauge)
1.7.5 Mark dimensions on work using Marking gauge
1.7.6 Fix the work in the vice
1.7.7 Perform cutting along the grains using Rip saw
1.7.8 Perform cutting perpendicular to the grains using cross cut saw

1.8. Planning of Wood
1.8.1 Identify the direction for planning wood stock
1.8.2 Select appropriate jack plane
1.8.3 Prepare the jack plane for planning
1.8.4 Load and unload the blade of a jack plane
1.8.5 Select appropriate work holding device
1.8.6 Perform marking on work using appropriate tool
1.8.7 Fix the job in the vice
1.8.8 Plane the surfaces on all four sides using jack plane

1.9. Chiselling of Wood
1.9.1 Select appropriate chisels and saw
1.9.2 Select appropriate work holding device
1.9.3 Select appropriate measuring and marking tools
1.9.4 Fix the job in the vice
1.9.5 Mark the position of grooves on job using marking gauge
1.9.6 Cut sides of grooves by hand saw
1.9.7 Chip the material using firmer chisel by applying pressure with mallet
1.9.8 Finish the grooves with rasp file

1.10. Preparation of a Dove-Tail Joint

1.10.1 Select the appropriate cutting tools and work holding devices
1.10.2 Plane the wooden pieces on all sides
1.10.3 Mark an angle of 150^0 with bevel square
1.10.4 Trim the dovetail by chisel to exact size
1.10.5 Cut the dovetail groove on second piece
1.10.6 Finish the groove
1.10.7 Assemble the two pieces to prepare dovetail halving joint by using mallet

1.11. Preparation of Mortise and Tenon Joint

1.11.1 Select the appropriate cutting tools and work holding devices
1.11.2 Plane the two pieces to the required size using jack plane
1.11.3 Mark the dimensions to make tenon using mortise gauge
1.11.4 Cut tenon with tenon saw along the marked lines
1.11.5 Use firmer chisel to remove the excess material to set finished tenon
1.11.6 Mark the dimension to make mortise on the second piece with mortise gauge
1.11.7 Use mortise chisel to provide recess in the second piece to accommodate tenon
1.11.8 Assemble the two pieces by fitting the tenon into mortise

1.12. Wood Turning on Lathe

1.12.1 Select appropriate tools
1.12.2 Plane the four corners of the work piece using jack plane
1.12.3 Mark the centres of the job on either side
1.12.4 Mount the job between head stock & tailstock centres
1.12.5 Fix the tool in the tool post & position it in appropriate height
1.12.6 Start the lathe to make the work piece to revolve at desired speed
1.12.7 Feed the bevel gauge against the rotating work to get the required size and shape
1.12.8 Use outside callipers to check the diameter of the pin
1.12.9 Use parting off tool to reduce the diameter on either ends of the pin
1.12.10 Remove the rolling pin between centres and cut off excess material on either sides

1.13. Preparation of any Household Article (Ex: Stool)

1.13.1 Prepare the drawings of a stool required for a particular drawing table
1.13.2 State the specifications of the wood stock required
1.13.3 Identify the type of joints to be made
1.13.4 Identify the operations to be made and their sequence
1.13.5 Perform operations to produce pieces of joint
1.13.6 Assemble all joints as per the drawing

2.0. Fitting Shop

Upon successful completion of this unit, students will be able to

Theory (The equipment will be demonstrated and explained in the lab.):

2.1 List various fitting tools.
2.2 Distinguish between marking and measuring tools.
2.3 List cutting tools.
2.4 List various work holding devices.

2.5 List various checking and measuring instruments.
2.6 Explain fitting operations such as marking, sawing, chipping, filing, grinding, drilling and tapping with legible sketch.
2.7 State the working principle of drilling
2.8 List two types of drilling machines
2.9 Describe the Sensitive drilling machine with line diagram
2.10 Describe the radial drilling machine with line diagram
2.11 Mention the specifications of drilling machine
2.12 Explain the nomenclature of the drill bit
2.13 Sketch the geometry of twist drill
2.14 List the functions of twist drill elements
2.15 List different operations on drilling machine
2.16 Differentiate between jigs and fixtures
2.17 List different types of Jigs and fixtures

Practical:

2.18. Perform Marking and Chipping operations on Mild steel flat

2.18.1 Identify appropriate measuring tools.
2.18.2 Handle appropriate marking tools.
2.18.3 Handle appropriate chipping tools.
2.18.4 Mark the dimensions

2.19. Cutting with hack saw of MS flats

2.19.1 Check the raw material for size
2.19.2 Fix the work piece in vice
2.19.3 Mark the work piece as per given dimensions
2.19.4 Perform dot punching
2.19.5 Load and unload hack saw blade from its frame

2.20. Drilling, chamfering on a MS flat

2.20.1 Check the raw material for size
2.20.2 Apply the chalk on the surface and on all sides of the flat
2.20.3 Layout the dimensions and mark the lines using dot punch
2.20.4 Chamfer the edges through filing
2.20.5 Locate the whole centres using odd leg callipers and centre punching
2.20.6 Identify appropriate drill bit
2.20.7 Load and unload drill bit from the machine

2.21. Tapping and Dieing on a MS flat

2.21.1 Check the raw material for size
2.21.2 Identify appropriate tap and die
2.21.3 Secure the tap in the wrench
2.21.4 Perform Tapping
2.21.5 Hold the bar in bench vice
2.21.6 Fix the die in die stock
2.21.7 Cut external threads using a Die
2.21.8 Check the fit for accuracy

2.22. Assembling of two pieces, matching by filing

2.22.1 Cut the pieces to size using hack saw

2.22.2 File surface of flat for trueness
2.22.3 Mark the surfaces as per dimensions
2.22.4 Perform cutting with hack saw as per marked lines
2.22.5 Smooth the surfaces with file
2.22.6 Assemble the two pieces

3.0. Forging Shop

Upon successful completion of this unit, students will be able to

Theory (The equipment will be demonstrated and explained in the lab.):

3.1 List various tools used in black-smithy.
3.2 List equipment used in a forging shop.
3.3 Explain the important smithy operations.
3.4 Explain the working principle of machine forging.
3.5 Explain machine forging operations such as upsetting, drawing down and punching with legible sketch.
3.6 Explain the working principle of forging press with legible sketch.
3.7 List the forging defects.

Practical:

3.8. Conversion of Round to Square

3.8.1 Identify the holding and striking tools
3.8.2 Heat the specimen to the appropriate temperature
3.8.3 Remove the specimen and hold it on the anvil
3.8.4 Hammer the specimen to the required shape

3.9. Conversion of Round to Hexagon

3.9.1 Identify the holding and striking tools
3.9.2 Heat the specimen to the appropriate temperature
3.9.3 Remove the specimen and hold it on the anvil
3.9.4 Hammer the specimen to the required shape

3.10. Preparation of a Chisel from round rod

3.10.1 Identify the holding and striking tools
3.10.2 Heat the specimen to the appropriate temperature
3.10.3 Remove the specimen and hold it on the anvil
3.10.4 Hammer the specimen to the required shape

3.11. Preparation of a ring and hook from M.S round

3.11.1 Identify the holding and striking tools
3.11.2 Heat the specimen to the appropriate temperature
3.11.3 Remove the specimen and hold it on the anvil
3.11.4 Hammer the specimen to the required shape

3.12. Preparation of a hexagonal bolt and nut

3.12.1 Identify the holding and striking tools
3.12.2 Heat the specimen to the appropriate temperature
3.12.3 Remove the specimen and hold it on the anvil
3.12.4 Hammer the specimen to the required shape

4.0. Sheet Metal Work

Upon successful completion of this unit, students will be able to

Theory (The equipment will be demonstrated and explained in the lab.):

4.1 List various marking tools in sheet metal work.

4.2 List various stakes.

4.3 List various measuring tools used in sheet metal work.

4.4 List various sheet metal joints.

4.5 Describe sheet metal operations such as shearing, bending drawing and squeezing.

4.6 Differentiate between riveting, soldering & brazing.

Practical:

4.7. Practice on cutting of sheet

4.7.1 Cut the required sheet from the stock using snip

4.7.2 Mark the dimensions on the sheet using scriber & steel rule

4.7.3 Draw the circular shapes using divider

4.7.4 Perform rough cutting of the curved shapes using chisel and finish cutting using snips

4.7.5 Cut the straight edges using straight snip

4.8. Formation of joints like grooved joint, locked groove joint

4.8.1 Cut the sheet into two halves

4.8.2 Form the flange on the sheet by folding the sheet along scribed lines using mallet & stakes

4.8.3 Perform bending edges of sheets applying moderate pressure using mallet

4.8.4 Interlock the bent edges and apply pressure with mallet to make required joint

4.9 Preparation of a rectangular open type tray

4.9.1 Draw the development of the object to be made

4.9.2 Place the pattern on the sheet

4.9.3 Mark the dimensions using scriber

4.9.4 Shear the required piece from the stock using straight snips

4.9.5 Mark the lines on the sheet to form bends

4.9.6 Strengthen the sides of sheet by single hem using hatchet stake

4.9.7 Form the sheet into desired shape using stakes

4.9.8 Seam the corners by inserting laps of the adjacent sides with single hem

4.10. Preparation of hollow cylinder

4.10.1 Draw the development of the object to be made

4.10.2 Place the pattern on the sheet

4.10.3 Mark the dimensions using scriber

4.10.4 Shear the required piece from the stock using straight snips

4.10.5 Mark the lines on the sheet to form bends

4.10.6 Strengthen the sides of sheet by single hem on top & bottom side using hatchet stake

4.10.7 Form the flat sheet into cylindrical shape by cylindrical stake and apply pressure using mallet

4.10.8 Prepare single hem on to longitudinal sides in opposite directions

4.10.9 Interlock the sides and apply pressure to make a strong joint

4.11. Preparation of pipe elbow

4.11.1 Draw the development of a cylindrical pipe truncated at an angle of 450 on one side

4.11.2 Cut the sheet over the marked dimensions using curved snips

4.11.3 Form the sheet into cylindrical shape using stakes

4.11.4 Seam the sides of two pipes using mallet

4.11.5 Seam the two pipes

4.11.6 Solder the joint to make leak proof

4.12 Preparation of funnel

4.12.1 Draw the development of upper and bottom conical parts

4.12.2 Place the pattern on the sheet and cut to required size

4.12.3 Form the sheet into conical shape using appropriate stake and mallet

4.12.4 Seam the top conical part and bottom conical part to obtain required funnel

4.13. Preparation of utility articles such as dust pan, kerosene hand pump

4.13.1 Draw the development of given dust pan

4.13.2 Scribe the lines on the sheet and cut to required size

4.13.3 Hem all the four sides to strengthen the edges

4.13.4 Form the sheet into designed shape using suitable stakes and mallet

4.13.5 Solder the corner lap joints to make the required dust pan

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3		2	2			1	1		
CO2	3		2	2			1	1		
CO3	3		2	2			1	1		
CO4	3		2	2			1	1		
CO5	3		2	2			1	1		
AVG	3		2	2			1	1		

COURSE CONTENTS

1.0 Introduction & Carpentry

Introduction

Methods of manufacturing processes - casting, forming, metal removal processes, joining processes, surface finishing processes, basic workshop processes - carpentry, fitting, hand forging, machine forging, sheet metal work, cold and hot working of metals.

Carpentry

Theory (The equipment will be demonstrated and explained in the lab.):

Marking & measuring tools: scales, rules, , flexible measuring rule (tape), straight edge, try square, bevel square, combination square, marking knife, marking gauge, mortise gauge, cutting gauge, wing compass, trammel, divider, spirit level, plum bob, specifications- uses.

Cutting Tools: **Saws:** ripsaw, cross cut saw (hand saw), panel saw, tenon or back saw, dovetail saw, bow saw, coping saw, compass saw, pad or keyhole saw, specifications & uses. **Chisels:** Firmer chisel, bevelled edge firmer chisel, parting

chisel, mortise chisel, inside and outside gauges, specifications and uses. **Planes:** Jack plane (wooden jack plane, metal jack plane.
Striking tools: Hammers - Warrington hammer, claw hammer, mallet, Specifications & uses.
Holding devices: Bench vice, bench stop, bench hold fast, sash cramp (bar cramp) G- cramp, Hand screw, specifications & uses.
Carpentry Processes : Marking, measuring, sawing, chiselling, planning, grooving, Rebating.
Carpentry joints: Halving Joint, mortise and tenon joint, butt joint. dowel joint, tongue & groove joint, screw & slot joint, dovetail joint, corner joint.
Wood working machines: Wood working lathe (wood turning lathe), circular saw, band saw, wood planer, sanding machine, belt sander, spindle sander, disc sander and grinder, specifications and uses.
Practicals:
1.1 Cutting of wood with hand saw.
1.2 Planning of wood.
1.3 Planning and chiselling of wood.
1.4 Preparation of dovetail joint.
1.5 Mortise and tenon joint.
1.6 Wood turning on a lathe.
1.7 Preparation of one household article.

2.0. Fitting
Theory (The equipment will be demonstrated and explained in the lab.):
Cutting tools: Files: Different parts of a file – sizes and shapes - flat file, hand file, square file, pillar file, round file, triangular file, half round files, knife edge file, needle file – specifications and uses.**Scrapers:** Flat, triangular, half round scrapers, specifications **&** uses. **Saws:** Hand hacksaw - solid frame, adjustable frame, specifications & uses, hand hacksaw blades. Power hack saw –description (horizontal reciprocating type), power hacksaw blade, specifications and uses, teeth set - saw material. **Reamer:** Hand reamer, machine reamer, straight and spiral flutes reamers, specifications and uses. **Taps:** Hand taps - taper tap, plug tap and bottoming tap, specifications and uses.
Striking Tools: Hammers: Parts, ball peen, cross peen, straight peen hammers, soft hammer, sizes, specifications and uses.
Marking Tools: Surface plate, V-block, angle plate, try square, scriber, punch, prick punch, centre punch, number punch, letter punch, specifications and uses.
Miscellaneous Tools: Screw drivers, spanners, single ended & double ended, box type, adjustable spanners, cutting pliers, nose pliers, allen keys, specifications and uses.
Checking and measuring instruments: Checking instruments: Callipers: Outside & Inside callipers, hermaphrodite (odd leg) calliper with firm joint, spring callipers, transfer calliper sizes & uses, dividers - sizes & uses**.**
Fitting Operations: Marking, sawing, chipping, filing, scrapping, grinding, drilling, reaming, tapping and dieing.
Work holding devices:Vices: Bench vice, leg-vice, hand vice, pin vice, tool makers vice, pipe vice, care of vices, specifications and uses.
Drilling: Type of drilling machines: sensitive & radial drilling machines, their constructional details and specifications. **Drill bits**: Terminology - geometry of twist drill – functions of drill elements.
Types of drills: Flat drill, straight fluted drill, twist drill, parallel shank, tapered shank, specifications &uses. **Operations:** Drilling, reaming, boring, counter boring,

counter sinking, tapping, spot facing and trepanning. **Jigs and Fixtures:** Types of jigs and fixtures –Differentiate jigs and fixtures.

Practicals:

2.1 Marking and chipping on Mild – steel flat 12 mm thick.

2.2 Cutting with hack saw, M.S. Flats of 6 mm thick.

2.3 Drilling, chamfering on a MS flat of 12 mm thick

2.4 Tapping and Dieing on a MS flat of 12 mm thick

2.5 Assembling of two pieces, Matching by filing (6 mm thick M.S. Plate)

3.0. Forging

Theory (The equipment will be demonstrated and explained in the lab.):

Hand forging tools: Anvil, swage block, hand hammers - types; sledge hammer, specifications and uses, tongs - types, specifications & uses, chisel - hot & cold chisels specifications & uses. swages - types and sizes, fullers, flatters, set hammer, punch and drift - sizes and uses.

Equipment: Open and closed hearth heating furnaces, hand and power driven blowers, open and stock fire, fuels-charcoal, coal, oil gaseous fuels.

Smith Operations: Upsetting, drawing down, setting down, punching, drifting, bending, welding, cutting, swaging, fullering and flattering.

Machine Forging: Need of machine forging, forging hammers - spring hammer, pneumatic hammer, drop hammer, forging press, hydraulic press - line diagram, machine forging operations - drawing, upsetting, punching, tools used in machine forging.

Forging defects: Types and remedies.

Practicals:

3.1 Conversion of round to square.

3.2 Conversion of round to Hexagon.

3.3 Preparation of chisel from round rod.

3.4 Preparation of ring and hook from M.S. round.

3.5 Preparation of a hexagonal bolt and nut.

4.0. Sheet Metal Work

Theory (The equipment will be demonstrated and explained in the lab.) :

Metals used for sheet metal work.

Sheet metal hand tools: **Measuring tools** - steel rule, circumference rule, thickness gauge, sheet metal gauge, straight edge, scriber, divider, trammel points, punches, chisels, hammers, snips or shears, straight snip, double cutting shear, squaring shear, circular shear, bench & block shears. **Stakes:** Double seaming stake, beak horn stake, bevel edged square stake, Hatchet stake, needle stake, blow horn stake, hollow mandrel stake, pliers (flat nose and round nose), grocers and rivet sets, soldering iron, specifications & uses.

Sheet Metal Operations: **Shearing:** Cutting off, parting, blanking, punching, piercing, notching, slitting, lancing, nibbling and trimming. **Bending:** Single bend, double bend, straight flange, edge hem, embossing, beading, double hem or lock seam. **Drawing:** Deep drawing, shallow or box drawing. **Squeezing:** Sizing, coining, hobbing, ironing, riveting.

Sheet Metal Joints: Hem Joint: single hem, double hem & wired edge, seam joint -lap seam, grooved seam, single seam, double seam, dovetail seam, burred bottom seam or flanged seam.

Fastening Methods: Rivetting, soldering, brazing & spot welding.

Practical:

4.1 Practice on cutting of sheet
4.2 Formation of joints like grooved joints, locked groove joint
4.3 Preparation of a rectangular open type tray
4.4 Preparation of hollow cylinder
4.5 Preparation of pipe elbow
4.6 Preparation of funnel
4.7 Preparation of utility articles such as dustpan, kerosene hand pump.

REFERENCE BOOKS

1. Production Technology by Jain & Gupta (Khanna Publishers)
2. Elementary Workshop Technology by Hazra Chowdary& Bhattacharya (Media Promoters)
3. Manufacturing Technology(Vol I) by P NRao (Mc Graw Hill)
4. Workshop Technology Vol I & II by Raghuvamshi
5. Workshop Technology by R.S. Khurmi & J.K.Gupta

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From Experiment 1
Unit Test-II	From Experiment 2
Unit Test-II	From Experiment 3 & 4

PHYSICS LAB

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME109L	Physics Lab	3	90	20	30	1.5

Note: For the Physics laboratory, half of the first-year students of each programme will attend, while the remaining half will attend the Chemistry laboratory. Thus, both laboratories will be engaged simultaneously during the 3-hour lab session.

TIME SCHEDULE

S. No	List of experiments	No. of Periods	COs
1.	Vernier calipers	03 + 03	CO1
2.	Micrometer (Screw gauge)	03 + 03	
3.	Verification of Lami's theorem using concurrent forces	03 + 03	
	Revision	03 + 03	
4.	Determination of 'g' using simple pendulum	03 + 03	CO2
5.	Focal length and focal power of convex lens by distant object method and U-V method	03 + 03	
6.	Verification of Boyle's law using Quill tube	03 + 03	
	Revision	03 + 03	
7.	Drawing of magnetic lines of force	03 + 03	CO3
8	Resonance apparatus–Determination of velocity of sound in air	03 + 03	
9	Refractive index of a solid using travelling microscope	03 + 03	
	Revision	03 + 03	
	Experiments for demonstration		
10	Meter bridge–Determination of resistance and specific resistance of material of given wire	03 + 03	CO4
11	Projectile motion- study the range of a projectile for different launch angles	03 + 03	
12	Generation of Beats using water columns	03 + 03	
	Total:	**45+ 45**	

COURSE OBJECTIVES

Upon completion of the course the student shall be able to

(1)	Apply practical physics principles to operate, troubleshoot, and optimize engineering devices.
(2)	Develop scientific skills through designing, conducting, and evaluating industry-relevant experiments to enhance technical proficiency.

COURSE OUTCOMES

CO1	ME109.1	Apply measurement techniques to improve accuracy; Explain forces maintaining equilibrium in physical systems.
CO2	ME109.2	Determine acceleration due to gravity experimentally; Investigate refraction of light at curved surfaces; Relate the gas pressure to volume variations at constant temperature.
CO3	ME109.3	Analyze the combined effect of magnetic fields (Earth and artificial magnet); Determine velocity of sound in air using resonance; Demonstrate U-V method to understand the refraction of light at curved surfaces.
CO4	ME109.4	Apply Kirchhoff's laws to compute the resistivity of a wire; Examine the projectile motion parameters; Observe and Interpret beat generation phenomenon.

LEARNING OUTCOMES

Upon completion of the course the student shall be able to

1. Apply measurement techniques using Vernier Calipers to determine the volumes of a cylinder and a sphere.
2. Use a screw gauge to measure and determine the thickness of a glass plate and the cross-sectional area of a wire.
3. Verify Lami's Theorem by analysing a system of concurrent forces.
4. Conduct simple pendulum experiment to calculate the acceleration due to gravity (g) and interpret the result through an L–T^2 graph.
5. Determine the focal length and power of a convex lens using distant object method and U–V method, and compare the results.
6. Verify Boyle's Law using a Quill tube by noting pressure (P) and length of air column(L).
7. Illustrate the behaviour of lines of magnetic field around a bar magnet using magnetic compass.
8. Determine the velocity of sound in air at room temperature and at 0°C using resonance apparatus.
9. Determine the refractive index of a solid by usingthe measurements taken with a travelling microscope.
10. Demonstrate the use of a meter bridge to determine the resistance and specific resistance of a given wire.
11. Simulate projectile motion and observe the range of the projectile for different launch angles using appropriate experimental setup.

12. Demonstrate the phenomenon of beats by creating beat patterns using water columns.

CO-PO/PSO MATRIX

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	1	1	1	1	1	1
CO2	3	1	1	1	1	1	1
CO3	3	1	1	1	1		1
CO4	3	1	1	2	1		1
Average	3	1	1	1.25	1	1	1

COURSE CONTENT

Name of the Experiment	**Competencies (Revised Bloom's Taxonomy)**	**Key Competencies (Revised Bloom's Taxonomy)**
1. Practice on Vernier Calipers	• Determine the least count • Place the object in accurate position. • Interpret scale readings • Calculate volume of cylinder and sphere	• Interpret Vernier readings • Compute volume using appropriate formulae • Apply measurement data to calculate physical quantities
2. Practice on Screw Gauge	• Determine the least count and zero error • Place the object in accurate position. • Interpret scale readings • Calculate thickness and cross-sectional area	• Analyze scale readings for zero error • Compute thickness and area from measurements • Apply micrometer data to solve practical problems
3. Verification of Lami's Theorem	• Setup experimental arrangement • Apply appropriate weights • Measure angles between forces • Analyze data to verify theorem	• Interpret directions and angles of forces • Evaluate force relationships • Validate Lami's Theorem using experimental data
4. Simple Pendulum	• Arrange the pendulum properly • Measure the time taken for 20 oscillations	• Measure oscillation intervals accurately • Calculate g using experimental data

	• Compute time period and acceleration due to gravity • Plot L–T^2 graph	• Interpret L–T^2 graph to confirm relationship
5. Focal Length and Power of Convex Lens	• Place the object and convex lens in proper positions. • Measure image distance • Compute focal length and power	• Determine focal length using both methods • Validate optical formulae using experiment
6. Boyle's Law Verification	• Record atmospheric pressure • Measure air column length and calculate the enclosed pressure • Analyze data for PxL consistency	• Setup quill tube in different positions for multiple readings • Interpret pressure–length data
7. Drawing of Magnetic Lines of force	• Draw meridian and set magnet orientation • Sketch the lines of magnetic field using compass.	• Visualize field pattern accurately • Analyze field symmetry
8. Velocity of Sound – Resonance Method	• Assemble apparatus and adjust reservoir • Identify resonating lengths • Calculate velocity of sound at room temperature and at 0^oC.	• Detect resonance points • Compute velocity using resonance data • Extrapolate to standard temperature
9. Refractive Index of a solid using Traveling Microscope	• Determine least count • Measure real and apparent thickness • Calculate refractive index	• Analyze scale readings • Apply refraction formula • Interpret refractive index of a solid.
10. Meter Bridge	• Connect circuit properly • Measure balancing length, radius of given wire • Compute resistance and specific resistance	• Analyze circuit behavior • Calculate unknown resistance • Interpret experimental values for resistivity
11. Projectile motion-study the range of a projectile for different launch angles	• Setup and align launcher • Adjust launch angles • Measure range	• Observe the variations in horizontal range for different angles of projection. • Evaluate trajectory data

12. Generation of Beats using water columns	• Setup beat source using glasses or online tone generator • Generate close frequencies • Detect and analyze beat pattern	• Observe frequency interference • Interpret beat frequency data • Analyze patterns using mobile sensors/ software

SCHEME OF VALUATION FOR END PRACTICAL EXAMINATION

Activity	Marks
Aim, Apparatus, Formulae	6
Tabulations and Readings	12
Calculations	4
Precautions, Results	3
Viva-voce	5
Total marks	**30**

REFERENCES

1. NCERT Physics Laboratory manual for Class XI
2. NCERT Physics Laboratory manual for Class XI
3. Experiments in Physics: A Laboratory manual by Daryl W Preston, Joseph W. Kane, Morton M. Sterheim

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From Experiment 1 to 3
Unit Test-II	From Experiment 4 to 6
Unit Test-II	From Experiment 7 to 9

CHEMISTRY LAB

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME110L	Chemistry Lab	3	90	20	30	1.5

Note: For the Physics laboratory, half of the first-year students of each programme will attend, while the remaining half will attend the Chemistry laboratory. Thus, both laboratories will be engaged simultaneously during the 3-hour lab session.

TIME SCHEDULE

S. No.	Name of the Experiment	No. of Periods	COs Mapped
1.	Introduction to Fundamentals of Analytical Chemistry.	03+03	CO1
2.	Chemical Recognition by Sensory Cues.	03+03	CO1
3.	Preparation of Standard Na_2CO_3 Solution.	03+03	CO1
4.	Estimation of HCl Using Standard NaOH Solution.	03+03	CO2
5.	Determination of Alkalinity of Water Sample.	03+03	CO2
	Revision	03+03	
6.	Estimation of Mohr's Salt Using Standard $KMnO_4$ Solution.	03+03	CO3
7.	Determination of Total Hardness of Water Using Standard EDTA Solution.	03+03	CO4
8.	Estimation of Chlorides Present in Water Sample Using Standard $AgNO_3$ Solution.	03+03	CO4
9.	Analyzing pH of Common Compounds Using Visual and Instrumental Methods.	03+03	CO5
	Revision	03+03	
	Demonstration Experiments		
10.	Demonstration of Copper Deposition on an Object by Using Electrolysis Process.	03+03	CO5
11.	Demonstration of Construction and Working of a Galvanic Cell.	03+03	CO5
12.	Open Ended Experiments/Micro Projects – I.	03+03	CO5
13.	Open Ended Experiments/Micro Projects – II.	03+03	CO5
	TOTAL	**45+45**	

COURSE OBJECTIVES

Upon completion of the course, student shall be able to:	
(i)	Perform fundamental analytical chemistry techniques, identify chemical substances using sensory cues and accurately prepare standard solutions.
(ii)	Evaluate and judge the neutralization point in acid base titration.
(iii)	Evaluate the endpoint of reduction and oxidation reaction.
(iv)	Judge the stable end point of complex formation, stable precipitation.
(v)	Determine the pH of compounds, demonstrate copper deposition using electrolysis, and the working of a galvanic cell.

COURSE OUTCOMES

CO1	ME110.1	Perform fundamental analytical chemistry techniques, identify chemical substances using sensory cues and accurately prepare standard solutions.
CO2	ME110.2	Evaluate and judge the neutralization point in acid base titration.
CO3	ME110.3	Evaluate the endpoint of reduction and oxidation reaction.
CO4	ME110.4	Judge the stable end point of complex formation, stable precipitation.
CO5	ME110.5	Determine the pH of compounds, demonstrate copper deposition using electrolysis, demonstrate the working of a galvanic cell.

LEARNING OUTCOMES

Upon completion of the course the student shall be able to:

1.0 Practice volumetric measurements (using pipettes, measuring jars, volumetric flask, burettes) and gravimetric measurements (using different types of balances), making dilutions, etc.

2.0 Identify the chemical compounds and solutions by senses.

3.0 Practice making standard Na_2CO_3 solutions.

4.0 Conduct titrations adopting standard procedures and using standard NaOH solution for estimation of HCl.

5.0 Conduct titrations adopting standard procedures to determine the alkalinity of given samples of water (one ground water and one surface / tap water) using standard H_2SO_4 solution.

6.0 Conduct titrations adopting standard procedures and using standard $KMnO_4$ solution for estimation of Mohr's Salt.

7.0 Conduct titrations adopting standard procedures to determine the total hardness of given samples of water (one ground water and one surface / tap water) using standard EDTA solution.

8.0 Conduct titrations adopting standard procedures to determine the chlorides present in the given samples of water (one ground water and one surface / tap water) and waste water by using standard $AgNO_3$ solution.

9.0 Conduct the test on given samples of water / solutions (like soft drinks, sewage etc.,) to determine their pH using pH paper, Universal indicator, digital pH meter.

10.0 Demonstrate the electrolysis process of Copper deposited on an object.

11.0 Understand the construction and working principle of a Galvanic cell and identify how chemical energy is converted into electrical energy through redox reactions.

12.0 Collect water sample from nearby water body and test for any two parameters **[Parameters – Alkalinity, Hardness, Chloride and pH].**

13.0 Collect water sample from nearby sewage/industrial effluent and test for any two parameters. **[Parameters – Alkalinity, Hardness, Chloride and pH]**

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2		1			1			
CO2	3	2		1						
CO3	3	2		1						
CO4	3	2		1	1					
CO5	3	2	1	1	1		1			
Average	3	2	1	1	1		1			

Competencies and Key Competencies to be Achieved by the Student

Name of the Experiment (No of Periods)	**Competencies**	**Key Competencies**
Introduction to Fundamentals of Analytical Chemistry. (03)	• Develop a foundational understanding of analytical chemistry principles and demonstrate proficiency in basic laboratory techniques, data analysis, and safety protocols.	• Students will master the foundational principles and laboratory techniques of analytical chemistry.

Name of the Experiment (No of Periods)	Competencies	Key Competencies
Chemical Recognition by Sensory Cues. (03)	• Develop skills in conducting simple tests and making accurate observations. • Interpret results to draw conclusions about the nature of chemical compounds.	• Develop skills in conducting simple tests and making accurate observations. • Interpret results to draw conclusions about the nature of chemical compounds.
Preparation of Standard Na_2CO_3 Solution. (03)	• Weighing the salt to the accuracy of 0.01mg • Measuring the water with volumetric flask, measuring jar, volumetric pipette and graduated pipette.	• Weighing the salt to the accuracy of 0.01 mg. • Measuring the water with volumetric flask, measuring jar, volumetric pipette and graduated pipette.
Estimation of HCl Solution Using Standard NaOH Solution. (03)	• Cleaning the glass ware and rinsing with appropriate solutions. • Making standard solutions. • Measuring accurately the standard solutions and titrants. • Filling the burette with titrant. • Fixing the burette to the stand • Effectively controlling the flow of the titrant. • Identifying the endpoint. • Making accurate observations. • Calculating the results.	• Making standard solutions. • Measuring accurately the standard solutions and titrants. • Effectively controlling the flow of the titrant. • Identifying the endpoint. • Making accurate observations.
Determination of Alkalinity of Water Sample (03)		
Estimation of Mohr's Salt Using Standard $KMnO_4$ Solution. (03)		
Determination of Total Hardness of Water Using Standard EDTA Solution. (03)		

Name of the Experiment (No of Periods)	Competencies	Key Competencies
Estimation of Chlorides Present in Water Sample by Using Standard $AgNO_3$ Solution. (03)		
Analyzing pH of Common Compounds Using Visual and Instrumental Methods. (03)	• Know pH range (0 – 14) and classify substances as acidic, neutral and basic. • Accurately measure pH using pH paper and universal indicator. • Note color changes and interpret pH values correctly. • Perform precise pH tests to ensure reliable results. • Record pH data and observations clearly. • Connect pH results to real-world contexts. • Familiarize with instrument. • Choose appropriate 'Mode'/ 'Unit'. • Prepare standard solutions/buffers, etc. • Standardize the instrument with appropriate standard solutions. • Make measurements accurately.	• Accurately measure pH using pH paper and universal indicator. • Perform precise pH tests to ensure reliable results. • Prepare standard solutions/buffers, etc. • Standardize the instrument with appropriate standard solutions. • Make measurements accurately.
Demonstration of Copper Deposition on an Object by Using Electrolysis Process. (03)	• Prepare standard solutions. • Selection of electrodes. • Set up and perform an electrolysis experiment accurately and safely. • Analyze the deposition of Copper on an object.	• Set up and perform an electrolysis experiment accurately and safely. • Analyze the deposition of Copper on an object.
Demonstration of Construction and Working of Galvanic Cell.(03)	• Prepare standard solutions. • Selection of electrodes. • Making of salt bridge. • Construct a simple galvanic cell using appropriate electrodes and electrolyte solutions. • Explain the working principle of a galvanic cell, including electron flow, redox reactions,	• Construct a simple galvanic cell using appropriate electrodes and electrolyte solutions. • Explain the working principle of a galvanic cell, including electron flow, redox reactions, and the function of the salt bridge.

Name of the Experiment (No of Periods)	Competencies	Key Competencies
	and the function of the salt bridge	
Open Ended Experiments /Micro Projects – I. (03) Open Ended Experiments/ Micro Projects – II. (03)	• Identifies a relevant chemical problem or question based on prior knowledge. • Demonstrates proficiency in basic chemistry lab techniques (e.g., titration, preparation). • Prepares solutions accurately (Molarity, dilutions, standardizations). • Handles chemicals safely following MSDS guidelines and standard lab practices. • Uses instruments relevant to the experiment (e.g., pH meter, and digital balance) correctly. • Calibrates and maintains instruments when needed. • Interprets instrumental output with understanding of underlying chemical principles. • Makes accurate, timely and detailed observations of chemical reactions (e.g., color changes, precipitate formation). • Records quantitative and qualitative data systematically. • Maintains an organized and complete lab notebook. • Works effectively in pairs or groups; shares responsibilities and discusses findings collaboratively. • Presents results through oral discussion, lab reports, or visual presentations using proper chemical terminology.	• Prepares solutions accurately (Molarity, dilutions, standardizations). • Uses instruments relevant to the experiment (e.g., pH meter, and digital balance) correctly. • Calibrates and maintains instruments when needed. • Makes accurate, timely and detailed observations of • chemical reactions • (e.g., color changes, precipitate formation).

REFERENCE BOOKS

1. VOGEL's Textbook of Quantitative Analysis, Sixth Edition, Pearson Education Limited.
2. VOGEL's Textbook of Qualitative Analysis, Seventh Edition, Pearson Education Limited.
3. Y. Bharathi Kumari & Jyotsna Cherukuri - Laboratory Manual of Engineering Chemistry for Engineering Students of JNT Universities.
4. Instrumental Methods of Chemical Analysis.
5. NCERT Chemistry Laboratory Manual for Class XII.
6. Practical Chemistry by the Royal Society of Chemistry Education.

SCHEME OF VALUATION FOR END PRACTICAL EXAMINATION

Activity	Marks
Aim, Apparatus, Formulae	6
Tabulations and Readings	12
Calculations	4
Precautions, Results	3
Viva-voce	5
Total marks	**30**

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From Experiment 1 to 3
Unit Test-II	From Experiment 4 to 6
Unit Test-II	From Experiment 7 to 9

COMPUTER & DIGITAL SKILLS LAB

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME111L	COMPUTER & DIGITAL SKILLS LAB	03	90	40	60	3

TIME SCHEDULE

Chapter No.	Chapter/Unit Title	No of sessions each of 3 periods duration	No of Periods	CO's Mapped
1.	Computer hardware and Software Basics	1	3	CO1
2.	Windows Operating System	1	3	CO1
3.	MS Word	6	18	CO2
4.	MS Excel	7	21	CO3
5.	MS Power Point	6	18	CO4
6.	AI, ML & Quantum computing Tools	9	27	CO5
Total periods		**30**	**90**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	familiarize with basics of Computer Hardware and Software
2	familiarize operating systems
3	Familiarize with Microsoft word
4	Familiarize with Microsoft Excel
5	familiarize with Microsoft Power point
6	familiarize with AI, ML, Quantum Computing Tools

COURSE OUTCOMES

CO1	ME111.1	Identify hardware and software components
CO2	ME111.2	Prepare documents with given specifications using word processing software
CO3	ME111.3	Use Spread sheet software to make calculation and to draw various graphs/charts.
CO4	ME111.4	Use Power point software to develop effective presentation for a given theme or topic.
CO5	ME111.5	To use basic AI ,ML& Quantum Computing Tools

LEARNING OUTCOMES

I. Computer Hardware and Software Basics

1. To get familiarized with Computer system and hardware connections
   b). To start and Shut down Computer correctly
   c). To explore Windows Desktop
2. To check the software details of the Computer
3. To check the hardware present in your computer

II. Windows's operating system

4. To work with Files and Folders
5. To use Windows Accessories: Calculator –Notepad –WordPad–MS Paint

III. MS-WORD

6. To get familiarized with Ribbon layout of MSWord.
7. To perform basic word processing
8. To use basic formatting techniques
9. To insert a table of required number of row sand columns
10. To insert Objects, Clipart and Hyperlinks
11. To use Mail Merge feature of MS Word
12. To use Equations and symbols features

IV. MS-EXCEL

13. To get familiarized with MS-EXCEL ribbon layout
14. To access and enter data in the cells
15. To edit a spread sheet-Copy, Cut, Paste, and selecting Cells
16. To use built in functions and Data Formatting
17. To create Excel Functions, use auto fill feature
18. To enter a Formula for automatic calculations
19. To sort and filter data in sheet.
20. To present data using Excel Graphs and Charts.
21. To format a Work sheet in Excel for printing using Page layout
22. To develop lab report formats of respective discipline.

V. Practice with MS-POWERPOINT

23. To get familiarized with Ribbon layout features of Power Point.
24. To create a simple Power Point Presentation
25. To set up a Master Slide in Power Point

26. To insert Text and Objects
27. To insert Flow Charts
28. To insert Tables
29. To insert Charts/Graphs
30. To insert video and audio
31. To animate text, objects and slides.
32. To Review Presentations

VI. AI,ML & Quantum Computing Tools

33. To get familiarized with AI Tools
34. To get familiarized with working of Chat GPT
35. Identify Objects using AI Tools based on CNN, YOLO, SSD,R-CNN
36. To paraphrase text using AI Tools (PEGASUS,GPT, T5)
37. To use text-to-Image Generation AI Tools (DALL-E,MID JOURNEY)
38. To use voice command simulation AI Tools (SPEECH-TO-TEXT)
39. To get familiarized with ML Tools
40. To get familiarized with Quantum Computing Tools
41. To familiarize with quantum bits (qubits) using Dirac notation
42. To familiarize the behavior of single and multiple qubit gates.
43. To familiarize with Qubit as a Coin / Spin Analogy

Key competencies:

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
1 (a).	To get familiarized with Computer system and hardware connections	a. Connect cables to external hardware and operate the computer	a. Identify the parts of a computer system: i). CPU ii). Mother Board iii) Monitor iv) CD/DVD Drive v) Power Switch vi) Start Button vii) Reset Button viii) RAM ix) SSD /HDD b. Identify and connect various peripherals c. Identify and connect the cables used with computer system d. Identify various ports on CPU cabinet and connect Keyboard, Mouse and peripherals
1(b).	Start and Shut down Computer correctly	a. Login and logout as per the standard procedure b. Operate mouse & Key Board	a. Login using the password b. Start and shut down the computer c. Use Mouse and Key Board

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
1 (c).	Explore Windows Desktop	a. Access application programs using Start menu b. Use taskbar and Task manager	a. Familiarity with Start Menu, Taskbar, Icons and Shortcuts b. Access application programs using Start menu, Task manager c. Use Help support
2.	Check the software details of the computer System	a. Access the properties of computer and to find the details	a. Finding the details of operating system being used b. Finding the details of edition/version Service Pack installed
3.	Check the hardware present in your computer	a. Access device manager and to find the details b. Type /Navigate the correct path and Select icon related to the details required	a. Finding the CPU name and clock speed b. Finding the details of RAM and hard disk present c. Accessing Device manager using Control Panel and check the status of devices like mouse and key board c. Using My Computer to check the details of Hard drives and partitions
4.	Working with Files and Folders	a Create files and folders b Rename, arrange and search for the required folder/file c Restore deleted files from Recycle bin	a. Create folders and organize files indifferent folders b. Use cut, copy and paste commands to organize files and folders c. Arrange icons by name, size, type and Modified d. Search for a file or folder and find its path e. Create short cut to files and folders (in other folders) on Desktop f. Familiarity with the use of My Documents g. Familiarity with the use of Recycle Bin
5.	Use Windows Accessories like Calculator– Notepad– WordPad –MS Paint	a. Use windows accessories and select correct text editor based on the situation. b. Use MS paint to create /Edit pictures	a. Access Calculator using Run command b. Familiarity with the use of Calculator c. Create Text Files using Notepad, WordPad and observe the difference in file sizes

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
		and save in the required format	d. Use MS paint to create .jpeg, .bmp files
6.	Get familiarized with Ribbon layout of MS word.	a. Create a Document and name appropriately and save it b. Set paper size and print options	a. Create/Open a document b. Use Save and Save as features c. Work on two Word documents simultaneously d. Choose correct Paper size and Printing options
7.	Perform basic Word Processing	a. Use key board and mouse to enter/edit text in the document. b. Use short cuts c. use Spell /Grammar Check features for auto corrections	a. Typing text b. Keyboard usage c. Mouse Usage (Left click/Right click/Scroll) d. Using Keyboard shortcuts e. Using Find and Replace features in MS-word f. Use Undo and Redo Features e. Use spell check to correct Spellings and Grammar
8.	Use basic formatting techniques	a. Format Text and paragraphs and using various text styles. b. Use bullets and numbers to create lists. c. Use Templates/Themes d. Insert page numbers, date, headers and footers	a. Formatting Text b. Formatting Paragraphs c. Setting Tabs d. Formatting Pages e. Use various Font Styles f. Insert bullets and numbers g. Using Themes and Templates h. Insert page numbers, header and footer
9.	Insert a table of required number of rows and columns	a. Insert table in the word document and edit b. Use sort option for arranging data.	a. Editing the table by adding the fields, deleting rows and columns, inserting sub table, marking borders. Merging and splitting of cells in a Table b. Changing the back ground color of the table c. Using table design tools d. Using auto fit – fixed row/column height/length –

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
			Even distribution of rows /columns feature e. Converting Text to table and Table to Text f. Use Sort feature of the Table to arrange data in ascending/descending order
10.	Insert objects, clipart and Hyperlinks	a. Insert hyperlinks & Bookmarks b. Create organization charts/flow charts	a. Creating a 2-page document and Insert hyperlinks and Bookmarks. b. Creating an organization chart c. Preparing an Examination schedule notice with a hyper link to Exam schedule table.
11.	Use Mail merge feature of MSWord	a. Using Mail merge feature	a. Using mail merge to prepare individually addressed letters d. Using mail merge to print envelopes.
12.	Use Equations and symbols features.	a. Enter Mathematical symbols and Equations in the word document	a. Exploring various symbols available b. Inserting a symbol in the text c. Inserting mathematical equations in the document
13.	Get familiarized with MS Excel Ribbon layout	a. Get familiarized with excel layout b. Use various features available in toolbar	a. Open /create an MS Excel spread sheet and familiarity with MS Excel layout b. Use Quick Access Tool bar, Title Bar, Worksheets, Formula Bar, Status Bar
14.	Access and Enter data in the cells	a. Access and select the required cells by various addressing methods b. Enter and edit data	a. Moving around a Work sheets using Quick access toolbar Selecting Cells, Entering Data-Editing a Cell, Wrapping of Text-Deleting a Cell Entry, saving a File, Closing Excel
15.	Edit spread sheet select, Copy, Cut, Paste	Format the excel sheet	a. Inserting and Deleting Columns and Rows b. Creating Borders c. Merging and aligning center d. Adding back ground Color Changing the Font, Font Size, and Font Color e. Formatting text with Bold,

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
			Italicize, and Underline f. Working with Long Text, Change a Column's Width
16.	Use built in functions and Format Data	Use built in functions in Excel	a. Performing Mathematical Calculations b. Verification AutoSum c. Perform Automatic Calculations d. Aligning Cell Entries
17.	Enter a Formula for automatic calculations	Enter formula for automatic calculations	a. Entering formulae b. Using Cell References in Formulae c. Using Automatic updating function of Excel Formulae d. Using Mathematical Operators in Formulae d. Using Excel Error Message and Help
18.	Create Excel Functions, Fill Cells	a. To Create Excel sheets involving cross references and equations b. Using the advanced functions for conditional calculations	a. Using Reference Operators b. Working with sum, Sum if, Count and Count If Functions c. Filling Cells Automatically
19.	Sort and filter data in sheet.	a. Refine the data in a worksheet and keep it organized b. Narrow a worksheet by selecting specific choice	a. Sorting data in multiple columns b. Sorting data in a row c. Sorting data using Custom order d. Filter data in work sheet
20.	Practice Excel Graphs And Charts	a. Use data in Excel sheet to Create technical charts and graphs b. Prepare various graphs from data.	a. Using data in sheets for getting charts. b. Producing various charts.
21.	Format a and print features Work sheet in	Format Excel sheet a. Insert headers &footers and print	a. Shading alternate rows of data b. Adding currency and percentage symbols c. Changing height of a row and

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
	Excel, use page setup		width of a column d. Changing data alignment e. Inserting Headers and Footers f. Set Print Options and Printing.
22.	Develop lab report formats of respective discipline	Use Headers/Footers/Page Numbers for preparing reports	a. Creating Lab reports using MS Excel
23.	Get familiarized with Ribbon layout &features of PowerPoint.	Access required options in the toolbar	Explore and use various options in PowerPoint a. Home b. Insert c. Design d. Animation e. Slideshow f. View b. Review
24.	Create a simple Power Point Presentation	a. Create simple Power Point presentation with photographs /Clip Art and text boxes Use bullets option	a. Inserting a New Slide into Power Point b. Changing the Title of a Power Point Slide c. Using Bullets in PowerPoint d. Adding an Image to a Power Point Slide e. Adding a Text box to a Power Point slide
25.	Set up a Master Slide in PowerPoint and add notes	a. Setup Master slide and format b. Add notes to master slide.	a. Creating a PowerPoint Design Template b. Modifying themes c. Switching between Slide master view and Normal view d. Formatting a Design Template for Master Slide e. Adding a Title Slide to a Design Template f. Using the Slide Show g. Adding Notes to a Power Point Presentation slide

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
26.	Insert Text and Objects	a. Insert Text and Objects b. Use 3d features	a. Inserting Text and objects b. Setting Indents and line spacing c. Inserting pictures/clipart d. Formatting pictures e. Inserting shapes and word art f. Using 3d features to g. Arrange objects
27.	Create Flow Charts /Organizational Charts	a. Create organizational Charts and flow charts using smart art	a. Creating a Flow Chart in PowerPoint b. Grouping and Ungrouping Shapes h. Use smart art
28.	Insert Tables	a. Insert tables and format	a. Using Tables in PowerPoint b. Formatting the Table Data c. Changing Table Background
29.	Insert Charts/Graphs	a. Create charts and Bar graphs, Pie Charts and format.	a. Creating 3D Bar Graphs in PowerPoint b. Working with the Power Point Datasheet c. Formatting a PowerPoint Chart Axis d. Formatting the Bars of a Chart e. Creating Power Point Pie Charts f. Using Pie Chart Segments g. Creating 2D Bar Charts in Power Point h. Formattingthe2DChart i. Formatting a Chart Back ground
30.	Insert audio & video, Hyperlinks in a slide and Add narration to the slide	a. Insert Sounds and Video in appropriate format. b. Add narration to the slide c. Use hyperlinks to switch to different slides and files	a. Inserting sounds in the slide and hide the audio symbol b. Adjusting the volume in the settings c. Inserting video file in the format supported by PowerPoint in a slide d. Using automatic and on click options e. Adding narration to the slide f. Insert Hyperlinks

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
31.	Create Animation effects	d. Add animation effects	a. Applying transitions to slides b. Using special animation effects like Entrance, Emphasis, Motion c. Paths &Exit as per requirement.
32.	Reviewing presentation	a. Use Spell and Grammar check feature b. Setup slideshow c. Add timing to the slides e. Setup automatic slide show	a. Checking spelling and grammar b. Previewing presentation c. Setting up slideshow d. Setting up resolution e. Using Rehearse Timing feature in PowerPoint f. Using PowerPoint Pen Tool During slideshow g. Saving h. Printing presentation Slides as Hand-out
33	Familiarizing with AI Tools	Introductions of AI tools and their applications. Understand the basic use cases and functionality of AI tools (like Chat GPT, Google Gemini, Teachable Machine, etc.). 1.	a) Grasping the concept of Artificial Intelligence and how tools mimic human thinking or behavior. b) Identifying and interacting with AI tools such as: **Chat GPT** (natural language processing), **Google Teachable Machine** (image/audio classification), **DALL·E / Bing Image Creator** (AI art), **Grammarly / Quillbot** (AI-based writing assistants).
34	Usage of ChatGPT	a) Introduction to ChatGPT, an AI-powered conversational assistant. b) To explore ChatGPT's capabilities in answering questions,	a) Operating the ChatGPT interface (web or app), input prompts, and interpret outputs. b) Using ChatGPT to generate summaries, ideas, code snippets, explanations, emails, etc.

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
		generating content, and solving problems.	c. Evaluating the relevance and accuracy of ChatGPT's responses.
35	Object identification using AI Tools based on CNN, YOLO, SSD, R-CNN	a. Get awareness about object detection techniques using AI. b. To explore how AI tools based on**CNN, YOLO, SSD, and R-CNN** detect and classify objects in images/videos.	a) Differentiating object detection from image classification. b) Using web-based AI tools or platforms that demonstrate object detection (e.g., Teachable Machine, Roboflow, Edge Impulse, Hugging Face Demos). c) Observing and comparing the speed, accuracy, and bounding box behavior of different models.
36	Paraphrase text using AI Tools (PEGASUS, GPT, T5)	a. Get awareness about AI-powered text paraphrasing techniques. b. To explore the usage and functioning of transformer-based models like **PEGASUS**, **GPT**, and **T5**	a) Recognizing of Natural Language Processing (NLP) tasks and how transformer models like PEGASUS, GPT, and T5 can be used. b) Using AI tools to generate reworded versions of sentences or paragraphs while retaining the original meaning. c) Interacting with user-friendly interfaces like: • Hugging Face demos • ChatGPT • Quillbot • Parrot.ai
37	Text-to-Image Generation using AI Tools (DALL-E, MIDJOURNEY)	a) Get awareness about**text-to-image generation** using advanced AI models. b) To explore the usage of tools like **DALL·E** and **Mid journey** convert text prompts into realistic or artistic images.	a. Learning usage of how AI models generate visual content from natural language prompts. b. Formulating effective, clear, and creative text prompts to generate meaningful images. c. Enhancing creative thinking by translating ideas into visual representations using AI.

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
			d. Analyzing and comparing output quality, style, and relevance between DALL·E and Mid journey.
38	Voice Command Simulation using AI Tools (SPEECH-TO-TEXT)	a. Get awareness about **Speech-to-Text (STT)** technology and its role in AI-powered voice recognition systems.	a. Using AI tools to generate text from speech. b. Reading prompts and commands to analyze how accurately the tool transcribes voice. c. Using voice to simulate commands such as opening files, dictating emails, or interacting with virtual assistants.
39	Usage of ML Tools	a) To use ML tools for suitable real-world applications b. To use **popular ML tools and platforms** through simple, hands-on demonstrations.	a. Understanding key ML terms like dataset, training, testing, classification, prediction, and accuracy. b. Learning to use beginner-friendly ML tools such as: • **Teachable Machine by Google** (image/audio recognition) • **Microsoft Lobe** (no-code image classification) • **Weka** (GUI-based ML toolkit) • **IBM Watson Studio** (visual data workflows)
40	Usage of Quantum Computing Tools	a. To explore and interact with **quantum computing simulation tools** and platforms.	a. Understanding key terms: **Qubit**, **Superposition**, **Entanglement**, **Quantum Gate**, **Quantum Circuit**. b. Navigate and use beginner-friendly quantum computing tools: • **IBM Quantum Experience (IBM Q / Qiskit)** • **Microsoft Quantum Development Kit** • **Quirk (online quantum circuit simulator)**

Exp / Task / Ex No	Name of Experiment /Task /Exercise	Objectives	Key competencies
			• **Quantum Playground by Google**
41	To familiarize with quantum bits (qubits) using Dirac notation	a) To introduce the concept of a **qubit** as the fundamental unit of quantum information. b) To understand the representation of qubits using **Dirac (bra-ket) notation**.	• Identify and interpret the basic qubit states: • $\|0\rangle = \begin{bmatrix}1\\0\end{bmatrix}$ • $\|1\rangle = \begin{bmatrix}0\\1\end{bmatrix}$ • Understand that a qubit can exist in a **superposition**: • $\|\psi\rangle = \alpha\|0\rangle + \beta\|1\rangle$, where α and β are complex numbers and $\|\alpha\|^2 + \|\beta\|^2 = 1$ a) Learn how to write and read quantum states using the kept ($\|\rangle$) and bra ($\langle\|$) notations. b) Understand the purpose of $\langle\psi\|$ and how it represents a dual vector in quantum mechanics.
42	To familiarize the behaviour of single and multiple qubit gates.	a. To understand the concept of **quantum gates** and their role in quantum circuits.	a) Recognize the function and matrix representation of: • **Single-qubit gates**: ○ **Pauli-X (NOT)**: flips $\|0\rangle \leftrightarrow \|1\rangle$ ○ **Hadamard (H)**: creates superposition ○ **Pauli-Z**: applies a phase flip • **Multi-qubit gates**: ○ **CNOT**: flips target qubit based on control ○ **Toffoli (CCNOT)**: controlled-controlled NOT **SWAP**: exchanges the states of two qubits
43	To familiarize with Qubit as a Coin / Spin Analogy	a) To introduce the concept of a **qubit** using intuitive physical analogies. b) To help students understand **quantum superposition** through the **coin toss** or **spin-½ particle** analogy.	a. Relate a **qubit in superposition** to a **coin spinning in the air**: • Classical coin: heads (0) or tails (1) • Spinning coin: both until observed ($\|0\rangle$ and $\|1\rangle$ at once) b.Use **spin analogy**: a particle with spin "up" ($\|0\rangle$) or "down" ($\|1\rangle$), or in between (superposition)

REFERENCES

1. Fundamentals of Computers – R Rajaraman, Niharika Adabala
2. Introduction to Computers – Peter Norton, 7Th Edition, McGrawHill
3. Microsoft Office (Office2012 & Microsoft 365)-John Lambert. Curis Frye by Pearson Publication
4. Introduction to MS Office by Indira Gandhi National University
5. Emerging Technologies for Engineers – Reema Thareja, Wiley Emerging Technologies Series

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1 to 12
Unit Test-II	From 3 to 32
Unit Test-II	From 33 to 43

III SEMESTER

DIPLOMA IN MECHANICAL ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
III SEMESTER

Course Code	Course Title	No. of Periods / Week		Practicum (Y/N)	Total No. of Periods /Semester	Credits	Scheme of Examination			
		Theory	Practical/ Tutorial				Duration (hours)	FA Marks	SA Marks	Total Marks
THEORY COURSES										
26ME301T	Strength of Materials	6	-	N	90	4	3	30	70	100
26ME302T	Basic Thermodynamics	6	-	N	90	4	3	30	70	100
26ME303T	Manufacturing Technology I	6	-	N	90	4	3	30	70	100
ELECTIVE COURSES										
26ME304E	Engineering Mathematics-II	3	-	N	45	2	3	30	70	100
26ME305E	Metrology & Instrumentation									
26ME306E	Advanced materials and Nano Technology									
AUDIT COURSE										
26ME307A	Basic Electrical Engineering	2	-	N	30	-	-	-	-	-
PRACTICAL COURSES										
26ME308D	Production drawing		6	N	90	2	3	40	60	100
26ME309L	Material Testing Lab		3	N	45	1.5	3	40	60	100
26ME310L	Manufacturing and Metrology Lab		7	N	105	2	3	40	60	100
26ME311L	Student Centric Activities		3	N	45	0.5	-	-	-	-
	TOTAL	**23**	**19**		**630**	**20**		**240**	**460**	**700**

Note 1: 0.5 credits will be awarded for student centric activities based on the participation in the extra Curricular activities like NSS/NCC/Clean and Green or Sports/ Games

Note 2: 26ME304E is common elective to all programmes. 26ME302T is common with 26MR302T, 26ME303T is common with 26MR303T, 26ME305E is common with 26MR305E, 26ME306E is common with 26MR306E, 26ME307A is common with 26MR307A, 26ME308D is common with 26MR308D, 26ME309L is common with 26MR309L, 26ME310L is common with 26MR310L.

STRENGTH OF MATERIALS

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
C26ME301T	Strength of Materials	06	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1	Simple Stresses and Strains	23	25	3	2	CO1
2	Strain Energy	12	11	1	1	CO2
3	Shear Force and Bending Moment Diagrams	20	22	2	2	CO3
4	Theory Of Simple Bending & Deflection of Beams	20	25	3	2	CO4
5	Torsion In Shafts and Springs	15	17	3	1	CO5
	Total	**90**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	The concepts of stress and strain and to find them in structural member viz., bars, beams, shafts for the given conditions.

COURSE OUTCOMES

CO1	ME301.1	Explain the concept of stress and strain and various constituent Relations
CO2	ME301.2	Calculate the strain energies in the bars

CO3	ME301.3	Calculate and draw the shear force and bending moment diagrams for the Cantilever and Simply Supported beams subjected to Point loads, uniformly distributed loads and Combined Loads.
CO4	ME301.4	Calculate the Flexural stresses, deflections in Cantilever and Simply Supported beams of simple cross-sections
CO5	ME301.5	Calculate the Torsional Stresses in circular shafts and Stiffness of the springs.

LEARNING OUTCOMES:

Upon the completion of course the student shall be able to

1.0 Simple Stresses and Strains

1.1 Classify various loads
1.2 Differentiate rigid body from the deformable body
1.3 Explain the Mechanical properties of Metals
1.4 Explain the concept of stress and strain
1.5 Draw the stress – strain diagrams for ductile and brittle materials subjected to tensile forces.
1.6 Define elastic constants and Poisson's ratio.
1.7 Write the expression relating the elastic constants and Poisson's ratio.
1.8 Numerical problems related to the above cases.
1.9 Calculate the stresses and strains in bars of uniform and varying cross – sections subjected to end forces only.
1.10 Define composite bar.
1.11 Define thermal stresses.
1.12 Calculate the thermal stresses in uniform bars.

2.0 Strain Energy

2.1 Understand the concept of strain energy and define the terms related to it
2.2 Write the expressions for the stresses developed in bars subjected to Gradual, Sudden and Impact loads.
2.3 Calculate the Maximum stresses and strain energy stored in the bars subjected to above loads.

3.0 Shear Force and Bending Moment Diagrams

3.1 State the concept of beams
3.2 Classify beams based on supports.
3.3 Define the shear force and bending moment in beams
3.4 Calculate the Shear Force and Bending Moment in Cantilever, Simply Supported beams subjected to Concentrated, UDL and combined loads. Draw their variation along the length of the beams.
3.5 Numerical problems related to the above cases.

4.0 Theory of Simple Bending and Deflection of Beams

4.1 Define a) Neutral layer, b) Neutral Axis, c) Radius of curvature d) Moment of Resistance, e) Bending stress f) Moment of Inertia g) Section Modulus f) Flexural Rigidity
4.2 Write the expression for the Bending Moment (Flexural Formula) by stating the assumptions.
4.3 Calculate the bending stresses in beams of various cross-sections.

4.4 Define the slope and deflection of beam.
4.5 Write the expressions for slope and deflection in cantilever and simply supported beams for standard cases. Numerical problems related to the above cases.

5.0 Torsion in Shafts and Springs

5.1 Define shaft and write expression for the Torsion equation by stating the assumptions.
5.2 Calculate the dimensions of the solid and hollow circular shafts subjected to torsion and also check them for rigidity.
5.3 Compare the strength and weight of the solid and hollow shafts for the given conditions.
5.4 Numerical problems related to the above cases.
5.5 Function of spring
5.6 Types and applications of springs
5.7 Define the terms related to closed coil helical spring
5.8 State the formulae for the stress and deflection of closed coil helical spring
5.9 Compute the stress and deflection of the closed coil helical spring

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
C01	3	2	1				1	1	2	
C02	3	2	1				1	1	2	
C03	3	2	1				1	1	2	
C04	3	2	1				1	1	2	
C05	3	2	1				1	1	2	
AVG	3	2	1				1	1	2	

COURSE CONTENTS

1. Simple Stresses and Strains

Classification of Loads and their effects - Difference between rigid body and deformable body - Mechanical properties of Metals - Concept of stress and strain - Hooke's law - Stress-strain diagrams for ductile and brittle materials - elastic constants – Poisson's ratio - Factor of safety - Relation between elastic constants, Stresses and strains in the bars - Stresses and strains in uniform bars and varying cross-section subjected to end point loads only – concept of composite bars and the stresses and strains in the composite bars – Numerical problems on Thermal stresses in uniform and composite bars.

2. Strain Energy

Strain energy or resilience, proof resilience and modulus of resilience - Strain energy in the bars of uniform cross-sections – Expressions for the stress in the bars of uniform cross-section using strain energy concept for the following cases - i) Gradually applied load, ii) Suddenly applied load, iii) Impact/shock load – calculation of strain energy stored in the bars for above types of loading - Related numerical problems on the above cases.

3. Shear Force & Bending Moment Diagrams

Classification of beams based on supports - Types of Loads – Concentrated load, UDL and UVL- Definition and explanation of shear force and bending moment - Calculation of shear force and bending moment at any point along the length of the beam and drawing the diagrams by the analytical method only for the following cases - a) Cantilever with concentrated and uniformly distributed loads, b) Simply supported beam with concentrated and uniformly distributed loads.

4. Theory of Simple Bending and Deflection of Beams

Explanation of the terms - a) Neutral layer, b) Neutral Axis, c) Radius of curvature d) Moment of Resistance, e) Bending stress f) Moment of Inertia g) Section Modulus f) Flexural Rigidity - Assumptions in theory of simple bending- Write the Bending / Flexural Equation $M / I = \sigma / Y = E / R$ - Problems on calculating the bending stress, dimensions of the cross-section of beam, safe load and radius of curvature - Definition of slope and deflection of beams - Deflection formulae without proof for cantilever and simply supported beams with point load and uniformly distributed load only (Standard cases only)

5. Torsion in Shafts and Springs

Definition and functions of shaft - Calculation of polar moment of inertia and polar section modulus for solid and hollow shafts - Assumptions in simple torsion – write torsional equation $T / J = \tau / R = G\theta / L$ - Problems on design of shaft based on strength and rigidity - Numerical Problems related to comparison of strength and weight of solid and hollow shafts.

Explanation about spring - Classification of springs - Nomenclature of closed coil helical spring- Deflection formula for closed coil helical spring (without derivation) - Explanation about stiffness of spring-Semi elliptical or leaf spring - deflection and stress formula (without derivation) - Numerical problems on closed coil helical spring.

REFERENCE BOOKS

1. Strength of Materials by B.C. Punmia
2. Strength of Materials by R.S. Khurmi S & Chand Company
3. Strength of Materials by SBTET
4. Strength of Materials by Ramamrutham

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.4
Unit Test-II	From 3.5 to 5.9

BASIC THERMODYNAMICS

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
C26ME302T	Basic Thermodynamics	06	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1	Fundamentals of Thermodynamics	26	25	3	2	CO1
2	Thermodynamic Processes of Gases	14	22	2	2	CO2
3	Vapour Processes	18	22	2	2	CO3
4	Air Standard Cycles	15	14	2	1	CO4
5	Fuels and Combustion	17	17	3	1	CO5
	Total	**90**	**100**	12	8	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Analyse the Thermodynamic Processes of gases and vapour, Air Standard cycles and Calorific values of Fuels and Combustion equations of fuels.

COURSE OUTCOMES

CO1	ME302.1	Explain The Basics and Laws of Thermodynamics and Solve Problems on Thermodynamic Laws
CO2	ME302.2	Solve The Problems on Thermodynamic Processes.
CO3	ME302.3	Understand The Properties and Solve Problems on Thermodynamic Processes of Steam
CO4	ME302.4	Discuss Air Standard Cycles in Order to Compare with The Actual Cycles Used in Various Thermodynamic Systems
CO5	ME302.5	Explain Different Methods to Determine the Calorific Values of Fuels and Know the Minimum Air Required for Complete Combustion of the given Fuel.

LEARNING OUTCOMES

Upon on completion of the course the student shall be able to:

1.0 Fundamentals of Thermodynamics

1.1 Define the System, Boundary, Universe and Working Fluid of a Thermodynamic System.
1.2 Explain the Three Types of Thermodynamic Systems with Examples.
1.3 List and Explain Different Extensive and Intensive Properties of a Thermodynamic System with Examples.
1.4 Define Thermodynamic State, Path, Process and Cycle with Graphical Representations.
1.5 Define the Terms Heat, Work, Quasi-Static Work and Flow Work.
1.6 State the Concept of Entropy and Change of Entropy with Mathematical Expression.
1.7 Differentiate Reversible and Irreversible Processes with Examples.
1.8 State the Relationship Connecting the Two Specific Heats and Characteristic Gas Constant (R).
1.9 Define the Zeroth Law of Thermodynamics and Thermal Equilibrium.
1.10 State First Law of Thermodynamics for a Cycle, its Significance, Limitations and Applications.
1.11 Write Non-Flow Energy Equation (NFEE) Stating the Units of the Terms Involved and Solve Simple Problems on Non-Flow Energy Equation Applicable to Closed Systems.
1.12 Write Steady Flow Energy Equation (SFEE) Stating the Units of the Terms Involved and Solve Simple Problems on Steady Flow Energy Equation Only.
1.13 State Clausius and Kelvin-Planck Statements of Second Law of Thermodynamics – Significance – Applications.
1.14 Differentiate Heat Engine, Heat Pump and Refrigerating Machine.
1.15 Define Perfect Gas and Derive the Characteristic Gas Equation.
1.16 State Boyle's Law, Charle's Law, Avogadro's Law, Regnault's Law and Joule's Law with Graphical Representations and Mathematical Expressions.
1.17 Write Universal Gas Equation.
1.18 State Relationship Between Characteristic Gas Constant (R), Universal Gas Constant (Ru) and Molecular Weight (M).
1.19 Define Specific Heat, Specific Heat at Constant Pressure (Cp) and Specific Heat at Constant Volume (Cv).
1.20 State the Relationship Connecting the Two Specific Heats and Characteristic Gas Constant (R).
1.21 Solve Simple Problems Using Gas Laws and Gas Equations.

2.0 Thermodynamic Processes on Gases

2.1 List Thermodynamic Processes on Gases.
2.2 Explain Various Thermodynamic Processes Such as Isochoric, Isobaric, Isothermal Isentropic and Polytropic Processes with Pressure -Volume and Temperature– Entropy Diagrams.
2.3 Write mathematical expressions for Change in Internal Energy, Work Transfer, Heat Transfer, Change in Enthalpy and Change in Entropy For Isochoric, Isobaric, Isothermal, Isentropic and Polytropic Processes (Without Proofs)
2.4 Solve Simple Problems on the Above Thermodynamic Processes.
2.5 Description of Hyperbolic, Free Expansion and Throttling Processes.

3.0 Vapour Processes

3.1 Define the term Pure Substance and give examples for pure substances.
3.2 Explain phase change process of steam.
3.3 Define the terms (a) Dryness fraction (b) Degree of superheat of vapour.
3.4 Define and write expressions for various steam properties such as enthalpy, Specific volume, entropy, work of evaporation, true latent heat
3.5 List out various vapour processes
3.6 Represent Isochoric, Isobaric, Isothermal, Adiabatic, Polytropic and Throttling processes of vapour on p-V and T-s diagrams
3.7 Write mathematical expressions for Heat transfer, Work transfer, change in internal energy, change in enthalpy and change in entropy of vapour in the above cases.
3.8 Solve simple problems by using Steam tables and Mollier chart for the above cases.
3.9 State the purpose of calorimeter and list different types of calorimeters.

4.0 Air Standard Cycles

4.1 Define the Term 'Air Standard Cycle'.
4.2 List Important Air Standard Cycles and their Practical Applications.
4.3 Define the Term Air Standard Efficiency.
4.4 State the Assumptions Made in the Analysis of 'Air Standard Cycles'.
4.5 Explain the Thermodynamic Processes of Carnot Cycle with P-V and T-S Diagrams.
4.6 Solve Simple Problems for Calculating the Air Standard Efficiency of a Carnot Cycle.
4.7 Explain the Thermodynamic Processes of Otto Cycle With P-V and T-S Diagrams.
4.8 Solve Simple Problems for Calculating the Air Standard Efficiency of an Otto cycle.
4.9 Explain the Thermodynamic Processes of Diesel Cycle with P-V and T-S Diagrams.
4.10 Solve Simple Problems for Calculating the Air Standard Efficiency of a Diesel Cycle.
4.11 Compare Otto Cycle and Diesel Cycle.

5.0 Fuels and Combustion

5.1 Define the Terms Fuel and Classify Fuels with Examples.
5.2 State the Advantages, Disadvantages and Applications of Commonly Used Solid, Liquid and Gaseous Fuels.
5.3 Compare Solid, Liquid and Gaseous Fuels.
5.4 Define the Term Calorific Value of a Fuel.
5.5 Define Higher Calorific and Lower Calorific Values of Fuel with Units.
5.6 Solve Simple Problems on Calculating the Higher Calorific Value of a Fuel and Then Lower Calorific Value of the Fuel by Using Dulong's Formula.
5.7 Describe Bomb Calorimeter for the Determination of Calorific Value of the Solid and Liquid Fuels.
5.8 Describe Junker's Gas Calorimeter for the Determination of Calorific Value of Gaseous Fuel.
5.9 Define Combustion, Reactants and Products of Combustion
5.10 Write Chemical Equations for the Combustion of Unit Mass/Unit Volume of the Given Fuels.

5.11 Estimate the Minimum Air Required and Excess air Required for Complete Combustion of Unit Mass / Unit Volume of a Fuel of Given Composition.

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2					1	1	1	
CO2	3	2					1	1	1	1
CO3	3	2					1	1	1	1
CO4	3	2					1	1	1	
CO5	3				2		1	1	1	
AVG	3	2			2		1	1	1	1

COURSE CONTENT

1.0 Fundamentals of Thermodynamics

Definition of Thermodynamic System, Boundary, Surroundings, Universe, Working Fluid of a System- Types of Thermodynamic Systems: Closed, Open and Isolated Systems with Examples;- Properties of Thermodynamic System: Intensive and Extensive Properties with Examples;- Definitions of Various Properties of System Namely Pressure, Volume, Specific Volume, Density, Temperature and their Units with Mathematical Expressions.

Definitions for Thermodynamic State, Path, Process and Cycle with Graphical Representations;- Reversible and Irreversible Processes – Examples – Conditions for Reversibility of a Process and a Cycle.

Definitions for Heat, Work, Entropy and Change in Entropy with units and Mathematical Expressions - Importance of Pressure-Volume (P-V) and Temperature-Entropy (T-S) Diagrams.

Thermal Equilibrium and Thermodynamic Equilibrium - Statements of Zeroth, First, Second and Third Laws of Thermodynamics –- Definitions of Heat Engine, Heat Pump and Refrigerator – Non-Flow Energy Equation **(Without Proof)** - Simple Problems on NFEE - Steady Flow Energy Equation **(Without Proof)** - Simple Problems on SFEE only.

Perfect Gas Laws – Laws of Perfect Gases – Boyle's, Charles', Gay-Lussac's, Joule's, Regnault's And Avogadro's Laws– Derive Characteristic Gas Equation PV = mRT - Write Universal Gas Equation- Definition of Specific Heat of a Gas - Specific Heat at Constant Pressure and Specific Heat at Constant Volume a Gas – Relation Between the Two Specific Heats and Characteristic Gas Constant - Expressions for Change in Enthalpy And Change in Internal Energy — Simple Problems on the Above.

2.0 Thermodynamic Processes on Gases

Description of Constant Volume, Constant Pressure, Isothermal, Isentropic (Reversible Adiabatic) and Polytropic Processes - Explanation of the Above Thermodynamic Processes with the help of Pressure -Volume and Temperature–Entropy Diagrams- Write the Mathematical Expressions for Change in Internal Energy, Work Transfer, Heat Transfer, Change in Enthalpy and Change in Entropy for Isochoric, Isobaric, Isothermal, Isentropic and Polytropic Process

(Without Proofs) - Simple Problems- Description of Hyperbolic, Free Expansion and Throttling Processes.

3.0 Thermodynamic Processes of Vapour

Properties of steam – Formation of Steam– Saturation Temperature – Enthalpy of Water (Saturated Water) – Enthalpy of Evaporation – Conditions of Steam: Wet, Dry and Superheated Steam - Dryness Fraction –Enthalpy and Entropy of Wet, Dry and Superheated Steam - Advantages of Superheated Steam.

Thermodynamic Processes of Vapour: Mathematical Expressions for Heat Transfer, Work Transfer, Change in Internal Energy, Change in Enthalpy and Change in Entropy of Vapour in Isochoric, Isobaric, Isothermal, Adiabatic, Polytropic and Throttling Processes - Simple Problems by Using Steam Tables and Mollier Chart – Purpose of Calorimeter – Classification of Calorimeters.

4.0 Air Standard Cycles

Meaning of air standard cycle – important air standard cycles - assumptions made in the analysis of various air standard cycles– air standard efficiency; explanation of thermodynamic processes of carnot cycle on p-v and t-s diagrams – mathematical expression for air standard efficiency of carnot cycle (**derivation omitted**) – simple problems on carnot cycle - explanation of thermodynamic processes of otto cycle on p-v and t-s diagrams – mathematical expression for air standard efficiency of otto cycle (**derivation omitted**) – simple problems on otto cycle - explanation of thermodynamic processes of diesel cycle on p-v and t-s diagrams – mathematical expression for air standard efficiency of diesel cycle (**derivation omitted**) - simple problems on diesel cycle- reasons for the highest efficiency of carnot cycle over other air standard cycles working between same temperature limits - comparison of otto cycle and diesel cycle

5.0 Fuels and Combustion

Fuels: Definition Of Fuel – Renewable Energy Sources and Non-Renewable Energy Sources of Fuels-Classifications of Fuels as Solid, Liquid and Gaseous Fuels with Examples – Merits, Limitations and Applications of The Above Fuels - Calorific Value of Fuels – Higher and Lower Calorific Values – Dulong's Formula – Simple Problems – Determination of Calorific Values of Solid and Liquid Fuels by Using Bomb calorimeter and Gaseous Fuels by Using Junker's Gas Calorimeter. (**Description Only**).

Combustion: Definition Of Combustion- Write Combustion Chemical Equations for The Combustion of Carbon, Hydrogen, Sulphur, Methane and Ethane – Calculation of Minimum Air Required for Complete Combustion of Fuel on Mass Basis and Volume Basis – Simple Problems – Need of Excess Air.

REFERENCE BOOKS

1. Engineering Thermodynamics, P. K. Nag, McGraw Hill Education Publishers
2. Thermodynamics, 2004, C. P. Arora, McGraw Hill Education Publishers
3. Thermal Engineering - J.K. Guptha and R. S. Khurmi, S. Chand& Company

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.4
Unit Test-II	From 3.5 to 5.11

MANUFACTURING TECHNOLOGY-I

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
C26ME303T	Manufacturing Technology- I	06	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1.	Classification of Engineering Materials	18	17	3	1	CO1
2.	Production Lathes	20	22	2	2	C02
3.	Shaper, Slotter and Planer	17	22	2	2	CO3
4.	Foundry	17	22	2	2	C04
5.	Grinding and Finishing Processes	18	17	3	1	CO5
Total		90	100	12	8	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Understand the mechanical properties engineering materials
2	Describe the construction details and various operations on Lathe Machines, Shaper, Slotter, Planer, Foundry
3	Describe the basic workshop operations of foundry and Grinding and Finishing Processes

COURSE OUTCOMES

CO1	ME303.1	Introduction to Engineering Materials
CO2	ME303.2	Describe various operations on the Lathe Machine
C03	ME303.3	Describe various operations on 1. Shaper, 2. Slotter and 3. Planer
CO4	ME303.4	Describe various moulding sands and its properties, casting and special casting methods. Describe the various casting defects
CO5	ME303.5	Describe the working of different grinding machines and surface finishing processes.

LEARNING OUTCOMES

Upon completion of the course, the student shall be able to

1.0 Introduction to Engineering Materials

1.1 Classify the engineering materials as metals, non-metals, and composites
1.2 List the Constituents in composites and types of reinforcements.
1.3 List the various engineering materials and their applications.
1.4 State the importance of various Engineering Materials used in Mechanical processes/industries.
1.5 Define the following Properties. i) Tensile, compressive and shear strength ii) Ductility iii) Hardness iv) Toughness v) Brittleness vi) Impact strength vii) Fatigue and viii) Creep Resistance.
1.6 Explain the composition, properties and applications of Cast Iron–Grey, White, Malleable, and Spheroidal.
1.7 State the basis of classification of plain carbon steels.
1.8 List out any five applications of above steels. Describe the need for alloying the steel with other elements.
1.9 State the composition, properties, and industrial applications of alloy steels.
1.10 Identify the need for non-ferrous metals and their alloys in engineering applications.
1.11 Describe the properties and applications of –Copper, Aluminium, Tin, Zinc, Lead, Nickel, Magnesium and Chromium.
1.12 Write the composition, properties and industrial application of Copper and Aluminium alloys.
1.13 List the properties of bearing metal

2.0 Production Lathes

2.1 State a) The working principle of lathe machine b) The specifications of lathe machine
2.2 List a) The six types of lathe machines b) List any three work holding devices
2.3 Describe the working of Lathe with legible sketch
2.4 Explain
  a) The procedure for Turning, Facing, taper turning, thread cutting, knurling, forming, drilling, boring, reaming, key way cutting operations on Lathe machine.
  b) The methods of taper turning on lathe machine.
2.5 Calculate included angle for taper turning.

3. Shaper, Slotter, and Planner

3.1 Describe
  a) The construction and working principle of shaper with legible sketch.
  b) The construction and working principle of slotter with legible sketch.
  c) The construction and working principle of planer with legible sketch.
3.2 List the operations performed on shaper, slotter, and planer.
3.3 State
  a) The specifications of shaper.
  b) The specifications of slotter.
  c) The specifications of planer.
3.4 Explain
  a) The principle of quick-return mechanism as applied to shaper and Planer.
  b) Crank & slotted lever mechanism for obtaining the quick-return motion.
  c) Whit worth mechanism for obtaining the quick-return motion.

4. Foundry

4.1 State
- (a) List various advantages of casting over other processes
- (b) limitations of the casting process

4.2 List hand moulding tools

4.3 Mention the various properties of good moulding sand and types of moulding sands

4.4 List various types of patterns

4.5 Describe the casting process with legible sketch and identify various a Casting defects

4.6 Explain
- (a) Principle and application of die casting
- (b) Principle and application of hot chamber and cold chamber die casting
- (c) Principle and application of centrifugal casting
- (d) Principle and application of CO2 process
- (e) Principle and application of investment casting

5. Grinding and Finishing Processes

5.1 Explain the principle of metal removal by grinding

5.2 Explain the working of Cylindrical and Centreless grinding machines.

5.3 List types of abrasives with examples.

5.4 List the types of bonds used in the grinding wheel.

5.5 Explain the standard marking system of a grinding wheel.

5.6 List the uses of different work-holding devices.

5.7 Explain (a) Balancing (b) Dressing (c) Truing of the grinding wheel.

5.8 Explain
- a) Honing, Lapping, Super finishing processes
- b) The principle of hot dipping processes, namely: Galvanising,
- c) tin coating, Parkerizing and Anodising.

5.9 Describe
- a) The principle of Electro–plating with a legible sketch.
- b) The processes of various organic coatings

5.10 List six various organic coatings

5.11 State
- a) The principles of metal spraying.
- b) The features of wire process and powder process.

5.12 Select the appropriate process for surface roughness of a given application.

5.13 State the principle and types of jig boring

5.14 State principle and types of Broaching

CO-PO/PSO MATRIX

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3				1		1			
CO2	3				1		1			
CO3	3				1		1			
CO4	3				1		1			
CO5	3				1		1			
AVG	3				1		1			

COURSE CONTENT

1.0 Introduction to Engineering Materials

Classification of engineering materials – Metals (ferrous, non-ferrous), non-metals (polymers, ceramics), Composites (Metal matrix composites, polymer matrix composites, ceramic matrix composites, Nano composites). Constituents in composites (matrix, reinforcement), Different types of reinforcements. A few Mechanical Engineering Materials, Importance of their study with applications. Various mechanical properties of engineering materials – Tensile strength, Compressive strength, Ductility, Malleability, Hardness, Toughness, Brittleness, Impact strength, Fatigue, Creep resistance

Classification of Cast Iron – Grey, White, Malleable, Spheroidal – Composition, properties and applications. Plain Carbon Steels: Effect of carbon in steels, Soft, Mild, Medium and High carbon and also their properties and applications.

Alloy Steels: Nickel Steels, Chromium steels, 18/8 stainless steel, High Speed Steels, Manganese Steel. Properties and uses of Copper, Aluminium, Tin, Zinc, Lead, Nickel, Magnesium and Chromium alloys, Copper and Aluminium alloys- Properties of bearing metals, Babbit metals.

2.0 Lathe and Lathe Work

Working Principle of Lathe - types of Lathes - Engine lathe – construction details and specifications. Nomenclature of single point cutting tool, geometry, tool signature, functions of tool angles. General and special operations – (Turning, facing, taper turning, thread cutting, knurling, forming, drilling, boring, reaming, key way cutting.) Methods of taper turning – explanation. Lathe accessories viz., work holding devices and tool holding devices

3.0 Shaping, Slotting, and Planning

Introduction to shaper, slotter, planer. Constructional details and specifications of shaper, slotter and planer. Operations on these machines. Tools and materials. Driving mechanisms - quick return arrangement - crank & slotted lever mechanism, whit worth mechanism.

4.0 Foundry

Introduction: Evolution of foundry as a manufacturing process, advantages and limitations of casting over other manufacturing processes.

Foundry equipment: Hand moulding tools: shovel, riddle, rammers, trowels, slicks, lifter, strike-off bar, sprue pin bellow, swab, gate cutter, mallet, vent rod, draw spike, rapping plate or lifting plate, pouring weight, gagger, clamps, spirit level, moulding boxes, snap box & flash box.

Sands: Properties of moulding sand- porosity, flowability, collapsibility, adhesiveness, cohesiveness and refractoriness.

Types of moulding sand: green sand, dry sand, loam sand, facing sand, backing sand, parting sand, core sand, system sand their ingredients and uses. Various types of patterns Casting: green sand and dry sand moulding, cement bonded moulding, shell moulding, ceramic moulding, defects in castings and their remedies.

Special casting processes: (Principles and applications only) die casting – hot chamber and cold chamber, centrifugal casting, CO2 process, investment casting.

5.0 Grinding Machines

Principle of Grinding – Abrasives: Natural and Artificial - Types of Bonds and Applications – Grit, Grade and Structure of wheels - Standard marking systems of grinding wheel – Selection of grinding wheel.

Grinding machines classification and applications – Specifications - Principle of operation of Cylindrical grinder and Centreless grinder- Advantages & Limitations of centreless grinding - Work holding devices - Balancing of grinding wheels – Dressing and Truing of grind wheels.
Finishing Processes: Finishing by grinding: Honing, Lapping, Super finishing. Electroplating – Basic principles – Plating metals – applications. Hot dipping: Galvanizing, Tin coating, Parkerising, Anodizing. Metal spraying: wire process, powder process and applications.
Organic coatings: Oil-based, Lacquer based paints, Enamels, Bituminous paints, rubber base coating.
Jig Boring: Introduction to jig boring - Types of jig boring machines
Broaching: Principle of Broaching- Types of Broaching Machines

REFERENCE BOOKS

1. Elements of Work Shop Technology vol.I & II by Hazra Choudry
2. Manufacturing Technology(volume-1) by PN Rao (Tata Mc Graw Hill)
3. Production Technology - R.C. Patel
4. Production Technology - Jain & Gupta.
5. Material Science and Engineering Raghavan PHI Publishers
6. Introduction to Physical Metallurgy Avner Tata McGraw Hill Publishers
7. Material science and metallurgy O P Khanna Dhanpati Rai Publishers

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.2
Unit Test-II	From 3.3 to 5.14

ENGINEERING MATHEMATICS-II

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME304E	Engineering Mathematics-II	3	45	30	70	2

S. No.	Unit Title	No. of periods	COs mapped
1	Applications of Definite Integrals.	15	CO1
2	Differential Equations	15	CO2
3	Probability & Statistics	15	CO3
	Total Periods	**45**	

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
Unit – I: Applications of Definite Integrals						
1	Area of curves	4	7	1	½	CO1
2	Volumes of Solids of Revolution	3	4	0	½	CO1
3	Mean and RMS values	4	11	1	1	CO1
4	Numerical Integration	4	8	0	1	CO1
Unit – II: Differential Equations						
5	Introduction to Differential Equations	4	6	2	0	CO2
6	Solution of first order differential equations	6	14	2	1	CO2
7	Solution of second order homogeneous andnon-homogeneous linear differential equations	5	14	2	1	CO2
Unit – III: Probability and Statistics						
8	Probability	5	14	2	1	CO3
9	Measures of Dispersion	6	14	2	1	CO3
10	Correlation	4	8	0	1	CO3
	Total	45	100	12	8	
			Marks	36	64	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Apply integral techniques to solve various engineering problems.
2	Solve first-order and first-degree differential equations and second-order homogeneous and non-homogeneous linear differential equations.
3	Analyse data using the concepts of probability and statistical techniques.

COURSE OUTCOMES

CO1	ME304.1	Apply definite integrals in engineering applications.
CO2	ME304.2	Solve first-order and first-degree differential equations and second-order homogeneous and non-homogeneous linear differential equations.
C03	ME304.3	Apply various probability and statistical techniques for data analysis.

LEARNING OUTCOMES

C.O.1 Apply definite integrals in engineering applications.

L.O.1.1 Find the area bounded by a curve and axes.

1.2 Determine the volumes of solids of revolution along the x-axis.

1.3 Obtain the Mean and R.M.S values of simple functions.

1.4 Solve the problems of areas using Numerical Integration.

C.O.2 Solve first-order and first- degree differential equations and second-order homogeneous and non-homogeneous linear differential equations.

L.O. 2.1 Define a Differential equation, its order and degree.

2.2 Find order and degree of a given differential equation.

2.3 Form a differential equation by eliminating arbitrary constants.

2.4 Solve the first order and first degree differential equations by variables separable method.

2.5 Solve linear differential equation of the form $\frac{dy}{dx} + Py = Q$, where P and Q are functions of x only or constants.

2.6 Solve Differential equations of the type $(aD^2 + bD + c)\, y = 0$ where a ($\neq 0$), b, and c are real numbers.

2.7 Define complementary function, particular integral and general solution of a non-homogeneous linear differential equation of second order with constant coefficients.

2.8 Describe the method of solving $f(D)y = e^{ax}$, where f(D) is a polynomial of second order.

C.O. 3 Apply various probability and statistical techniques for data analysis.

L.O.3.1 Recall the basic probability principles.

3.2 State addition theorem of probability for two mutually exclusive and exhaustive events.

3.3 Solve simple problems on addition theorem.

3.4 Explain conditional event and conditional probability.
3.5 Solve simple problems on conditional probability.
3.6 Explain dependent, independent events and state multiplication theorem.
3.7 Solve simple problems on multiplication theorem.
3.8 Recall the measures of central tendency.
3.9 Explain the significance of measures of dispersion to determine the degree of heterogeneity of the data.
3.10 Find the measures of dispersion, Range, Mean Deviation and Standard Deviation for ungrouped data.
3.11 Explain the merits and demerits of these measures of dispersion.
3.12 Explain bivariate data.
3.13 Explain the concept of covariance and correlation between two variables.
3.14 Find Spearman's rank correlation coefficient.

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	3	3				3	3	1
CO2	3	1	1	1				3	1	1
CO3	3	3	3	3				3	3	3
Avg.	3	2.33	2.33	2.33				3	2.33	1.66

COURSE CONTENT

1. Applications of Definite Integrals
Area bounded by a curve and axes. Volume of Solids of Revolutions. Mean and RMS values of a function on a given interval. Numerical Integration.

2. Differential Equations
Definition of a differential equation, Order and degree of a differential equation, Formation of differential equations. Solutions of differential equations of first order and first degree using variables separable method and linear differential equation of the type $\frac{dy}{dx} + Py = Q$. Solutions of homogenous and non-homogeneous linear differential equations of second order with constant coefficients.

3. Probability & Statistics
Addition theorem of probability, conditional probability, dependent and independent events with multiplication theorem. Measures of dispersion, range, mean deviation and standard deviation of ungrouped data, merits and demerits. Bivariate data, correlation, Spearman's rank correlation coefficient.

TEXT BOOK

Engineering Mathematics-II, a textbook for second year third semester diploma courses, prepared & prescribed by SBTET, AP.

REFERENCE BOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
2. Schaum's Outlines Differential Equations, Richard Bronson & Gabriel B. Costa
3. Schaum's Outline: Introduction to Probability and Statistics, Seymour Lipschutz & John J. Schiller.
4. M.Vygodsky, Mathematical Handbook: Higher Mathematics, Mir Publishers, Moscow.

SUGGESTED E-LEARNING REFERENCES

1. https://www.khanacademy.org/
2. https://www.wolframalpha.com/
3. https://onlinecourses.nptel.ac.in/
4. http://tutorial.math.lamar.edu/

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 2.5
Unit Test-II	From 2.6 to 3.14

METROLOGY AND INSTRUMENTATION

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME305E	Metrology & Instrumentation	03	45	30	70	2

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1.	Measuring Instruments & their Characteristics	8	14	2	1	CO1
2.	Linear and Angular Measurements	12	25	3	2	CO2
3.	Dimensional and Surface Metrology	05	14	2	1	CO3
4.	Transducers	08	22	2	2	CO4
5.	Measurement of Angular Speed, Temperature, Pressure, and Flow	12	25	3	2	CO5
Total		45	100	12	8	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Understand measuring instruments, transducers and advanced measuring instruments

COURSE OUTCOMES

CO1	ME305.1	Describe various measuring instruments and its characteristics
CO2	ME305.2	Explain various linear and angular instruments
CO3	ME305.3	Explain dimensional and surface metrology.
CO4	ME305.4	Explain various transducers
CO5	ME305.5	Discuss measurement of angular speed, temperature, pressure and flow.

LEARNING OUTCOMES

1.0 Measuring Instruments & Their Characteristics

1.1 Define Metrology, Measurement and Standard of Measurement
1.2 Explain the Significance of Measurement
1.3 Classify and Explain the Methods of Measurement
1.4 Classify Type of errors
1.5 Describe Precision, Accuracy, Sensitivity, Hysteresis, Response Time, Repeatability, Calibration, Uncertainty of Measurement, and Interchangeability
1.6 Explain standardization and standardize organizations
1.7 List Measuring Instruments and Systems and explain their functions
1.8 Select the appropriate Measuring Instruments for a given application
1.9 Explain calibration of measuring instruments

2.0 Linear and Angular Measurement

Linear Measurement

2.1 Describe the construction features and use of Steel Rule, Calipers, Surface Plate, Angle Plate, V-block
2.2 Describe the construction features and use of Vernier calipers, vernier height and depth gauges, micrometres
2.3 Explain slip gauges, Cylinder bore gauges, feeler, wire gauges, Telescopic Gauge, Gauge Blocks. Checking flatness, roundness, and squareness

Angular Measurement

2.4 Describe the construction features and use of instruments for angular measurements: bevel protector, sine bar, angle gauges.
2.5. Describe the construction features of opto-mechanical measurements for angular Measurement: Tool Maker's Microscope.

3.0 Dimensional and Surface Metrology

3.1 Explain Limits, Fits, and Tolerances
3.2 Define Terminology of Surface Roughness
3.3 Illustrate the Concept of Primary Texture and Secondary Texture
3.4 Analyze Factors Affecting Surface Finish
3.5 Calculate CLA, RMS, and Ra Values
3.6 Describe and Demonstrate Stylus Probe Instruments – Taylor Surface Talysurf

4.0 Transducers

4.1 Define Transducer
4.2 Classify Transducers: Active & Passive, Analog & Digital
4.3 Explain Mechanical Detector elements: Mass Sensing Elements, Thermal Detectors (basic idea only)
4.4 Explain Resistive, Piezoelectric, and Capacitive Transducers
4.5 Define Strain Gauges
4.6 List and Describe the Requirements of a Strain Gauge
4.7 Explain Types of Strain Gauges

5.0 Measurement of Angular Speed, Temperature, Pressure, and Flow

5.1 Measurement of angular speed
- 5.1.1 List Types of Tachometers
- 5.1.2 Explain and illustrate the working principle of:
  - Mechanical Tachometers – Revolution Counter and Timer, Slipping Clutch Tachometer.

- Electrical Tachometer

5.2 Measurement of Temperature
- 5.2.1 List Types of Thermometers
- 5.2.2 Explain Bimetallic Thermometer
- 5.2.3 Explain Thermocouple
- 5.2.4 Explain Thermistor
- 5.2.5 Describe and Compare Pyrometers: Radiation and Optical

5.3 List Pressure Measurement Devices and Explain Bourdon Tube Pressure Gauge.

5.4 List Flow Meters and Explain Rotameters, Hot Wire Anemometer (Constant Temp & Constant Current), and Ultrasonic Flow Meter

CO-PO/PSO MATRIX

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1			3			1	1		
CO2	1			3			1	1		
CO3	1			3			1	1		
CO4	1			3			1	1		
CO5	1			3			1	1		
AVG	1			3			1	1		

COURSE CONTENT

1.0 Measuring Instruments & Their Characteristics

Definition of Metrology, Define Measurement, Standard of measurement, Explain the Significance of Measurement, Explain Methods of Measurement a. Direct and Indirect, b. Primary, Secondary, and Tertiary, c. Contact and Non-contact, Types of Errors - Controllable and Random Errors, Precision, accuracy, sensitivity, hysteresis, response time, repeatability, calibration, uncertainty of measurement, interchangeability, Standardization and standardizing organizations, Classify Instruments, List the Instruments and Measuring Systems- Their Functions, Selection of Measuring Instruments, Calibration of measuring instruments

2.0 Linear and Angular Measurement

Linear Measurement

Construction features and use of instruments for non-precision linear measurement: steel rule, callipers, surface plate, angle plate, V-block, Construction features and use of instruments for precision measurements: vernier calipers, vernier height and depth gauges, micrometers, Slip gauges, Indian standards of slip gauges, sets of slip gauges, use of slip gauges. Cylinder bore gauges, feeler, and wire gauges, Telescopic Gauge, Gauge Blocks. Checking flatness, roundness, and squareness.

Angular Measurement - Construction features and use of instruments for angular measurements: bevel protector, sine bar, angle gauges. Opto-mechanical measurements for angular Measurement: Tool Maker's Microscope.

3.0 Dimensional and Surface Metrology

Limits, Fits, and Tolerance, Terminology of surface roughness, Concept of primary texture and secondary texture, Factors affecting surface finish, CLA, RMS,

and Ra value, Principle and operation of stylus probe instruments. Taylor surface talysurf.

4.0 Transducers

Define Transducer, Classification of Transducers (Active & Passive, Analog & Digital), elastic and force balance transducers. Mechanical Detector Elements: Mass Sensing Elements, Thermal Detectors (basic idea only). Explain the Resistive Transducer, the Piezoelectric Transducer, and the Capacitive Transducer. Define Strain Gauges, List the requirements of a strain gauge, Explain the types of strain gauges: unbounded metal strain gauges, bonded metal wire strain gauges, bonded metal foil strain gauges, bonded semiconductor strain gauges.

5.0 Measurement of Angular Speed, Temperature, Pressure, and Flow

Measurement of angular speed: List the types of Tachometers, explain the working principle of the following Tachometers with a legible sketch: Mechanical Tachometers-Revolution counter and timer, slipping Clutch Tachometer. Electrical / electronic tachometers, Stroboscopes, Incremental and absolute encoders, Laser Doppler velocimeters / interferometers. Measurement of Temperature: List the types of thermometers, explain the Bimetallic thermometer, Thermocouples, thermistors, Bimetallic thermometers, Infrared pyrometers, and thermal cameras, Fiber optic temperature sensors, Calibration, range, linearization, and error sources. Explain Pyrometers-Radiation and Optical. Measurement of Pressure: List the Types of Pressure Measurement Devices. Explain the Bourdon tube Pressure gauge, Manometers, Elastic and force balance transducers, Strain gauge pressure cells, Piezoelectric, piezo resistive, and capacitive pressure sensors, High-pressure and low-pressure measurement techniques, Applications for mechanical and industrial systems. Measurement of Flow: List the Types of Flow meters- Explain Rota meters, hot wire anemometer (constant temp and constant Current), and an Ultrasonic flow meter

REFERENCE BOOKS

1. Mechanical Measurements &Control-Dr. D. S. Kumar (Metropolitan Book Co. Pvt. Ltd)
2. Mechanical & Industrial Measurements - R. K. Jain
3. Engineering Metrology and Measurements – N.V. Raghavendra & L. Krishnamurthy
4. A Textbook of Engineering Metrology – I.C. Gupta
5. Metrology and Measurement– Anand Bewoor & Vinay Kulkarni

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.3
Unit Test-II	From 3.4 to 5.4

ADVANCED MATERIALS AND NANO TECHNOLOGY

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME306E	Advanced Materials and Nanotechnology	03	45	30	70	2

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1	Introduction to Advanced Materials	06	17	3	1	CO1
2	Composite Materials	10	22	2	2	CO2
3	Smart Materials	10	22	2	2	CO3
4	Advanced Material Testing and Characterization	10	22	2	2	CO4
5	Nano Materials	09	17	3	1	CO5
	Total	**45**	**100**	12	8	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Understand mechanical properties of advanced engineering materials, Nanotechnology principles and the testing of materials

COURSE OUTCOMES

CO1	ME306.1	Describe various properties of Advanced Materials
CO2	ME306.2	Explain Composite Materials Fabrication processes and its applications in various fields.
CO3	ME306.3	Describe different types of Smart Materials and their properties
CO4	ME306.4	Explain Destructive and Non-Destructive tests.
CO5	ME306.5	Discuss Nano Materials properties and its applications

LEARNING OUTCOMES

Upon completion of the course the student shall be able to

1.0 Introduction to Advanced Materials

1.1 Define advanced materials and Classify the advanced materials
1.2 Explain the need and importance of advanced materials in mechanical engineering
1.3 Compare the advanced materials with conventional materials
1.4 Explain the Mechanical Properties of advanced materials
1.5 Explain the thermal Properties of advanced materials
1.6 Explain the Electrical Properties of advanced materials
1.7 Explain the Magnetic Properties of advanced materials

2.0 Composite Materials

2.1 Define composite Materials
2.2 Classify the composite materials like Particle-reinforced, Fiber-reinforced, Structural- Matrix materials: Polymer, Metal, Ceramic
2.3 Explain the various Fabrication methods of composites like Hand lay-up, Compression moulding, Pultrusion
2.4 Explain the applications of composite materials in automotive, aerospace, and construction
2.5 State the Advantages and Disadvantages of Composite Materials

3.0 Smart Materials

3.1 Define Smart Materials
3.2 Explain different types of smart materials like Shape Memory Alloys (SMA), Piezoelectric materials, Magnetostrictive materials, Electro-rheological fluids.
3.3 Explain Working principle and applications of smart materials in actuators, sensors, robotics
3.4 Define Superalloys
3.5 Explain the properties and applications of super alloys
3.6 Explain the engineering ceramics and their properties (Alumina, Silicon carbide)
3.7 Explain about High-performance polymers: PTFE, PEEK-Thermal barrier coatings and corrosion-resistant materials

4.0 Advanced Material Testing & Characterization

4.1 Differentiate destructive and non-destructive testing
4.2 Explain the procedure for Non-destructive tests like Ultrasonic, Radiography, Magnetic particle testing
4.3 Explain the procedure for Microstructure analysis using Optical microscope
4.4 Explain the procedure for Mechanical testing: Hardness, Tensile and Impact

5.0 Nano Materials

5.1 Explain the properties of nanomaterials
5.2 Explain the Synthesis techniques like Chemical vapor deposition (CVD), Ball milling
5.3 Explain the applications of nanomaterials in coatings, lubricants, electronics.

CO-PO/PSO MATRIX

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3				1		1			
CO2	3				1		1			
CO3	3				1		1			
CO4	3				1		1			
CO5	3				1		1			
AVG	3				1		1			

COURSE CONTENTS

1.0 Introduction to Advanced Materials

Definition and classification of advanced materials-Need and importance in mechanical engineering-Comparison with conventional materials-Properties: Mechanical, Thermal, Electrical, and Magnetic.

2.0 Composite Materials

Definition and types: Particle-reinforced, Fiber-reinforced, Structural-Matrix materials: Polymer, Metal, Ceramic. Fabrication methods: Hand lay-up, Compression moulding, Pultrusion - Applications in automotive, aerospace, and construction.

3.0 Smart Materials

Introduction to smart materials: Types: Shape Memory Alloys (SMA), Piezoelectric materials, Magnetostrictive materials, Electro-rheological fluids-Working principle and applications in actuators, sensors, robotics.

High-Performance Materials-Superalloys: Properties and applications-Engineering ceramics and their properties (Alumina, Silicon carbide)-High-performance polymers: PTFE, PEEK-Thermal barrier coatings and corrosion-resistant materials.

4.0 Advanced Material Testing & Characterization

Non-destructive testing (NDT): Ultrasonic, Radiography, Magnetic particle testing-Microstructure analysis: Optical microscopy -Mechanical testing: Hardness, Tensile, Impact.

5.0 Nano Materials

Basics of nanotechnology-Properties of nanomaterials-Synthesis techniques: Chemical vapor deposition (CVD), Ball milling-Applications in coatings, lubricants and electronics.

REFERENCE BOOKS

1. Materials Science and Engineering – William D. Callister
2. Engineering Materials – R.K. Rajput
3. Composite Materials – Krishan K. Chawla
4. Introduction to Nanotechnology – Charles P. Poole

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.3
Unit Test-II	From 3.4 to 5.3

BASICS OF ELECTRICAL ENGINEERING

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME307A	BASICS OF ELECTRICAL ENGINEERING	02	30	-	-	-

TIME SCHEDULE

S. No.	Unit Title	No of Periods	COs Mapped
1	Electrical Engineering Fundamentals	10	CO1
2	Electrical Machines	10	CO2
3	Electrical Measuring Instruments	6	CO3
4	Electrical Safety	4	CO4

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Impart basic knowledge of electrical quantities, laws and Kirchhoff's laws.
2	Give basic knowledge of how electrical machines work and their use in practical applications.
3	Provide basic knowledge of electrical measuring instruments and to create awareness about electrical safety practices.

COURSE OUTCOMES

CO1	ME307.1	Understand basic electrical concepts and simple laws used in electrical engineering.
CO2	ME307.2	Learn the basic working and uses of common electrical machines like motors and transformers.
CO3	ME307.3	Use simple electrical measuring instruments to measure voltage, current, power and energy.
CO4	ME307.4	Follow basic electrical safety rules and use protective devices to avoid accidents in workshops and industries.

LEARNING OUTCOMES

1.0 Electrical Engineering Fundamentals

1.1. Define voltage, current, resistance and power.

1.2. State **Ohm's** law and Kirchhoff's laws.

1.3. Differentiate between DC supply and AC supply.

1.4. Define energy and state how electrical energy consumption is calculated in a house.
1.5. List common applications of electricity in workshops like lighting, welding and motors.

2.0 Electrical Machines
2.1. Define an electrical machine and state its uses.
2.2. State the need for transformer and classify the transformers.
2.3. Identify the parts of a DC motor and state applications of DC motors.
2.4. State the basic working of an induction motor and list its applications.
2.5. List common electrical machines used in fans, pumps, lathes, compressors etc.

3.0 Electrical Measuring Instruments
3.1. State the purpose of an ammeter and state how it is connected in the circuit.
3.2. State the purpose of a voltmeter and state how it is connected in the circuit.
3.3. Define a wattmeter and state its use.
3.4. Define an energy meter and list places where it is used.
3.5. State the importance of measuring instruments in workshops.

4.0 Electrical Safety
4.1. List common electrical hazards in homes and workshops.
4.2. State basic safety rules and list different electrical safety equipment.
4.3. State the need for earthing and list different types of earthing systems.
4.4. Define a fuse and circuit breaker and state their functions.
4.5. List first aid steps to be taken in case of electric shock.

CO-PO/PSO MATRIX

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	1	3	2	1
CO2	3	2	2	2	-	-	-	3	3	-
CO3	3	2	-	-	-	2	-	3	3	1
CO4	3	3	2	2	1	-	1	3	3	-
CO5	3	3	3	-	1	2	1	3	3	1
Average	3	2.4	1.4	2	0.4	2	0.6	3	2.8	1

COURSE CONTENT

1.0 Electrical Engineering Fundamentals
Concepts of voltage, current, resistance and power – Ohm's law and Kirchhoff's laws – Difference between DC supply and AC supply – Energy and calculation of electrical energy consumption in households – Applications of electricity in workshops such as lighting, welding and motors.

2.0 Electrical Machines
Electrical machines and their uses – Need for transformers and their classification – Parts and applications of DC motors – Basic working and applications of induction motors – Electrical machines commonly used in fans, pumps, lathes and compressors.

3.0 Electrical Measuring Instruments

Purpose and circuit connection of ammeters – Purpose and circuit connection of voltmeters – Wattmeter and its use – Energy meter and its applications in homes, industries and workshops – Importance of measuring instruments in electrical maintenance and workshop practice.

4.0 Electrical Safety

Electrical hazards in homes and workshops – Safety rules and safety equipment – Need for earthing and different earthing systems – Fuse and circuit breakers with their functions – First aid steps in case of electric shock.

REFERENCE BOOKS

1. V.K. Mehta, Rohit Mehta – Basic Electrical Engineering – S. Chand Publications
2. B.L. Theraja, A.K. Theraja – A Textbook of Electrical Technology (Vol. I & II) – S. Chand Publications
3. S. Rao – Testing, Commissioning, Operation and Maintenance of Electrical Equipment – Khanna Publishers
4. Surajit Das, Sunil S. Rao – Handbook on Electrical Safety – Khanna Publishers

PRODUCTION DRAWING

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME308D	Production Drawing	06	90	40	60	2

TIME SCHEDULE

S. No		Major Topics	No of Periods
1.	PART-A	Introduction	3
2.		Fastening Devices	9
3.		Welding and Piping Layouts and Joints	3
4.		Engineering Fits, Tolerances & Materials	
		4.1 Limits, Fits & Tolerances	6
		4.2 Geometrical Tolerances	3
		4.3 Surface finish	3
		4.4 Specification of materials and Standard Components	3
5	PART-B	Assembly and Detailed Part Drawing	60
Total			90

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	familiarise Conventional symbols of mechanical components, Conventional methods of representing threaded fasteners
2	familiarise with limits, fits, tolerances, and surface treatment symbols adopted in the production drawings
3	Have a clear visualisation of objects and proficiency in reading and interpreting assembly and part drawings
4	Use reinforcing and enhancing the knowledge and skills acquired in the assembly and part drawings

COURSE OUTCOMES

CO1	ME308.1	Use the conventional symbols as per IS code SP46.
CO2	ME308.2	Use the Conventional methods of representing fasteners and joints Use the specifications of material and geometrical tolerances
C03	ME308.3	Draw the welded fabrication drawings Prepare the construction piping layouts and joints
CO4	ME308.4	Specify the limits, fits and allocate tolerances for machine components. Use the specifications of material and geometrical tolerances
CO5	ME308.5	Draw the assembly drawing of a machine component for the given details. Apply concepts and methods in the preparation of production drawings. Convert machine drawings into production drawings

LEARNING OUTCOMES

Upon completion of the course, the student shall be able to

1.0 Introduction

1.1 Importance of Machine Drawing and Production Drawing
1.2 Brief revision of 1st and 3rd angle projections
1.1 Understand the concepts of Orthographic projections and Sectional views
1.2 Differentiate between machine drawing and production drawing
1.3 Explain abbreviations for materials, draughting abbreviations
1.4 State the factors that govern the preparation of a production drawing.
1.5 Identify the components of a production drawing

2.0 Fastening Devices

2.1 Draw the standard thread profiles.
2.2 Draw bolted connections to standard proportions.
2.3 Draw different types of keys and cotters and Riveted Joints.

3.0 Welding And Piping Layouts And Joints

3.1 Identify the common components of a piping layout.
3.2 Identify the conventional symbols used for the various components of piping layout.
3.3 Prepare single-line and double-line diagrams of piping layouts.
3.4 Identify the different types of welds and their symbolic representation as per B.I.S., SP-46 2003
3.5 Identify the elements of the welding symbol and their standard location on the symbol.

4.0 Fits, Tolerances &Engineering Materials

4.1 Limits, Fits & Tolerances
4.1.1 Systems of fits-problems relating Hole basis and Shaft basis system and schematic diagrams- Select dimensions from B.I.S.
4.1.2 Tables to obtain clearance, transition, and interference fit for a given set of mating parts.
4.1.3 Selection of fits and tolerances from B.I.S. tables.
4.1.4 Indicate fits on the drawings
4.1.5 Introduction and indication of form and position tolerances on drawings
4.2 Importance of geometrical tolerances & indicating geometrical tolerances on the drawing
4.3 Surface finish
4.3.1 Explain Symbols indicating surface texture
4.3.2 Surface roughness obtainable from various manufacturing processes, recommended surface roughness on mechanical components.
4.3.3 Symbols representing direction of lay.
4.3.4 Heat treatment and surface treatment symbols used on drawings.
4.4 Specification of materials and Standard Components
4.4.1 Identify the materials of various components
4.4.2 Specify the Raw materials as per Commercial/ BIS Standards
4.4.3 Identify the standard part that can be procured directly from the market and specify the part as per Commercial/ BIS Standards

5.0 Assembly And Detailed Part Drawing

5.1 Indicate the sequence of the production.
5.2 List the sequence of steps for preparing the assembly drawing.

5.3 Prepare the list of parts.
5.4 Prepare the assembly drawing for the given components drawing.
5.5 Prepare the relevant views of the parts of the assembly drawing

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			2			1	3	1	1
CO2	3			2			1	3	1	1
CO3	3			2			1	3	1	1
CO4	3			2			1	3	1	1
CO5	3			2			1	3	1	1
AVG	3			2			1	3	1	1

COURSE CONTENT

1.0 Introduction
Drawing Sheet Sizes, drawing sheet layout, Title block, Standard abbreviations - Conventional representation of materials and machine components, method of indication notes on drawings, Importance of Machine Drawing, Brief revision of 1st and 3rd angle projections, Understand the concepts of Orthographic projections and Sectional views.

2.0 Fastening Devices
Temporary and Permanent fastenings and their areas of application-thread nomenclature, forms of screw thread profiles, Bolts and Nuts: Specification of bolts and nuts, Different types of bolted joints (like using through bolts, studs, screws, eyebolt etc.,) in different applications. Purpose of lock nuts and their Types, Keys and cotters: Types of keys and cotters. Riveted Joints- types

3.0 Welding and Piping Layouts And Joints
Pipes and tubes. Classification-Components of pipe layout. Screw fitting Unions: Screwed ground and flanged, Valves: Gate valve, angle valve, check valve, Various conventional symbols used for the above components. **Different types of welded Joints** - basic symbols including sectional representation as per table of I.S. standards - Elements of welding symbol and their standard location, the symbol as per IS standards reference Code, arrow head, weld symbol, supplementary symbol, dimensions of welds, method of welding process, special reference. Supplementary symbols.

4.0 Fits, Tolerances & Engineering Materials
Limits, allowance and fits-definitions- Select dimension from standards to give different type of fit for a given mating parts, Types of fits - problems relating Hole basis and Shaft basis system and schematic diagrams- Select dimensions from B. I. S. Tables to obtain clearance, transition and interference fit for a given set of mating parts, Selection of fits and tolerances from B. I. S. tables, Indicate fits on the drawings. Indication of geometrical tolerance on the drawing, indication of feature controlled, form and position tolerances on drawings,
Surface roughness terminology- surface roughness values, surface roughness obtainable from various manufacturing processes, recommended surface roughness on mechanical components.

Materials of the parts of the assembly-size of the part, estimation of the Raw material required for a component and specification. Standard components: Parts like bolts, nuts, and Bearings, etc.

5.0 Assembly and Detailed Part Drawing

Need and functions of assembly and detailed drawings. Steps in preparing assembly drawings. Bill of materials and parts list. Exercises in preparing assembly drawings of commonly available engineering components.

Indicate the sequence of the production, specify the relevant tools to obtain the accuracy and finish. Indicate the suitable equipment, specify the type of measuring instruments to be used to check the prescribed accuracy, and specify of standard components.

Prepare Assembly and detailed part drawings of the machine components of the following machine parts: Draw only the front view and top view (Full Section / Half Section with dimensions, including the Bill of materials, of the machine elements in the Drawing Sheet.

Knuckle Joint	Flanged Coupling	Stuffing Box
Cross head	Eccentric	Foot Step bearing
Plummer Block	Screw Jack	Lathe Tool post

REFERENCE BOOK

1. Engineering Drawing by A.C. Parkinson.
2. Machine Drawing by N.D. Bhat.
3. Machine Drawing by R.B. Gupta.
4. Machine Drawing by N.Siddeswar, Kannaih, Sastri. (MGH Publishers)
5. IS 696 – 1972-Code of Practice for General Engg. Drawing & B.I.S Code– SP. 46. IS696–1988-IS Code on fits and tolerances.
6. K.L. Narayana, P. Kannaiah, & K. Venkata Reddy " A Textbook of Machine Drawing"
7. R.K. Jain, Engineering Metrology, 2016 Khanna Publications
8. Machine Drawing by G.R Nagpal
9. Production Drawing by K.L. Narayana, P. Kannaiah, & K. Venkata Reddy

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From Learning Outcome 1.1 to 4.4.3
Unit Test-II	From Learning Outcome 5.1 to 5.5

MATERIAL TESTING LAB

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME309L	Material Testing Lab	03	45	40	60	1.5

TIME SCHEDULE

S. NO	EXPERIMENT TITLE	NO.OF PERIODS
1	Simple Tension Test	06
2	Compression Test	06
3	Shear Test	03
4	Impact Test (Charpy & Izod)	06
5	Hardness Test (Brinell & Rockwell Tests)	06
6	Flexural Test on Simply Supported & Cantilever Beams	06
7	Deflection Test on Helical Spring	03
8	Liquid Penetrant Test	03
9	Preparation a specimen for microstructural analysis	03
10	Study the microstructure of metals	03
TOTAL		45

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	conduct tests on various equipment for the given sample to find the mechanical properties of the metals and operate the metallurgical microscope to see and draw the microstructure of metals

COURSE OUTCOMES

CO1	ME309.1	Operate the UTM to conduct various tests like i) Tension test ii) Compression Test iii) Shear test iv) Deflection Test on Spring to get basic mechanical properties of metals
CO2	ME309.2	Conduct the Hardness tests and Impact tests to find Hardness and Impact Strength of given metals
CO3	ME309.3	Perform Flexural Test on Simply Supported & Cantilever Beams to determine the Young's Modulus and Stiffness of the beam material
CO4	ME309.4	Perform the Liquid Penetrant Test to detect the Surface defects in Metals
CO5	ME309.5	Prepare a specimen and study the microstructure of metals.

LEARNING OUTCOMES

Upon completion of the course the student shall be able to

Understand the various material testing methods.

1. Conduct simple tension test to find the various mechanical properties of the given material such as: yield stress, ultimate stress, percentage of elongation, percentage of reduction in area and Young's Modulus.
2. Conduct experiments on concrete cube, cast iron, timber to test for its compressive strength.
3. Conduct Shear test to find shear strength of the given Material
4. Practice the method of determining the Young's modulus of materials by the principle of deflection.
5. Determine the modulus of rigidity by the method of deflection of helical spring.
6. Conduct hardness tests to find the hardness of given material.
7. Conduct impact tests to find the impact strength of given metal
8. Perform the Liquid penetrant test to detect the surface defects in Metals
9. Specimen preparation for the metallography.
10. Study of microstructures of Mild steel, Pure Iron, Grey Cast Iron, S.G. Iron, Eutectoid steel, Stainless steel, Aluminium, Brass, Bronze.

KEY COMPETENCIES TO BE ACHIEVED BY THE STUDENT

Exercise	Key competencies expected	Max. Marks	Marks awarded
1. Simple Tension Test	A. Fix the specimen in the jaws of the machine	02	
	B. Fix the strain gauge to the specimen	02	
	C. Apply the load gradually on the specimen	02	
	D. Record the load, elongation without error	01	
	E. Plot the graph stress Vs strain	01	
	F. Locate the points - elastic limit, yield stress, ultimate stress on the graph	02	
	Total	10	
2. Compression test	A. Place the specimen in the machine properly	04	
	B. Apply the load on the specimen gradually	04	
	C. Record the ultimate load	02	
	Total	10	
3. Shear Test	A. Place the specimen in the correct set of bushes in the shear shackles	04	
	B. Apply the load on the specimen gradually	04	
	C. Record the ultimate load	02	
	Total	10	
4. Impact test	A. Prepare the specimen as per the specifications	05	
	B. Fix the specimen on the machine appropriately	02	

	C. Release the load to hit the specimen cautiously	02	
	D. Record the energy absorbed by the specimen and find the impact strength	01	
	Total	10	
5. Hardness test	A. Place the specimen on the anvil of the specimen and fix the indenter	01	
	B. Place the loads on the load pan corresponding to the material of the specimen and size of indenter	01	
	C. Make the indent on the specimen properly	02	
	D. Measure the diameter of indentation with Brinell microscope	03	
	E. Calculate hardness number	03	
	Total	10	
6. Flexural Test on Beams	A. Measure the cross-sectional dimensions of the beam with vernier calliper	02	
	B. Place the weight pans/hangers at the required positions	01	
	C. Fix the dial indicator at the correct location	02	
	D. Apply the loads gradually (in ascending and descending order)	01	
	E. Note the dial indicator readings(deflections) without parallax error	02	
	F. Plot the graph between load and deflection	01	
	G. Find the Stiffness and Young's Modulus of the beam material	02	
	Total	10	
7. Torsion test of springs	A. Measure spring diameter and spring wire diameter with vernier callipers	04	
	B. Measure deflection at applying load	02	
	C. Calculate modulus of rigidity of spring material	04	
	Total	10	
8. Liquid Penetrant Test	A. Apply a special liquid penetrant to the surface of the Test specimen	05	
	B. Allow the penatrant to seep into any cracks	02	
	C. Draw the penetrant out, using a developer		
	D. Make the defects visible	03	
	Total	10	

Study of micro structure of Metals and alloys	A. Prepare specimen	05	
	B. Handling microscope to observe microstructure	02	
	C. Draw the microstructure of given material	03	
	Total	10	

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1			3			1			
CO2	1			3			1			
CO3	1			3			1			
CO4	1			3			1			
CO5	1						1			
AVG	1			3			1			

COURSE CONTENTS

1. Determination of yield stress, ultimate stress, percentage of elongation, percentage of reduction in area, Young's modulus by conducting tension test on Universal testing machine.
2. Determination of crushing strength of concrete cube, cast iron, timber etc., using UTM/CTM
3. Determination of shear strength of given material using UTM
4. Determination of Young's Modulus by conducting flexural test on simply supported and cantilever beams of given material
5. Determination of Modulus of rigidity of spring steel by the deflection of springs.
6. Determination of impact strength of the material using Izod and Charpy's tests.
7. Determination of hardness of material using Brinell and Rockwell Testing methods.
8. Detection of surface defects in metals using Liquid penetrant Test
9. Specimen preparation for the metallography.
10. Study of microstructures of Mild steel, Pure Iron, Grey Cast Iron, S.G. Iron, Eutectoid steel, Stainless steel, Aluminium, Brass, Bronze.

REFERENCE BOOKS

1.Material Science & Metallurgy by O.P. Khanna
2.Material Science by R.S. Khurmi
3.Testing of Engineering Materials by H.E. Davis
4.Engineering Materials & Metallurgy by Kodgire
5.Mechanical Behaviour of Materials by V. Raghavan

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From Experiment 1 to 5
Unit Test-II	From Experiment 6 to 10

MANUFACTURING AND METROLOGY LAB

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME310L	Manufacturing and Metrology lab	07	105	40	60	2

TIME SCHEDULE

S. No	Major Title	No of Periods
1.	Foundry	24
2.	Turning	24
3.	Welding	12
4.	Metrology laboratory	45
Total		105

COURSE OBJECTIVES

Upon completion of the course, the student shall be able	
1	To Familiarize tools used in Foundry, Machine shop and Welding
2	To handle the tools appropriately and safely
3	To reinforce theoretical concepts by practising relevant exercises of foundry, machine shop and welding
4	Obtain skill in mould Preparation, casting, machining and arc welding

COURSE OUTCOMES

CO1	ME310.1	Practice the casting principles and operations in foundry
CO2	ME310.2	Practice the turning operations on Lathe
CO3	ME310.3	Practice the joining of metals by Arc Welding
CO4	ME310.4	Perform measurements using various measuring instruments viz., slip gauges, sine bar, ring gauges, plug gauges and dial gauges etc.,

LEARNING OUTCOMES

Upon completion of the course the student shall be able to

1 Foundry

1.1 Perform mould preparation for Solid Bearing

- Write the sand moulding procedures in foundry.
- Prepare a mould sand mix.
- Identify various tools used in foundry shop.
- Select the moulding boxes
- Prepare a mould ready for casting with proper provision for runners, risers and gates
- Locate the cope over the drag without any mismatch

1.2 Perform mould preparation for Flange Coupling

- Write the sand moulding procedures in foundry.
- Prepare a mould sand mix.
- Identify various tools used in foundry shop.
- Select moulding boxes
- Prepare a mould ready for casting with proper provision for runners, risers and gates
- Locate the cope over the drag without any mismatch

1.3 Perform mould preparation for Split Bearing

- Write the sand moulding procedures in foundry.
- Prepare a mould sand mix.
- Identify various tools used in foundry shop.
- Select moulding boxes.
- Prepare a mould ready for casting with proper provision for runners, risers and gates
- Locate the cope over the drag without any mismatch

1.4. Perform mould preparation for Connecting Rod

- Write the sand moulding procedures in foundry.
- Prepare a mould sand mix.
- Identify various tools used in foundry shop.
- Select moulding boxes.
- Prepare a mould ready for casting with proper provision for runners, risers and gates
- Locate the cope over the drag without any mismatch

1.5. Perform mould preparation for V-Pulley

- Write the sand moulding procedures in foundry.
- Prepare a mould sand mix.
- Identify various tools used in foundry shop.
- Select moulding boxes.
- Prepare a mould ready for casting with proper provision for runners, risers and gates
- Locate the cope over the drag without any mismatch

1.6. Perform mould preparation for Gear Pulley

- Write the sand moulding procedures in foundry.
- Prepare a mould sand mix.
- Identify various tools used in foundry shop.

- Prepare mould in two boxes, three boxes.
- Prepare a mould ready for casting with proper provision for runners, risers and gates
- Locate the cope over the drag without any mismatch

2. Turning

2.1. Perform Facing Operations

- Select proper tool to perform the job.
- Perform job setting
- Perform tool setting
- Centre the job by dial gauge
- Select the suitable speed for different operations
- Practice facing operation on a lathe machine
- Use measuring instruments for taking dimensions

2.2. Perform Plain Turning Operations

- Select proper tool to perform the job.
- Centre the job by dial gauge
- Select the suitable speed for different operations
- Practice plain turning operation on a lathe machine
- Use measuring instruments for taking dimensions.

2.3. Perform Step Turning Operations

- Select proper tool to perform the job.
- Centre the job by dial gauge
- Select the suitable speed for different operations
- Practice step turning operation on a lathe machine
- Use measuring instruments for taking dimensions

2.4. Perform Taper Turning Operations

- Select proper tool to perform the job
- Calculate the taper angle.
- Perform job setting on Lathe machine
- Perform step turning operation on lathe.
- Practice different taper turning methods on lathe
- Perform taper turning for the required tapers by swivelling the compound rest.
- Use measuring instruments for taking dimensions

2.5. Perform Collar Turning Operations

- Select proper tool to perform the job.
- Perform job setting on the lathe machine
- Select the suitable speed for different operations
- Practice step turning operation on a lathe machine for collars
- Use measuring instruments for taking dimensions.

2.6. Perform Knurling Operations

- Select proper tool to perform the job.
- Perform job setting
- Perform tool setting
- Centre the job by dial gauge
- Select the suitable speed for different operations
- Practice knurling operation on a lathe machine
- Use measuring instruments for taking dimensions

3. Welding

3.1. Welding beads layout

- Perform Edge preparation
- Attach clamps on workpieces and grounding
- Select the correct rod and amperage range for the work you are attempting. Rod Angle (lead angle)
- Hold the electrode at suitable angle and distance with respect to the work piece to maintain the arc
- Perform Arc welding
- Identify the weld bead shape

3.2 Perform Lap Joint

- Perform Edge preparation
- Arrange the work pieces for lap joint
- Attach clamps on work pieces and grounding
- Select the correct rod and amperage range for the work you are attempting. Rod Angle (lead angle).
- Hold the electrode at suitable angle and distance with respect to the work piece to maintain the arc
- Perform Arc welding
- Identify the weld bead shape

3.3. Perform Butt Joint

- Perform Edge preparation
- Arrange the work pieces for butt joint
- Attach clamps on work pieces and grounding
- Select the correct rod and amperage range for the work you are attempting. Rod Angle (lead angle)
- Hold the electrode at suitable angle and distance with respect to the work piece to maintain the arc
- Perform Arc welding
- Identify the weld bead shape
- Perform spot welding

3.4. Perform T-Joint

- Perform Edge preparation
- Arrange the work pieces for T- joint
- Attach clamps on work pieces and grounding
- Select the correct rod and amperage range for the work you are attempting. Rod Angle (lead angle)
- Hold the electrode at suitable angle and distance with respect to the work piece to maintain the arc
- Perform Arc welding
- Identify the weld bead shape
- Perform spot welding

4.0 Metrology: Measuring Instruments

- Measuring the given component using Combination square, universal bevel protractor, sine bar.
- Measuring the given component using slip gauges, Ring and plug gauges, snap gauges
- Measuring the given component using Vernier height gauge, Vernier depth gauge, micrometer
- Measuring the given component using Tool Makers Microscope

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
C01	2		2	3			1	3	2	3
C02	2		2	3			1	3	2	3
C03	2		2	3			1	3	2	3
C04	2		2	3			1	3	2	3
AVG	2		2	3			1	3	2	3

COURSE CONTENT

1. Foundry

Moulding and casting of

1.1 Solid bearing
1.2 Flange coupling
1.3 Split bearing
1.4 Connecting rod
1.5 V – Pulley
1.6 Gear pulley

2. Turning

2.1 Facing
2.2 Plain Turning
2.3 Step Turning
2.4 Taper Turning
2.5 Turning Collars
2.6 Knurling

3. Welding

3.1 Layout of Beads
3.2 Lap joints
3.3 Butt joints.
3.4 T- joint

4. Metrology

4.1 Combination square, universal bevel protractor, sine bar.
4.2 slip gauges, Ring and plug gauges, snap gauges
4.3 Vernier height gauge, Vernier depth gauge, micrometer
4.4 Tool Makers Microscope

REFERENCES

1. Workshop Technology Vol–I by Hajra Choudhury
2. Workshop Technology by R.K. Rajput
3. A Textbook of Welding Technology by O.P. Khanna
4. Production Technology by P.C. Sharma
5. Engineering Metrology by R.K. Jain

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From Experiment 1 to 2
Unit Test-II	From Experiment 3 to 4

IV SEMESTER

DIPLOMA IN MECHANICAL ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
IV SEMESTER

Course Code	Course Title	No. of Periods / Week		Practicum (Y/N)	Total No. of Periods /Semester	Credits	Scheme of Examination			
		Theory	Practical/ Tutorial				Duration (hours)	FA Marks	SA Marks	Total Marks
THEORY COURSES										
26ME401T	Fluid Mechanics & Hydraulic Machinery	6	-	N	90	4	3	30	70	100
26ME402T	Applied Thermodynamics	6	-	N	90	4	3	30	70	100
26ME403T	Manufacturing Technology - II	6	-	N	90	4	3	30	70	100
ELECTIVE COURSES										
26ME404E	Refrigeration and Air Conditioning	3	-	N	45	2	3	30	70	100
26ME405E	Automobile Engineering									
AUDIT COURSE										
26ME406A	Artificial Intelligence & Machine Learning	2	-	N	30	-	-	-	-	-
PRACTICAL COURSES										
26ME407L	Applied Thermodynamics & Hydraulics Lab		6	N	90	2	3	40	60	100
26ME408L	Communication and Employability Skills		4	Y	60	2	3	40	60	100
26ME409L	Machine Tools Lab		6	N	90	1.5	3	40	60	100
26ME410L	Student Centric Activities		3	N	45	0.5	-	-	-	-
	TOTAL	**23**	**19**		**630**	**20**		**240**	**460**	**700**

Note 1: 0.5 credits will be awarded for student centric activities based on the participation in the extra Curricular activities like NSS/NCC/Clean and Green or Sports/ Games

Note 2: 26ME408L is common laboratory to all programmes. 26ME401T is common with 26MR401T, 26ME402T is common with 26MR402T, 26ME403T is common with 26MR403T, 26ME405E is common with 26MR405E, 26ME406A is common with 26MR406A, 26ME407L is common with 26MR407L.

FLUID MECHANICS & HYDRAULIC MACHINERY

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME401T	Fluid Mechanics & Hydraulic Machinery	06	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1	Properties of Fluid and fluid pressure measurement	13	14	2	1	CO1
2	Mechanics of Fluid flow	16	22	2	2	CO2
3	Flow through Pipes	16	22	2	2	CO3
4	Impact of jet on vanes	15	14	2	1	CO4
5	Hydraulic Machines	30	28	4	2	CO5
Total		90	100	12	8	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Understand the Fluid properties and pressure measurement
2	Understand the behaviour of liquids in motion and various losses in flow through conduits.
3	Understand the working of hydraulic machines

COURSE OUTCOMES

CO1	ME401.1	Selection of suitable fluid for various applications based on fluid properties
C02	ME401.2	Apply the continuity and Bernoulli's equation on flow of liquids through conduits
C03	ME401.3	Estimate frictional losses, minor losses and design the pipe for flow of liquids through pipes.
C04	ME401.4	Analyze forces on plates or vanes due to impact of jets
CO5	ME401.5	Describe the working of hydraulic machines and estimate the work done and efficiency of hydraulic machines

LEARNING OUTCOMES

Upon the completion of the course the student shall be able to

1.0. Understand the Fluid Properties and Pressure

1.1 Define fluid
1.2 Classify fluids
1.3 Define fluid mechanics
1.4 Classify fluid mechanics
1.5 Define statics, kinematics and dynamics
1.6 Define (i) Density (ii) Specific volume (iii) Specific weight (iv) Specific gravity (v) Surface tension (vi) Capillarity (vii) Compressibility (viii) Bulk modulus and solve simple problems
1.7 Define viscosity
1.8 State Newton's law of Viscosity
1.9 Define dynamic viscosity, kinematics viscosity and state their units
1.10 Variation of viscosity with temperature
1.11 Define fluid pressure and its units
1.12 Finding the Fluid pressure at a point
1.13 State Pascal's law
1.14 Explain the difference between absolute pressure, atmospheric pressure, gauge pressure and vacuum pressure
1.15 Classify pressure measuring instruments with examples.
1.16 Explain Piezometer, simple and differential U-Tube manometers with sketches and Solve Simple problems.
1.17 Explain the construction and working of Bourdon tube pressure gauge

2.0. Understand the Behaviour of Liquid in Flow

2.1 Define fluid kinematics and dynamics
2.2 State the types of fluid flow
2.4 Define (i) steady flow and unsteady flow (ii)uniform flow and non-uniform flow (iii) one, two and three dimensional flow (iv) rotational and irrotational flow (v) laminar and turbulent flow (vi) compressible and incompressible flows
2.5 Define rate of flow or discharge
2.6 State law of continuity and explain continuity equation and solve simple problems on discharge and law of continuity.
2.7 List and explain various types of heads of liquid in motion
2.8 State the assumptions and limitations of Bernoulli's theorem
2.9 State Bernoulli's theorem
2.10 Write Bernoulli's equation (without proof) and solve simple problems.
2.11 List the practical applications of Bernoulli's theorem.
2.12 Explain working principle of Pitot tube meter
2.12 Explain working principle of venturi meter.
2.13 Explain working principle of Orifice meter.
2.14 solve simple problems on Venturi meter and Orifice meter

3.0. Flow of Liquids through Pipes

3.1 Define and classify the loss of energy in pipes
3.2 Define loss of head in pipes due to friction (major energy losses)
3.3 State the Darcy- Weisbach's formula (without proof) and solve simple Problems.

3.4 State Chezy's equation for frictional losses solve simple Problems.
3.5 List out the minor energy losses in pipe along with formulae.
3.6 Explain Hydraulic gradient line and Total energy line.
3.7 Explain the function of siphon and give reason for limiting the height of the pipes
3.8 Explain Pipes in series, pipes in parallel and concept of equivalent pipe with applications and solve simple Problems.
3.9 State the condition for maximum transmission of power and maximum efficiency (without proof)
3.10 Solve simple problems on Power Transmission.

4.0 Describe the Concept of Impact of Jets on Plate in Various Conditions

4.1 Derive an expression for the force of jet exerted on a fixed flat plate held normal to the jet
4.2 Derive an expression for the force of jet exerted on a fixed flat plate held inclined to the jet
4.3 Derive an expression for the force of jet exerted on a fixed curved plate strikes at center.
4.4 Derive an expression for the force of jet exerted on a moving flat plate held normal to the jet
4.5 Derive an expression for the force of jet exerted on a moving flat plate held inclined to the jet
4.6 Derive an expression for the force of jet exerted on series of flat plates fixed on the rim of wheel
4.7 Derive an expression for the force of jet exerted on series of radial curved vanes
4.8 Explain power and efficiency of jet for all the above with formulae and solve the problems

5.0 Understand the Working of Hydraulic Machines

5.1 State the importance of water turbines
5.2 Explain the schematic layout of Hydraulic Power plant
5.3 Definition and classifications of turbines
5.4 Definitions of heads and efficiencies of turbine
5.5 Explain the construction details and working of Pelton wheel.
5.6 Write down the formulae for work done and efficiency of Pelton wheel
5.7 Explain the construction details and working of Francis turbine.
5.8 write down the formulae for work done and efficiency of Francis turbine.
5.9 Explain the construction details and working of Kaplan turbine.
5.10 write down the formulae for work done and efficiency of Kaplan turbine
5.11 Solve the problems on water turbines
5.12 Define the hydraulic pump and explain its function.
5.13 Classify the hydraulic pumps
5.14 Explain the principle of operation of reciprocating pumps
5.15 Describe the constructional details of single acting pump and double acting pump
5.16 Explain the slip in the reciprocating pump
5.17 Explain the principle of air vessel with respect to reciprocating pump
5.18 Explain the constructional details of centrifugal pump
5.19 Compare the centrifugal pump with a reciprocating pump
5.20 Explain the working of multi-stage pumps with a legible sketch (Series and parallel)
5.21 Explain the importance of priming in centrifugal pump

5.22 Explain the phenomenon of cavitation and state its effect
5.23 Write the expressions for static and manometric head of centrifugal pump
5.24 Write the formula for work done by the impeller of centrifugal pump
5.25 Explain the various losses and efficiencies of a centrifugal pump
5.26 Solve simple problems on centrifugal pumps
5.27 Smart Pumping Systems & IoT

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3						1	2	3	1
CO2	3	2					1	2	3	1
CO3	3	2					1	2	3	1
CO4	3	2					1	2	3	1
CO5	3	2					1	2	3	1
AVG	3	2					1	2	3	1

COURSE CONTENTS

1.0. Properties of Fluid and Fluid Measurement

Fluid, Properties of fluids - Definitions, units and formulae of Mass Density, Specific Volume, Specific Weight, Specific Gravity, Viscosity, Newton's law of viscosity, Kinematic Viscosity, cohesion and adhesion, Surface Tension, Capillarity, Compressibility and Bulk Modulus and their units - classifications of fluids - simple problems.

Pressure and units of pressure - Relation between vacuum, gauge, absolute and atmospheric pressure, Pressure head of a liquid, Pascal's law - Pressure measuring instruments: Piezometer, Manometers –Simple U-tube and Differential U-tube - Simple problems on U-tube manometers – Working Principle and construction of Bourdon Pressure gauge.

2.0. Mechanics of Fluid Flow

Fluid Kinematics & Dynamics: Eulerian & Lagrangian description of the flow field-Types of fluid flow, Steady and unsteady flow, Uniform and non-uniform flow - laminar and turbulent flows, Rotational and Irrotational flow, Compressible and in-compressible flow - Rate of flow or discharge, Continuity equation, Simple problems. Various forms of energy present in fluid flow, Pressure energy, Potential energy, Kinetic energy, total energy, Bernoulli's equation, assumptions made in Bernoulli's equation, applications of Bernoulli's equation- pitot tube, venturi meter and orifice meter- simple problems.

3.0. Flow through Pipes

Losses in pipe lines, Major losses Loss of head in pipes due to friction, Darcy-Weisbach's formula (without proof), Chezy's equation for frictional losses (without proof) - coefficient of friction and friction factor -Simple Problems ; minor losses – list and formulae to find out minor losses, Pipes in series, pipes in parallel, concept of equivalent pipe–Simple Problems - Hydraulic Gradient Line and Total Energy lines –siphon, Expressions for power transmitted through pipes carrying liquid under pressure. Expressions of transmission efficiency, condition for maximum efficiency (without proof). Simple problems on power transmission through pipes, Simple problems.

4.0. Impact of Jets on Vanes

Impulse-momentum principle, Force exerted by a jet striking normally on a fixed plate, inclined fixed plate, on fixed curved vane strikes at centre. Force of jet on moving flat plate held normal to the jet, moving flat plate held inclined to the jet, force of jet exerted on series of flat plates fixed on the rim of wheel and force of jet exerted on series of radial curved vanes-work done and efficiency. Simple Problems on impact of jets.

5.0. Hydraulic Machines

Introduction to hydraulic machines- water turbines, pumps. Use of water turbines in Hydro-electric power stations; line sketch showing layout of hydro-electric power plant, Classification of turbines. Working principle of Pelton wheel, Francis turbine and Kaplan turbine with simple line sketches only. Work done and Efficiencies of Pelton wheel and Francis turbine (Without derivation), Simple Problems on power & efficiency of water turbines, Function of a pump. Classification of pumps. Principle of operation of a reciprocating pump. Constructional details of single acting, double acting pumps. Coefficient of discharge, slip, % of slip and negative slip. Air vessel. Working principle & Constructional details of centrifugal pump. Comparison between Reciprocating and Centrifugal pumps. Priming of centrifugal pump and its necessary. Work done by the impeller, Static head, Manometric head. Efficiencies-Manometric efficiency, Volumetric efficiency, Mechanical efficiency and Overall efficiency. Cavitation and its effect. Simple problems on work, power and efficiency. Introduce the concept of integrating sensors, data analytics, and the Internet of Things (IoT) to create smart pumping systems with block diagram.

REFERENCE BOOKS

1	Fluid Mechanics	Dr. A. K. Jain	Khanna Publishers, Delhi
2	Fluid Mechanics and Machinery	B C S Rao	Tata McGraw Hill Publishers
3	Fluid Mechanics and Hydraulic Machines	R.K.Bansal	Laxmi Publications(P)Ltd New Delhi
4	Fluid Mechanics and Hydraulic Machines	Dr.D. S. Kumar	S.K KATARIA &SONS. New Delhi
5	Fluid Mechanics	Frank M. White & Henry Xuo	McGraw Hill Publishers
6	Fluid Mechanics Fundamentals & Applications	Yunus A. Cengel, John M. Cimbala	McGraw Hill Publishers

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.10
Unit Test-II	From 4.1 to 5.27

APPLIED THERMODYNAMICS

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME402T	Applied Thermodynamics	06	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1	Internal Combustion Engines.	30	25	3	2	CO1
2	Air Compressors	10	14	2	1	CO2
3	Power Plants	25	25	3	2	CO3
4	Gas Turbines & Jet Propulsion.	10	14	2	1	CO4
5	Basics of Refrigeration and Air conditioning	15	22	2	2	CO5
	Total	90	100	12	8	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	apply the principles and concepts of thermodynamic systems to solve the real time applications

COURSE OUTCOMES

CO1	ME402.1	Describe the working of I.C. Engines and Solve numerical problems related to performance of I.C. Engines.
CO2	ME402.2	Describe the working of Air compressors and solve numerical problems.
CO3	ME402.3	Describe the functions and working of elements of thermal power plant and Nuclear power plants.
CO4	ME402.4	Describe the working of Gas turbines and Jet propulsion
CO5	ME402.5	Understand the principles and concepts of R&AC systems

LEARNING OBJECTIVES

Upon completion of the course the student shall be able to

1.0 Internal Combustion Engines and Transmission

1.1 Define “Heat Engine” and classify heat engines based on the location of

combustion.
1.2 Classify Internal Combustion Engines.
1.3 Describe the working of four-stroke petrol and diesel engines with line diagrams.
1.4 Describe the working of two-stroke petrol engine with line diagrams.
1.5 Compare two stroke engines with four stroke engines
1.6 Describe the working of fuel system of diesel engine with a line diagram.
1.7 Describe the working of fuel system of petrol engine with a line diagram.
1.8 Describe the working of Zenith carburetor with a neat sketch.
1.9 Explain different methods of cooling systems of I.C engines.
1.10 Explain different methods of Ignition systems of IC engine.
1.11 Explain different methods of lubricating systems in I.C. engines.
1.12 Explain different methods of governing of I.C. engines.
1.13 List performance parameters of an IC engine.
1.14 Write the mathematical formulae for the performance parameters of an I.C engine
1.15 Solve simple problems on various performance parameters.
1.16 Draw the layout of automobile transmission system and mention function of each component

2.0 Air Compressors

2.1. List the functions of air compressors and the uses of compressed air.
2.2. Categorize the different types of air compressors.
2.3. Describe the working of a single stage reciprocating air compressor with a line diagram
2.4. State the formula for work done and power required to compress the air in a single stage air compressor. (No derivation).
2.5. Solve simple problems on single acting single stage reciprocating air compressors. (Neglecting clearance volume).
2.6. Summarize the advantages of multi-stage compression over single stage compression.
2.7. Explain the use of intercooler.
2.8. List the types of rotary compressors- Distinguish reciprocating air compressors with rotary air compressors.
2.9. Describe the working of a centrifugal compressor, axial flow type compressor and vane type compressor with a line diagrams.

3.0 Power Plants

3.1 Describe the functions of elements of a thermal power plant.
3.2 State the functions of a boiler
3.3 Classify the boilers.
3.4 Distinguish between water-tube and fire-tube boilers
3.5 State the need of high pressure modern boilers
3.6 Explain the working principle of Lamont and Benson Boilers with legible sketches.
3.7 State the function of the mountings such as pressure gauge, water level indicator, safety valve, fusible plug, blow down cock and stop valve
3.8 State the function of the accessories such as feed pump, air preheater, economizer, super heater, steam traps and steam separators.
3.9 Explain the Flow of steam through nozzle.
3.10 Write the expression and calculate Velocity of steam at the exit of nozzle in terms of heat drop analytically and by using Mollier chart (simple problems).
3.11 Explain the principle of working of a steam turbine.
3.12 Classify the turbines with examples.

3.13 Explain the principle of working of a simple De-Laval turbine with a line diagram.
3.14 Explain the working principle of Parson's Reaction turbine with a line diagram.
3.15 State the function of Steam Condensers and give classification of steam condensers
3.16 Describe working of nuclear reactor.
3.17 Explain with the help of legible sketches the working principles of PWR and BWR.

4.0 Gas Turbines & Jet Propulsions

4.1 Define and classify the gas turbines.
4.2 Describe the working of an open cycle constant pressure type gas turbine with a line diagram.
4.3 Describe the working of a closed cycle constant pressure type gas turbine with a line diagram.
4.4 Explain the concept of jet propulsion.
4.5 Describe the principle of operation of Ram jet engine with a line diagram.
4.6 Describe the principle of operation of Turbo- jet engine with a line diagram.
4.7 State the applications of jet engine.
4.8 Describe the working of a rocket engine with a line sketch.
4.9 List the fuels used in Gas turbines and jet propulsion.

5.0 Refrigeration and Air Conditions

5.1 Define the term 'Refrigeration'.
5.2 List different methods of refrigeration and applications.
5.3 Define the terms 'Ton of Refrigeration, Coefficient of Performance.
5.4 Describe main components and Principle of working of a vapour compression refrigeration system.
5.5 Explain vapour compression refrigeration system with the help of p-V, T-s and p-H diagrams.
5.6 Describe the Principle of working of Ammonia vapour absorption refrigeration system.
5.7 Define Refrigerant and Classify refrigerants with examples.
5.8 List out properties of refrigerants
5.9 Define air conditioning
5.10 Explain Air conditioning as applied to human comfort.
5.11 Define Psychrometry- Define the terms: humidity, Relative humidity, dew point, DBT & WBT, Absolute humidity, humidity ratio, Degree of saturation, sensible heat, latent heat and total heat of moist
5.12 Explain the features of Psychrometric chart.
5.13 List and briefly explain various Psychrometric processes with the help of Psychrometric chart.

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2					1	1	2	
CO2	3						1	2	2	
CO3	3	2	2				1	2	3	
CO4	3	2					1	2	3	
CO5	3						1	1	2	
AVG	3	2	2				1	1.6	1.4	

COURSE CONTENTS

1.0 Internal Combustion Engines and Transmission

Heat engines – Classification - Internal combustion engines: Classification of I.C. engines – Components of I.C engine - Functions of each part and materials used for the parts – Working of four-stroke diesel engine, four stroke and two stroke petrol engines with line diagrams - Comparison of two stroke engines and four stroke engines - Comparison of diesel engine and petrol engine.

Description of diesel engine fuel system and petrol engine fuel system (only line diagram) - Working of Zenith Carburettor – Cooling system of I.C. engines: Working of Air cooling and water cooling systems- Ignition systems: Working of Battery coil ignition system and magneto ignition systems - Lubricating systems: Principle of operation of Splash and Pressure lubricating systems –Brief description of Governing systems of I.C. engines.

Recent advances in I.C. engines - Super charging and Turbocharging- basic concepts of different Fuel injection systems such as MPFI, CRDI, EGR and VVT – Salient features of BS-VI,VII Regulations.

Performance of I.C Engine -– Definitions and Mathematical Expressions for I.P, B.P, F.P, Mechanical efficiency, indicated thermal efficiency, Brake thermal efficiency and Specific fuel consumption- Simple problems on the above parameters.

Automobile Transmission - Layout of automobile transmission system- Functions of each component like Rear axle, Brake system and Suspension system -

2.0 Air Compressors

Functions of air compressor – Uses of compressed air – Types of air compressors – Working of Single stage reciprocating air compressor (with line-diagram) using p-V diagram. Formulae for work required and power required compressing the air for polytropic compression. (Derivations omitted) - Simple problems on calculation of work done and power required for single acting single stage air compressors. (Neglecting clearance volume). Multistage compressors – advantages over single stage compressors - Rotary compressors – Types – Describe the working of Centrifugal compressor - Axial flow type compressor - Vane type compressors- Advantages, disadvantages and applications.

3.0 Power Plants

Thermal Power Plants: Functions of the elements of a Thermal Power Plant – Definition of steam boiler - Functions and Classification of steam boilers – Examples -Comparison of water tube and fire tube boilers.

Modern high pressure boilers –Examples – Advantages - Working Principle of Lamont and Benson boilers with line diagrams.

Boiler Mountings: Functions of pressure gauge, water level indicator, fusible plug, blow down cock, stop valve, safety valves.

Boiler accessories: Functions of feed pump, economiser, super heater and air pre-heater, steam trap and steam separator

Steam Turbines.

Flow of steam through nozzle - Velocity of steam at the exit of nozzle in terms of heat drop by analytical and Mollier diagram

Steam Turbines: Classification of - Working principle of a simple De-Laval turbine - Working principle of a Parson's Reaction turbine - Difference between Impulse & Reaction turbines.

Steam Condensers: Functions – Elements of condensing plant- Classification of condensers.

Nuclear Power Plants: Nuclear fuels –fissile and fertile fuels – Nuclear fission and fusion – Working of Nuclear reactor – Working principle of pressurized water reactor – Working principle of boiling water reactor – Advantages and Disadvantages of nuclear power plants.

4.0. Gas Turbines & Jet Propulsion

Gas turbines: Purpose - Classification – Fuels used - Applications and limitations of gas turbines- Working of Open cycle and closed cycle gas turbines .

Jet Propulsion: Concept of Jet Propulsion – Principle of operation of jet engine – Applications- Types of Jet Propulsion - Principle of operation of Ram jet engine and Turbojet engines – Principle of working & applications of Rocket engine - Fuels used in jet propulsion.

5.0. Refrigeration & Air Conditioning

Introduction – Definition and meaning of refrigeration-Methods of refrigeration – unit of refrigeration – Refrigeration effect – Coefficient of Performance - applications of refrigeration

Working principle of simple vapour compression refrigeration system. Write expression for COP of vapour compression refrigeration cycle with the help of T-s & p-H diagrams –

Working principle of Ammonia vapour absorption refrigeration system –-

Refrigerants – Classification - Primary and secondary refrigerants with examples –- Properties of refrigerants.

Definition of Air conditioning – Applications- Classification - Human comfort – Factors effecting human comfort - effective temperature.

Definitions of Psychrometric terms– dry air, wet air, moist air, saturate air, Partial pressure, humidity, Relative humidity, dew point, DBT & WBT, Absolute humidity, humidity ratio, Degree of saturation, sensible heat, latent heat and total heat of moist

List and explanation of various psychrometric processes with the help of Psychrometric chart(problems omitted).

REFERENCE BOOKS

1.R.S. Khurmi & J K Guptha, Thermal Engineering, 2006, S CHAND publishers
2.Mahesh M Rathore, Thermal Engineering, 2010, MGH Publishers
3. Mathur & Mehtha, Thermal Engineering, 2009, Jain Brothers
4. Heywood, Internal Combustion Engines Fundamentals, 2017, MGH Publishers
5. P.L. Ballaney, Thermal Engineering, 1966, Khanna Publishers
6. Automobile technology – Narang.
7. Basic and Applied Thermodynamics by PK. Nag MGH Publishers
8. Thermodynamics an Engineering Approach by Yunus A. Cenegal MGH Publishers

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.8
Unit Test-II	From 3.9 to 5.13

MANUFACTURING TECHNOLOGY – II

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME403T	Manufacturing Technology - II	06	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1	Production of Iron and Steel	16	18	2	1.5	CO1
2	Heat treatment of Steel	12	17	3	1	CO2
3	Milling Machines and Gear Making Processes	24	22	2	2	CO3
4	Welding	22	22	2	2	CO4
5	Nonconventional Machining Processes	16	21	3	1.5	CO5
	Total	90	100	12	8	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Understand production of iron and steel, heat treatment methods Process
2	Explain construction and working of milling machines, Gear Making processes and Importance of nonconventional machining processes

COURSE OUTCOMES

CO1	ME403.1	Describe iron and steel production processes
CO2	ME403.2	Discuss the iron-carbon equilibrium diagram and heat treatment processes
CO3	ME403.3	Describe the constructional features of Milling machines and Gear Making Processes.
CO4	ME403.4	Explain the working principle of various welding processes and Describe welding operations by using different welding equipment.
C05	ME403.5	Describe different Nonconventional machining processes.

LEARNING OUTCOMES

Upon completion of the course the student shall be able to

1.0 Production of Iron and Steel

1.1 Name the various raw materials required for production of iron.
1.2 Describe the method of producing Pig Iron in Blast furnace.
1.3 Describe the puddling furnace to produce wrought iron.
1.4 Explain the process of manufacturing cast iron in Cupola.
1.5 Describe the manufacturing of steel by Bessemer process, L.D. process, Open Hearth and Electric Process.

2.0 Heat Treatment of Steel

2.1 Explain the cooling curves of pure metal.
2.2 Mention the allotropic forms of pure iron with temperatures and their crystal structures.
2.3 Draw the iron carbon equilibrium diagram, identify various structures of the iron carbon system.
2.4 State the importance of heat treatment for steels.
2.5 Explain Annealing, Normalising, Hardening and Tempering.
2.6 Explain use of case hardening processes like; carburizing, nitriding and Cyaniding.

3.0 Milling Machines and Gear Making Processes

3.1 Explain the working principle of a Milling machine
3.2 Explain the constructional details and Principle of operation of Column and knee type and Universal milling machines with legible sketches.
3.3 State the purpose and list the methods of indexing.
3.4 List different types of milling cutters and their applications.
3.5 State the functions of different tool holding devices.
3.6 State the functions of different work holding devices.
3.7 Explain various milling operations.
3.8 List specifications of milling machines.
3.9 List key aspects of gear Nomenclature
3.10 List methods of producing gears.
3.11 Describe the method of gear manufacturing by Gear shaping.
3.12 Describe the method of gear generation by Gear hobbing.
3.13 Explain various gear finishing operations.

4.0 Welding

4.1. State a) the necessity of welding
b) The advantages and limitations of welding.
c) The principle of flame cutting.
d) The relative advantages of flame cutting over other types of cutting.
4.2. List six welding processes.
4.3. Explain a) the principle of arc welding.
b) The principle of gas welding.
c) The principle of TIG and MIG welding.
d) Different welding procedures in arc and gas welding.
4.4. List a) The tools and equipment of arc welding.
b) The tools and equipment of oxy-acetylene welding.
4.5. Identify proper electrodes used for given metals
4.6. The gas cutting equipment.

4.7. List various defect in welds and their remedies.
4.8. Explain Modern welding techniques such as Submerged, CO_2, Atomic – Hydrogen, Ultrasonic welding

5.0 Non Conventional Machining Processes

5.1 Distinguish between nonconventional machining processes and conventional methods.
5.2 State the relative advantages and applications of nonconventional machining processes.
5.3 Describe Ultrasonic machining (USM) Process with advantages and disadvantages.
5.4 Describe Electrical Discharge Machining (EDM) Process with advantages and disadvantages
5.5 Describe of Abrasive jet machining (AJM) with advantages and disadvantages.
5.6 Describe of Laser beam machining (LBM) with advantages and disadvantages.

CO-PO/PSO MATRIX

CO's	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3			1			1	2	2	1
CO2	3			1			1	2	2	1
CO3	3			1			1	2	2	1
CO4	3			1			1	2	2	1
CO5	3			1			1	2	2	1
AVG	3			1			1	2	2	1

COURSE CONTENTS

1.0 Production of Iron and Steel

Raw materials, iron ores, Lime stone, Manufacturing of pig iron from blast furnace. Wrought iron by puddling furnace. Cast Iron from cupola. Production of steel by Bessemer, L.D. process; Open hearth and Electric processes.

2.0 Heat Treatment of Steel

Cooling curve for pure metal. Allotropic forms of pure Iron. Iron carbon equilibrium diagram. Importance of heat treatment. Heat treatment processes – annealing, normalizing, hardening, tempering, carburizing, nitriding and cyaniding.

3.0 Milling Machines and Gear Generating Processes

Definition - Types of Milling machines: Constructional details and Principle of operation of Column and knee type and Universal milling machines - Specification of milling machines – Purpose of indexing – Methods of indexing - Work holding and Tool holding devices – Types of milling cutters – Cutter materials - Milling Operations :Face Milling, Plain Milling, Side Milling, Straddle Milling and Gang Milling. Definition of Gear – Gear nomenclature - Methods of manufacturing of gears – Gear generating processes: Principle of operation of Gear Shaping and Gear hobbing – Gear materials - Gear finishing processes: Burnishing, Shaving, Honing, Lapping and Super finishing

4.0. Welding

Introduction-Classification of welding processes. Advantages and limitations of welding. Principles of arc welding. Arc welding equipment. Choice of electrodes for different metals. Principle of gas (oxy acetylene) welding. Equipment of gas welding. Welding procedures (arc& gas). Various flame cutting processes - Defects in welding and remedies – safety practices in welding. Modern welding methods, (Submerged, CO2, Atomic – Hydrogen, ultrasonic welding), Brief description of MIG & TIG Welding.

5.0 Non Conventional Machining Processes

Introduction – Comparison with Conventional machining processes – Methods of Nonconventional Machining Processes – Applications. Description of Ultrasonic machining (USM) Process - advantages – disadvantages. Description of Electrical Discharge Machining (EDM) Process – advantages – disadvantages. Description of Abrasive jet machining - advantages – disadvantages. Description of Laser beam machining - advantages – disadvantages.

REFERENCE BOOKS

1. Material Science and Engineering - Raghavan PHI Publishers
2. Introduction to Physical Metallurgy - Avner Tata McGraw Hill Publishers
3. Material science and metallurgy - O P Khanna Dhanpati Rai Publishers
4. Manufacturing Technology - P N Rao (MGH Publishers)
5. Production Technology - R.C.Patel
6. Production Technology - Jain & Gupta.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.10
Unit Test-II	From 3.11 to 5.6

REFRIGERATION & AIR CONDITIONING

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME404E	Refrigeration & Air Conditioning	03	45	30	70	2

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1	Fundamentals of Refrigeration	7	14	2	1	CO1
2	Vapour compression & Vapour absorption Refrigeration Systems	12	25	3	2	CO2
3	Refrigeration equipment & Applications of Refrigeration.	9	22	2	2	CO3
4	Air Conditioning & Psychrometry	9	25	3	2	CO4
5	Air Conditioning Equipment & Applications of Air Conditioning.	8	14	2	1	CO5
Total		45	100	12	8	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Analyse the reversed Carnot cycle and vapour compression, absorption refrigeration cycles.
2	Identify Psychrometric process for different applications and understand the concept of human comfort and affective temperature

COURSE OUTCOMES

CO1	ME404.1	Understand the principles of refrigeration
CO2	ME404.2	Understand the principles of vapour compression and vapour absorption systems.
CO3	ME404.3	Describe the Working of Refrigeration and Air Conditioning equipment.
CO4	ME404.4	Explain the various psychometric properties and Processes
CO5	ME404.5	Describe the working of air conditioning equipment and their applications.

LEARNING OUTCOMES

Upon on completion of the course the student shall be able to:

1.0 Fundamentals of Refrigeration

1.1 Define the term 'Refrigeration'.
1.2 List different methods of refrigeration with applications.
1.3 Define the term 'Ton of Refrigeration'. Give the value in S.I units.
1.4 Define the term 'Coefficient of Performance'.
1.5 Explain Carnot refrigeration cycle by plotting it on p-V and T-s diagrams.
1.6 Explain thermodynamic processes involved in air refrigeration cycle working on bell coleman cycle.

2.0 Vapour Compression and Vapour Absorption Refrigeration System

2.1 Describe main components and Principle of working of a vapour compression refrigeration system with flash chamber and accumulator.
2.2 Explain theoretical vapour compression refrigeration system with the help of p-V, T-s and p-H diagrams.
2.3 Calculate COP of ideal vapour compression refrigeration Cycle when the vapour is dry and saturated at the beginning and end of compression without undercooling - Simple problems.
2.4 Define Refrigerant and Classify refrigerants with examples.
2.5 Explain properties of various refrigerants
2.6 List out various refrigerants used.
2.7 Describe main components and Principle of working of Ammonia vapour absorption refrigeration system.
2.8 Describe the working of Electrolux refrigerator with the help of a legible sketch.
2.9 Describe the working of a solar powered vapour absorption refrigeration system with the help of a legible sketch.

3.0 Refrigeration Equipment & Applications of Refrigeration

3.1 State the functions of Refrigeration equipment.
3.2 List out different types of compressors
3.3 Explain principle of working of Hermetically sealed compressor
3.4 Explain principle of working of vane type rotary compressor
3.5 List out different types of condensers
3.6 Describe shell and coil condensers with the help of legible sketches.
3.7 Describe evaporative condensers with the help of legible sketches
3.8 List out different types of evaporators
3.9 Explain the flood
3.10 ed type evaporators with the help of legible sketches.

3.11 Explain the working of expansion devices such as capillary tube, thermostatic expansion valve, automatic expansion valve with the help of legible sketches.
3.12 Describe the working of a domestic refrigerator with the help of a legible sketch.
3.13 Describe the working of an ice plant with the help of a legible sketch.
3.14 Describe the working of a water cooler with the help of a legible sketch.

4.0 Air Conditioning & Psychrometry

4.1 Define air conditioning.
4.2 List modern applications of air conditioning.
4.3 Explain Air conditioning as applied to human comfort.
4.4 Define Psychrometry- Define the terms :humidity, Relative humidity, dew point, DBT & WBT, Absolute humidity, humidity ratio.
4.5 Explain the features of Psychrometric chart.
4.6 Simple problems by using Psychrometric chart and mathematical formulae
a. List and explain various Psychrometric processes with the help of Psychrometric chart.
b. Define cooling load and List the components involved in computation of cooling load
4.9 Define heating load and List the components involved in computation of heating load

5.0 Air Conditioning Equipment & Applications of Air Conditioning

5.1 State the functions of air conditioning equipment viz,. fans, ducts, filters, dust collectors, heating and cooling coils.
5.2 Explain various air distribution systems.
5.3 Describe the working of a window air – conditioner with a neat sketch.
5.4 Illustrate the working of summer air conditioning system.
5.5 Illustrate the working of winter air conditioning system.
5.6 Working of Split type, Central Air Conditioning systems (Description only)

CO-PO/PSO MATRIX

CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2				1	2	2	
CO2	3	2	2				1	2	2	
CO3	3						1	2	2	1
CO4	3	2	2				1	2	2	
CO5	3						1	2	2	1
AVG	3	2	2				1	2	2	1

COURSE CONTENT

1.0 Fundamentals of Refrigeration

Introduction – Definition and meaning of refrigeration-Methods of refrigeration – unit of refrigeration – Refrigeration effect – Coefficient of Performance – Power required Capacity of the refrigerating system-Simple problems

Working of Carnot refrigeration System - Thermodynamic analysis of Carnot refrigeration cycle on p-V and T-s diagrams.

Air Refrigeration System: Explanation of Thermodynamic Processes of Bell-Coleman Cycle with p-V and T- s diagrams.

2.0 Vapour Compression & Vapour Absorption Refrigeration System

Compression Refrigeration System: Functions of components and working principal of simple vapour compression refrigeration system with flash chamber and accumulator – Explanation of thermodynamic processes and Write expression for COP of vapour compression refrigeration cycle with the help of T-s & p-H diagrams – COP of theoretical vapour compression refrigeration system – Simple problems.

Wet and dry compression –Effect of under cooling and super heating on COP.

Refrigerants : Refrigerants – Classification - Primary and secondary refrigerants with examples – Selection of refrigerants – Thermal, Physical, Chemical, Safety and Environmental properties of ideal refrigerant –List the various refrigerants like Ammonia, Carbon di-oxide, Freon-12, Freon-22, Brine solutions, R-32, R-410a, R-134a and HFOs.

Vapour Absorption Refrigeration System: Functions of components and working principal of vapour absorption refrigeration system – Working of Electrolux refrigerator and Solar powered vapour absorption refrigeration systems.

3.0 Refrigeration Equipment and Application

Refrigeration Equipment

Equipment used in Refrigeration systems;

Compressors – types of compressors – Working of Hermetically sealed compressor – Working of vane type rotary compressor.

Condensers – types of condensers – Working of Air cooled, Water cooled and Evaporative type condensers.

Evaporators – types of evaporators – Working principle of flooded type evaporators.

Expansion devices – types of expansion devices – Working principle of capillary tube, thermostatic expansion device, automatic expansion valve with neat sketches.

Applications of Refrigeration:

Working of Domestic refrigerator, Ice plant and Water cooler with neat sketches.

AIR CONDITIONING

4.0 Air Conditioning & Psychrometry

Air conditioning: Definition – Applications- Classification - Human comfort – Factors effecting human comfort - effective temperature

Psychrometry – Definitions of Psychrometric terms– dry air, wet air, moist air, saturate air, Partial pressure, humidity, Relative humidity, dew point, DBT & WBT, Absolute humidity, humidity ratio, Degree of saturation, sensible heat, latent heat and total heat of moist air - Solving simple problems using psychrometric chart and mathematical formulas.

Psychrometric chart - List and explanation of various psychrometric processes with the help of Psychrometric chart (problems on psychrometric processes are omitted).

Cooling load: definition – List the components involved in computation of cooling load.
Heating load: definition – List the components involved in computation of heating load.

5.0 Air Conditioning Equipment & Applications

Air Conditioning Equipment: Functions of Air Conditioning equipment such as fans, supply ducts, outlets, return outlets, ducts, Grills, dampers, registers, humidifiers, dehumidifiers, Heating and cooling coils, Filters and dust collectors.
Working of Air distribution Systems: Radial perimeter, loop perimeter and extended plenum systems.

Applications of Air conditioning:

Describe the working of Window air conditioner – Describe the working of Summer and Winter air conditioning systems – Working Principle of Split type, Central AC systems.

REFERENCE BOOKS

1. Arora C P, Refrigeration and Air Conditioning, 2009, MGH Publishers
2. P N Ananthanarayana, Basic Refrigeration and Air conditioning, 2013, MGH Publishers
3. John Tomczyk, Troubleshooting and Servicing Modern Air Conditioning and Refrigeration Systems, 1995, Esco Press

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.5
Unit Test-II	From 3.6 to 5.6

AUTOMOBILE ENGINEERING

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME405E	Automobile Engineering	03	45	30	70	2

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1	Basics of Automobile Engineering	4	6	2		CO1
2	Automobile transmission systems	10	25	3	2	CO2
3	Automobile chassis & Body Engineering	11	25	3	2	CO3
4	Introduction to Electric, Electric hybrid vehicles & Energy storage	10	22	2	2	CO4
5	Drive Train and Electric Propulsion	10	22	2	2	CO5
TOTAL		45	100	12	8	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Understand the Details of components in automobiles (Transmission systems, Chassis and body
2	Understand the basic concepts, Energy storage, Drive train and Electric Propulsion details of Electric, Electric Hybrid vehicles.

COURSE OUTCOMES

CO1	ME405.1	Know the basics of automobile Engineering
CO2	ME405.2	Describe and explain the working of components of Automobile Transmission Systems
CO3	ME405.3	Describe and explain the components of Automobile Chassis and Body
CO4	ME405.4	Explain the basics of Electric, Electric Hybrid vehicles and Energy storage in Electric, Electric Hybrid vehicles
CO5	ME405.5	Explain the Drive trains and Electric Propulsion methods used in Electric, Electric Hybrid vehicles.

LEARNING OUTCOMES

Upon completion of the course the student shall be able to

1.0 Basics of Automobile Engineering

1.0 Define Automobile
1.1 Know the history of Automobiles
1.2 Know the developments of Automobile vehicles
1.3 State the recent trends in Automobile vehicles
1.4 Explain the constructional details of different types of Inlet and exhaust manifolds
1.5 State the requirements for good manifold design
1.6 Explain the constructional details of different types of air cleaners
1.7 State the necessity of Mufflers
1.8 List different types of Mufflers
1.9 State the necessity of Emission norms
1.10 List different types of emission norms

2.0 Automobile Transmission Systems

2.1 State the purpose of automobile transmission system.
2.2 Draw the layout of automobile transmission system and explain.
2.3 List the elements of transmission system of a vehicle.
2.4 State the function of clutch.
2.5 List different types of clutches.
2.6 Explain the principles of operation of the clutch.
2.7 Draw the line diagram and explain the working clutches Single plate, Multi plate, DCT, Torque converter and CVT.
2.8 State the function of gearbox.
2.9 List different types of gearboxes.
2.10 Explain the principles and operation of sliding mesh, Constant mesh and Synchromesh with number of speeds
2.11 State the function of propeller shaft and universal joints.
2.12 List various components of front axle assembly.
2.13 List various components of rear axle assembly.
2.14 State loads acting on the rear axles.
2.15 List different types of rear axles and Explain semi floating, three quarter floating and fully floating rear axles
2.16 State the necessity of differential unit and explain the working principle of differential
2.17 State the purpose of the four-wheel drive and explain the working principle of four-wheel drive.

3.0 **Automobile Chassis & Body Engineering**

3.1 State the functions of chassis frame.
3.2 Draw the layout of the chassis.
3.3 List the components of chassis frame.
3.4 List different types of chassis frames.
3.5 Know what is steering system and types of Steering systems
3.6 Explain Ackermann steering gear mechanism and Davis steering gear mechanism.
3.7 Know various terms of Steering geometry–camber, King-pin inclination, Caster, Toe-in,Toe-out, Combined inclination and Scrub radius
3.8 Know ECU Controlled Power Assisted Steering & Electronic Power Assisted Steering-

3.9 State the functions and requirements of automobile brakes.
3.10 List different types of brakes.
3.11 Draw the layout of hydraulic and pneumatic braking systems and explain.
3.12 Know suspension system and its functions
3.13 List various suspension systems used in present Automobiles.
3.14 Describe power windows and Central locking system.
3.15 State the importance of automobile safety
3.16 List various tests to check safety of automobile body

4.0 **Introduction to Electric and Electric Hybrid Vehicles & Energy Storage**
4.1 Describe the history of electric and electric hybrid vehicles.
4.2 Describe the Social and environmental importance of Electric and Electric Hybrid vehicles.
4.3 Explain basic components of Electric and Electric Hybrid vehicles.
4.4 What is Energy Storage & list the requirements of energy storage.
4.5 Explain the working principle of Nickel and Lithium based batteries.
4.6 What is fuel and list the types of fuel cells.
4.7 State the characteristics of fuel cells.
4.8 State the applications of fuel cells.
4.9 Explain Hybridization of Energy storage and battery management and safety.

5.0 Drive Train & Electric Propulsion
5.1 Know what is Hybrid Electric drive train and various types of Hybrid Electric drive trains.
5.2 Explain working principle of Series hybrid, parallel hybrid, series-parallel and complex drive trains.
5.3 Explain torque coupling parallel and speed coupling parallel hybrid electric drive
5.4 List out advantages of parallel hybrid drive train
5.5 Describe plug in hybrid electric vehicle drive.
5.6 Describe transmission system used in EV/EHV.
5.7 Explain the principle and operation of permanent magnet brushless dc motor drive.
5.8 Explain the principle and operation of switch reluctance motor drive.
5.9 Explain methods of control of motors.
5.10 Explain configuration of drives.
5.11 List the components of braking system of EV and EHV.

CO-PO/PSO MATRIX

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	1	1	1			1	2	
CO2	3	1		1				1	2	
CO3	3	2		1				1	2	
CO4	3	1	2	2	3		1	1	2	2
CO5	3		3	3	3	2	1	1	3	
AVERAGE	3	1	1.1	1.6	1.4	1	1	1	2.2	0.4

COURSE CONTENT

1.0 Basics of Automobile Engineering

Definition & History of Automobile – Know the developments of Automobile vehicles – State the recent trends in Automobile vehicles – Explain the constructional details of different types of Inlet and exhaust manifolds – State the requirements for good manifold design –Explain the constructional details of different types of air cleaners –State the necessity of Mufflers, List different types of Mufflers – Emission norms BS IV, BS VI.

2.0 Automobile Transmission Systems

Purpose of automobile transmission system – layout of automobile transmission system – elements of transmission system – Working principle of Clutch, functions and types of clutches, Working of Single and multi-plate clutches with line diagrams – Functions and types gear box, Working of Sliding mesh, Constant mesh and synchromesh Gear boxes with line diagrams. State the function of propeller shaft and universal joints–List various components of front axle assembly –Various components of rear axle assembly, State loads acting on the rear axles, different types of rear axles and Explanation of semi floating, three quarter floating and fully floating rear axles – Necessity of differential unit and explanation of the working principle of differential. – Purpose of the four-wheel drive and working principle of four-wheel drive.

3.0 Automobile Chassis & Body Engineering

Chassis frame-layout of the chassis frame and its main components-functions of the frame-types of chassis frames - - Know what is steering system and types of Steering systems, working of Ackermann steering gear mechanism and Davis steering gear mechanism, various terms of Steering geometry–camber, King-pin inclination, Caster, Toe-in, Toe-out, Combined inclination and Scrub radius ECU(Electronic control Unit) Controlled Power Assisted Steering & Electronic Power Assisted Steering- Functions and requirements of automobile brakes, different types of brakes – Mechanical, Hydraulic, Pneumatic, Electric brakes - Working of hydraulic brakes with line diagrams - Suspension system and its functions, various suspension systems used in present Automobiles – Describe power windows and Central locking system – State the importance of automobile safety - List various tests to check safety of automobile body

4.0 Introduction to Electric and Electric Hybrid Vehicles & Energy Storage

History of electric and electric hybrid vehicles – Social and environmental importance of Electric and Electric Hybrid vehicles – Basic components of Electric and Electric Hybrid vehicles – Explanation of concept Energy Storage requirements of energy storage – Explanation of the working principle of Nickel and Lithium based batteries – Concept Fuel cell, types of fuel cells, characteristics of fuel cells and the applications of fuel cells – Explanation of Hybridization of Energy storage- battery management and safety.

5.0 Drive Train & Electric Propulsion

Hybrid Electric drive train – a) Series hybrid b) parallel hybrid c) series – parallel d) complex drive train – torque coupling parallel hybrid electric drive – speed coupling parallel hybrid electric drive - advantages of parallel hybrid drive train – transmission for EV/EHV. DC motor drives –permanent magnet brushless dc motor drive (principle and operation) – switch reluctance motor drive (SRM)– control of motor and configuration of drives.

REFERENCE BOOKS

1. Heat Engine -by Pandya and Shah – Charotar Publishing House
2. Automobile Engineering Vol–I&II- by Kirpal Singh
3. Automobile Engineering – by G.B.S. Narang – Khanna Publishers
4. Automobile Engineering – by R.B. Gupta–Standard Publishers
5. Automobile mechanics – by William Chrouse–McGraw Hill Education.
6. Automotive Chassis-P.M. Heldt.
7. An introduction to Automobile Engineering-N.R.Khatawate
8. Automobile Engineering-by Banga and Nathun Singh
9. Automobile mechanics-by William Chrouse
10. Vehicular Electric Power Systems–Mehrdad Ehsani, Yimin Gao CRC Press2003
11. Electric and Hybrid Vehicles– I. Husain CRC Press2003

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.16
Unit Test-II	From 4.1 to 5.11

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME406A	Artificial Intelligence & Machine Learning	02	30	-	-	-

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions
1	Introduction to AI and ML	6			
2	Data Preparation and Feature Engineering	8	-	-	-
3	Machine Learning Algorithms	8	-	-	-
4	Integration with Mechanical Engineering	8			
	Total	**30**	-	-	-

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Understand the fundamental concepts of AI & ML Algorithms, Methods like neural networks, Fuzzy logic and deep learning.

COURSE OUTCOMES

CO1	ME406.1	Understand the fundamentals of Artificial Intelligence and Machine Learning.
CO2	ME406.2	Understand and prepare mechanical data for AIML analysis.
CO3	ME406.3	Gain foundational knowledge of machine learning, including commonly used classifiers and fundamental algorithms utilized in engineering contexts.
CO4	ME406.4	Understand Neural Networks, Fuzzy Logic, and Deep Learning methods for mechanical problem-solving.
CO1	ME406.1	Understand the fundamentals of Artificial Intelligence and Machine Learning.

LEARNING OUTCOMES

Upon completion of the Course the student shall be able to

1.0 Introduction to Artificial Intelligence and Machine Learning

1.1 Understand and explain the basic concepts and evolution of Artificial Intelligence and Machine Learning.
1.2 Identify the role and potential of AI/ML in the context of mechanical engineering.
1.3 Distinguish AI from related fields like data science and automation.

1.0 Data Preparation and Feature Engineering

2.1 Describe different data collection and acquisition techniques used in mechanical systems.
2.2 Perform data preprocessing tasks such as cleaning, normalization, and transformation.
2.3 Prepare real-world engineering data for machine learning processing and analysis.
2.4 Understand the importance of feature selection and extraction in machine learning models.
2.5 Apply techniques like PCA and ICA to reduce dimensionality in mechanical system datasets.
2.6 Identify and select relevant features that improve model performance.

3.0 Machine Learning Algorithms

3.1 Differentiate between supervised and unsupervised learning strategies.
3.2 Implement basic ML algorithms such as Linear Regression, Decision Trees, Naïve Bayes, K-Means, etc.
3.3 Evaluate and choose appropriate algorithms such as SVM, Random Forest, KNM for different mechanical engineering use cases (e.g., fault detection, quality prediction).
3.4 Describe the architecture and functioning of an Artificial Neural Network (ANN).
3.5 Understand the basics of deep learning with CNNs and how they are used in image-based diagnosis for mechanical components.
3.6 Apply basic Fuzzy Logic and Neuro-Fuzzy systems to solve control and classification problems in mechanical systems.

4.0 Integration With Mechanical Engineering

4.1 Outline the stages of building and validating a machine learning model.
4.2 Use performance evaluation metrics (like accuracy, precision, recall, etc.) to assess model efficiency.
4.3 Apply software tools like Python or MATLAB to develop and test basic ML models with engineering datasets.
4.4 Apply AIML knowledge to solve real-life mechanical engineering problems through case studies.
4.5 Design and execute small-scale AI-based projects (e.g., predictive maintenance of machines, energy optimization).
4.6 Collaborate in teams to document and present project outcomes effectively.

CO-PO/PSO MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
C01	3	3	2		2		1	3	2	1
C02	2	3	3		3		1	2	3	3
C03	2	3	3		3		1	2	3	3
C04	2	3	3		3		2	2	3	3
AVG	2.25	3	2.75		2.75		1.25	2.25	2.75	2.5

COURSE CONTENTS

1.0 Introduction to Artificial Intelligence and Machine Learning

Definition and scope of Artificial Intelligence and Machine Learning, Differences and relationships with Data Science, Importance and role of AI/ML in Mechanical Engineering, History and evolution of AI, Basic components of AI and human vs computer intelligence, dispelling common myths of AI/ML. Knowledge representation, reasoning, and problem solving, concepts of learning, planning, perception, and manipulation, symbolic and statistical approaches to AI. Introduction to machine learning types viz., Supervised learning, Unsupervised learning, Reinforcement learning.

2.0 Data Preparation and Feature Engineering

Data acquisition, preprocessing, and cleaning, feature extraction methods Statistical features, Principal Component Analysis (PCA), feature selection methods viz., ranking, entropy reduction, information gain, exhaustive, greedy methods. Application of feature extraction in mechanical engineering.

3.0 Machine Learning Algorithms

Classification of ML algorithms viz, Decision Tree, Naive Bayes, SVM, Random Forest, KNN for defect detection, condition monitoring. Linear/Logistic Regression, SVR for Performance prediction, thermal analysis. K-Means, Hierarchical clustering for grouping of faults or materials. Fundamentals of ANNs and Deep Learning. Basics of reinforcement Learning for control systems in robotics and autonomous vehicles.

4.0 Integration With Mechanical Engineering

AI in design and optimization of mechanical systems, AI for autonomous systems (vehicles, robotics), Predictive maintenance and fault diagnosis, Quality control and defect detection, energy optimization using AI/ML methods. Case studies for Structural analysis, production quality, process improvement.

Software Tools viz., Python programming basics for ML, Introduction to libraries like NumPy, scikit-learn, pandas and No-code AI tools for practical projects.

REFERENCE BOOKS

1. Artificial Intelligence in Mechanical and Industrial Engineering – Hridayjit Kalita, Kaushik Kumar, J. Paulo Davim.
2. Machine Intelligence in Mechanical Engineering - Elango Natarajan,K. Palanikumar, J. Paulo Davim, Kevin Kumar.
3. Machine Learning Crash Course for Engineers – E klas Hossain.
4. AI and ML for Mechanical and Electrical Engineering - Kaushik Kumar-Prabir Vinta, -Shubham Pande,

APPLIED THERMODYNAMICS AND HYDRAULICS LAB

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME407L	Applied Thermodynamics and Hydraulics Lab	06	90	40	60	2

TIME SCHEDULE

26ME407L (A) : Applied Thermodynamics lab : 45		
S. No.	EXPERIMENT	Periods
1	Flash & Fire point tests	09
2	Viscosity measurement	09
3	Valve timing diagram and Port timing diagram	06
4	Performance tests on S.I and C.I engines	09
5	Morse Test	03
6	Heat Balance Sheet	03
7	Performance of Air compressor	06
Total No. Periods		45

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	To familiarise with the knowledge of materials, tools and properties of fuels.
2	To reinforce the concepts of flash and fire points, viscosity by conducting corresponding experiments
3	To reinforce the concepts performance parameters of IC Engines, valve timing and port timing diagrams by conducting corresponding experiments

COURSE OUTCOMES

CO1	ME407(A).1	Determine the flash and fire points, viscosity of a given sample of fuel using given apparatus.
CO2	ME407(A).2	Conduct the tests to determine the performance of I C Engines using given apparatus.
CO3	ME407(A).3	Conduct the tests to determine the performance of Air compressors.
CO4	ME407(A).4	Analyses the experimental results to draw inferences, to make recommendations
CO5	ME407(A).5	Follow ethics and etiquette while working in a group and display professionalism while communicating as a member and a leader in a group.

LEARNING OUTCOMES

Upon on completion of the course the student shall be able to:

1.0 Conduct an experiment to determine the flash and fire point of a given sample of fuel using given apparatus

1.1 Place the oil cup in the apparatus
1.2 Fill the water in water bath through funnel
1.3 Fill the oil in the oil cup up to the gauge mark
1.4 Operate the shutter for opening and closing
1.5 Connect the equipment to the power supply
1.6 Operate the shutter lid to observe vapours
1.7 Operate the stirrer
1.8 Apply the test flame
1.9 Identify the colour change of the flame
1.10 Record the two temperatures of flash and fire point

2.0 Conduct an experiment to determine viscosity of a given sample of oil using given apparatus

2.1 Move and place the collecting flask
2.2 Insert the thermometer and hydrometer in the device
2.3 Fill the oil in the oil cup up to the gauge mark
2.4 Operate the regulator to vary the temperature
2.5 Stir the water to get the uniform temperature
2.6 Record temperature using thermometer
2.7 Open and close the ball valve
2.8 Collect 50 ml of oil in the collecting flask
2.9 Record the time taken to collect 50 ml using stop watch
2.10 Record the readings systematically
2.11 Calculate the Viscosity
2.12 Plot the related graphs

3.0 Conduct an experiment to draw the valve and port timing diagrams

3.1 Place the spirit level, metal tape and piece of chalk near the engine
3.2 Erase the previous chalk marks on the flywheel
3.3 Apply lubrication in the piston and valve mechanism
3.4 Fix the graduated disc to the crank shaft
3.5 Adjust the pointer to zero position of graduated disc
3.6 Mark the TDC and BDC on the disc using the Dial gauge
3.7 Mark the operations (Suction, Compression, Ignition, Expansion and Exhaust)
3.8 Measure the circumference of flywheel
3.9 Locate exact position of inlet valve/port opening and inlet valve/port closing by inserting feeler gauge between inlet roller and cam
3.10 Find exact position of Ignition starting and ignition tripping
3.11 Locate exact position of exhaust valve/port opening and exhaust valve/ port closing by inserting feeler gauge between outlet roller and cam
3.12 Measure the circumferential distances between the valve/port opening, closing, ignition starting and ignition tripping with respect to the TDC and BDC

4.0 Conduct an experiment to determine the performance parameters

4.1 Apply lubricant between the mating parts of the engine
4.2 Check the fuel oil supply line Place the thermometers at required positions Circulating the cooling water through the engine jacket before starting engine and after shutting down the engine
4.3 Start the engine using decompression lever
4.4 Run the engine for a certain period of time before loading
4.5 Measure speed of the engine with tachometer
4.6 Adjust spark timing in case of SI engine
4.7 Adjust the throttle valve to control the fuel supply in case of CI engine
4.8 Apply the load
4.9 Record brake load, speed of rotation (RPM) and the rate of fuel consumption
4.10 Remove the load

5.0 Conduct an experiment to find the performance on a multi cylinder engine

5.1 Apply lubricant between the mating parts of the engine
5.2 Check the fuel oil supply line
5.3 Place the thermometers at required positions
5.4 Circulating the cooling water through the engine jacket before starting engine and after shutting down the engine
5.5 Start the engine using decompression lever
5.6 Run the engine for a certain period of time before loading
5.7 Measure speed of the engine with tachometer
5.8 Apply the load
5.9 Record brake load, speed of rotation (RPM), the rate of fuel consumption
5.10 Cut off the first cylinder
5.11 Record brake load, speed of rotation (RPM), the rate of fuel consumption
5.12 Repeat the above operations for all the cylinders

6.0 Conduct an experiment to draw the heat balance sheet for given I C Engine

6.1 Apply lubricant between the mating parts of the engine
6.2 Check the fuel oil supply line
6.3 Place the thermometers at required positions
6.4 Circulating the cooling water through the engine jacket before startingengine and after shutting down the engine
6.5 Start the engine using decompression lever
6.6 Run the engine for a certain period of time before loading
6.7 Measure speed of the engine with tachometer
6.8 Adjust spark timing in case of SI engine
6.9 Adjust the throttle valve to control the fuel supply in case of CI engine
6.10 Apply the load
6.11 Record brake load, speed of rotation (RPM), the rate of fuel consumption, the rate of flow of cooling water and water inlet and outlet temperatures ofengine jacket
6.12 Record exhaust gas temperature at calorimeter outlet

7.0 Conduct performance test on Air compressor

7.1 Check the lubricating oil level in the crank case
7.2 Opening and closing of storage outlet valve
7.3 Checking orifice and its diaphragm condition
7.4 Fill water in U-tube manometer

7.5 Check function and usage of tachometer
7.6 Check function and usage of stop watch
7.7 Record time taken for 10 revolutions of energy meter disc
7.8 Record compressor speed (RPM) using tachometer
7.9 Record manometer readings
7.10 Record pressure gauge reading

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1			3			1	2	1	
CO2	1			3			1	2	1	
CO3	1			3			1	2	1	
CO4	1			3			1	2	1	
CO5	1			3			1	2	1	
AVG	1			3			1	2	1	

COURSE CONTENT

1. Determine the flash and fire points of the given sample of oil by using
   a) Abel's apparatus b) Pensky Martens apparatus c) Cleveland apparatus
2. Determine the viscosity of the given sample of oil by using
   a) Redwood viscometer – I, b) Redwood viscometer – II, c) Saybolt viscometer
3. Experiment to draw valve timing diagram of petrol and Diesel engines
4. Experiment to draw Port timing diagram of petrol and Diesel engines
5. Load test to determine performance parameters of petrol and Diesel engines
6. Morse test to determine IP of multi cylinder petrol engine
7. Load test to draw the Heat balance sheet
8. Performance test on Air compressor

REFERENCES

1. Internal Combustion Engines by V. Ganesan
2. A Textbook of Internal Combustion Engines by M.L. Mathur & R.P. Sharma
3. Thermal Engineering by R.K. Rajput
4. Thermal Engineering by P.K. Nag
5. Internal Combustion Engines by K.K. Ramalingam

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From Experiment 1 to 4
Unit Test-II	From Experiment 5 to 7

26ME407L (B) : Hydraulics lab : 45		
S. No.	EXPERIMENT	Periods
1.	Verification of Bernoulli's Theorem	09
2	Determination of the Coefficient of Discharge of Venturi Meter	03
3.	Determination of Friction Factor For A Given Pipeline	06
4	Performance Test on Centrifugal Pump	06
5	Performance Test on Reciprocating Pump	06
6.	Performance Test on Pelton Wheel	09
7.	Performance Test on Francis Turbine	06
Total No. Periods		45

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Familiarize with knowledge in verification of principles of fluid flow
2	Use skills in measuring pressure, discharge and velocity of fluid flow
3	Reinforce theoretical concepts by conducting experiments for Major and Minor Losses
4	Reinforce theoretical concepts by conducting experiments in performance testing of Hydraulic Turbines and Hydraulic Pumps

COURSE OUTCOMES

CO1	ME407(B).1	Perform experiments to verify Bernoulli's theorem
CO2	ME407(B).2	Perform experiments to determine the coefficient of discharge of Venturi meter.
CO3	ME407(B).3	Demonstrate the experiments to determine the co-efficient of friction of flow in a pipe and minor losses in pipe joints
CO4	ME407(B).4	Demonstrate the experiments on pumps to draw characteristic curves
CO5	ME407(B).5	Demonstrate the experiments on hydraulic turbines to draw characteristic curves

LEARNING OUTCOMES

Upon the completion of the course the student shall be able to

1.0 Verification of Bernoulli's Theorem

1.1 State Bernoulli's theorem

1.2 Identify the apparatus required

1.3 Explain the Test procedure to verify Bernoulli's experiment.

2.0 Determination of C_d of Venturimeter

2.1 State the practical applications of venturimeter.

2.2 Record the manometric head readings from U-tube manometer
2.3 Record the time taken for collecting volume of fluid by varying the discharge
2.4 Calculate the areas of the pipe and throat of the given venturimeter
2.5 Calculate coefficient of discharge of venturimeter.

3.0 Determination of loss of head due to friction in a given pipe
3.1 Measure the length of the given pipe
3.2 Record the pressure head readings from U-tube manometer
3.3 Record the time taken for collecting volume of fluid by varying the discharge
3.4 Calculate the loss of head through the pipe
3.5 Calculate the friction factor

4.0 Determination of Power required and Efficiency of Centrifugal Pump
4.1 Identify the components of centrifugal pump
4.2 Record the suction and delivery pressures from pressure gauges
4.3 Record the time taken for collecting the volume of fluid
4.4 Record the energy meter readings and calculate input power
4.5 Calculate the power input
4.6 Calculate the efficiency
4.7 Draw characteristic curves

5.0 Determination of Power required and Efficiency of Reciprocating Pump
5.1 Identify the components of reciprocating pump
5.2 Record the suction and delivery pressures from pressure gauges
5.3 Record the time taken for collecting the discharge
5.4 Record the energy meter readings and calculate input power
5.5 Calculate the power input
5.6 Calculate the efficiency
5.7 Draw characteristic curves

6.0 Determination of Power and Efficiency of Pelton Wheel
6.1 Identify the components of Pelton wheel
6.2 Start turbine by switching on jet of water slowly
6.3 Apply load steadily
6.4 Record load, speed
6.5 Calculate brake power and efficiency of turbine
6.6 Draw characteristic curves

7.0 Determination of Power and Efficiency of Francis Turbine
7.1 Identify the components of Francis Turbine
7.2 Start turbine by switching on jet of water slowly
7.3 Apply load steadily
7.4 Record load, speed
7.5 Calculate power and efficiency of turbine

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2			3			1	3	1	1
CO2	2			3			1	3	1	1
CO3	2			3			1	3	1	1
CO4	2			3			1	3	1	1
CO5	2			3			1	3	1	1
AVG	2			3			1	3	1	1

COURSE CONTENT

1. Verification of Bernoulli's Theorem
2. Determination of C_d of Venturimeter
3. Determination of Friction Factor for A Given Pipe Line
4. Performance Test on Centrifugal Pump
5. Performance Test on Reciprocating Pump
6. Performance Test on Pelton Wheel
7. Performance Test on Francis turbine

REFERENCES

1. Fluid Mechanics and Hydraulic Machines by R.K. Bansal
2. A Textbook of Hydraulics, Fluid Mechanics and Hydraulic Machines by R.S. Khurmi
3. Hydraulics and Fluid Mechanics Including Hydraulic Machines by P.N. Modi & S.M. Seth
4. Fluid Mechanics and Hydraulic Machines by S.C. Gupta

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From Experiment 1 to 4
Unit Test-II	From Experiment 5 to 7

COMMUNICATION AND EMPLOYABILITY SKILLS

(PRACTICUM – PRACTICAL)

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME408L	COMMUNICATION AND EMPLOYABILITY SKILLS	4	60	40	60	2

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	COs Mapped
1.	ABC of Communication	6	CO1
2.	Let's Learn to Listen	6	CO2
3.	I am...	4	CO4
4.	Let's Talk About...	4	CO4
5.	JAM	6	CO4
6	Interpreting Data	6	CO3
7	Your Perfect Profile	4	CO5
8	Group Discussion	8	CO4, CO5
9	Interview Skills	8	CO4, CO5
10	Making Presentations	8	CO3
	Total	**60**	

COURSE OBJECTIVES

(i)	To impart verbal and non-verbal communication skills
(ii)	To foster employability skills among the students for career building

COURSE OUTCOMES

Upon completion of the course, the student shall be able to:

CO1	ME408 .1	Practise appropriate body language and etiquette
CO2	ME408 .2	Listen and comprehend the listening inputs related to different genres effectively
CO3	ME408 .3	Interpret data and give oral and written presentations in academic and professional contexts
CO4	ME408 .4	Communicate effectively in interpersonal interactions, interviews, and group discussions
CO5	ME408 .5	Exhibit employability skills: job hunting, resume writing, and attending interviews

LEARNING OUTCOMES

UNIT 1: ABC of Communication

1.1. Understand and practice the process of communication.
1.2. Demonstrate appropriate body language traits for better communication.
1.3. Apply appropriate strategies to minimize various barriers of communication.
1.4. Communicate effectively in a given situation.

UNIT 2: **Let's Learn to Listen**

2.1. Identify and distinguish different phonic sounds in English language.
2.2. Practice active listening techniques for better comprehension.
2.3. Comprehend diverse listening inputs in academic, professional and everyday situations using appropriate strategies.

UNIT 3: I am...

3.1. Prepare an organised self-introduction for formal and informal situations.
3.2. Introduce yourself in job interviews effectively.
3.3. Demonstrate appropriate body language while introducing yourself.

UNIT 4: Let's Talk About...

4.1. Describe objects, places, events and people using appropriate adjectives.
4.2. Use appropriate sentences and expressions while describing.
4.3. Use suitable adjectives to convey mood or tone.

UNIT 5: JAM

5.1. Generate ideas on a given topic.
5.2. Organise the ideas sequentially for an effective JAM speech.
5.3. Speak spontaneously and fluently on a given topic within the stipulated time.

UNIT 6: Interpreting Data

6.1. Understand different forms of graphs, charts, diagrams and tables.
6.2. Analyse and interpret data.
6.3. Present the inferences and findings in spoken and written communication.

UNIT 7: Your Perfect Profile

7.1. Draft a customised professional resume.
7.2. Create a professional Applicant Tracking System (ATS) compliant Resume.

7.3. Draft a cover letter to communicate with prospective employers.

UNIT 8: Group Discussion

8.1. Understand the significance of group discussion and differentiate the various stages involved.

8.2. Practice various roles and skills involved in group discussion.

8.3. Demonstrate appropriate body language for effective participation in group discussion.

UNIT 9: Interview Skills

9.1. Practice proper interview demeanour.

9.2. Respond effectively to frequently asked interview questions (FAQs).

9.3. Demonstrate readiness for job opportunities.

UNIT 10: Making Presentations

10.1. Practise the principles of good presentation.

10.2. Use appropriate presentational aids.

10.3. Prepare and give presentations on various topics effectively.

CO-PO/PSO MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PS02	PS03
CO1	POs 1 to 5 are not directly applicable to the English course.							Programme Specific Outcomes are branch-specific, with technical aspects that are not directly applicable to the English Language course.		
CO2										
CO3						2	2			
CO4						2	2			
CO5						2	2			
Average						2	2			

CONTENTS

Sl. No.	Name of the Unit	Contents
1	ABC of Communication	• Aspects of Communication • Body language: Verbal & Nonverbal Communication • Communication Barriers • Strategies for effective communication
2	Let's Learn to Listen	• Basics of pronunciation: Vowel & Consonant sounds • Active vs Passive listening • Barriers to listening • Types of listening& Techniques for effective listening

		• Listening Comprehension Activities: Academic, Professional, Social conversations
3	I am…	• Significance of self-introduction in formal and informal contexts • Components and structure of self-introduction • Self-introduction in job interviews • Body language while introducing oneself
4	Let's Talk About…	• Describing objects, people, places and events • Using appropriate adjectives for different kinds of descriptions • Using right Tense and tone
5	JAM	• JAM – Structure and organisation • Generating and organising ideas for JAM speech • Dos and Don'ts of JAM • Strategies and techniques for effective JAM speech • Planning a perfect one-minute speech
6	Interpreting Data	• Presentation of data in Graphs, Charts, diagrams, and tables • Analysing and interpreting non-verbal data • Presenting non-verbal information in verbal form (spoken and written)
7	Your Perfect Profile	• Significance of a resume in career building • Resume, Curriculum Vitae (CV) and Bio-data • Applicant Tracking System (ATS) Resume – components and structure • Video Resume • Drafting a Cover letter
8	Group Discussion	• Significance of Group Discussion (GD) in job hunting • Process of Group Discussion • Sub skills of Group Discussion • GD Roles and Group dynamics • GD body language • Techniques for success in GD
9	Interview Skills	• Significance of Interviews in the Job Selection Process • Stages of Interview Preparation: Pre, While, and Post interview • Right demeanour and body language for interviews • Frequently Asked Questions (FAQs)
10	Making Presentations	• Principles of good presentation • Types of Presentational aids • Presentation etiquette • Giving effective presentations

REFERENCE BOOKS

1. T. Balasubramaian, "*A Textbook of English Phonetics for Indian Students*", Macmillan (2009)
2. J.D. O'Connor, "*Better English Pronunciation*", Cambridge (1980) Anand. S. Ganguly, *Group Discussion for Admissions and Jobs* (2010)
3. E. Suresh Kumar and P. Sreehari, *Communicative English*, Orient Blackswan (2019)

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 5.3
Unit Test-II	From 6.1 to 10.3

MACHINE TOOLS LAB

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME409L	MACHINE TOOLS LAB	06	90	40	60	1.5

TIME SCHEDULE

S.NO	EXPERIMENT TITLE	NO.OF PERIODS
1	Hands on practice on Milling Machine • T-Slot cutting • Spur Gear Cutting • Helical Gear Cutting	24
2	Hands on practice on Slotting Machine • Keyway Cutting	15
3	Hands on practice on shaper • Keyway Cutting on shaft	15
4	Hands on practice on Surface Grinding Machine • Preparation of Rectangular Block	15
5	Hands on practice on Oxy- Fuel Welding • Preparation of joining of metals	15
6	Assembly of gear, shaft and key	6
	TOTAL	90

COURSE OBJECTIVES

Upon completion of the course, the student shall be able	
1	To Familiarize Milling Machine
2	To handle milling, Slotting, Grinding operations safely.
3	To reinforce theoretical concepts by practising relevant exercises of Milling, slotting, Grinding and Welding Operations.
4	Obtain skill in Milling, slotting, Grinding, Shaping and Operations

COURSE OUTCOMES

CO1	ME409.1	Perform the operations on milling Machine
CO2	ME409.2	Perform the operations on Slotting Machine &shaper
CO3	ME409.3	Perform the operations on Shaping Machine
CO4	ME409.4	Perform the operations on Grinding Machine
CO5	ME409.5	Perform the operations on Oxy- Fuel Welding

LEARNING OUTCOMES

Upon completion of the course the student shall be able

1. Milling

Perform T-slot cutting on milling machine

1.1 Select proper tool to perform the job
1.2 Set the Job on Machine
1.3 Select the speed for milling operation
1.4 Practice T-slot cutting operation on a milling machine
1.5 Use measuring instruments for checking dimensions.
1.6 Indexing methods explanation and application on milling machine

Perform Spur gear cutting on milling machine

1.7 Select milling cutter to perform the job
1.8 Set the Job on Machine
1.9 Index the job
1.10 Select the speed for gear cutting operation
1.11Practice gear cutting operation on a milling machine
1.12 Use measuring instruments for checking dimensions

Perform helical gear cutting on milling machine

1.13 Select milling cutter to perform the job
1.14 Set the Job on Machine
1.15 Index the job
1.16 Select the speed for helical gear cutting operation
1.17 Practice helical gear cutting operation on a milling machine
1.18 Use measuring instruments for checking dimensions

2. Slotter

Perform keyway cutting on slotting machine

2.1 Select cutter to perform the job
2.2 Set the Job on Machine
2.3 Select the speed for Slotting operation
2.4 Practice slotting operation on a slotting
2.5 Use measuring instruments for checking dimensions

3. Shaper

Perform keyway cutting on shaping machine

3.1 Select cutter to perform the job
3.2 Set the Job on Machine
3.3 Select the speed for shaping operation
3.4 Practice key way cutting on a shaper
3.5 Use measuring instruments for checking dimensions

4. Grinding

Perform surface grinding on rectangular block

4.1 Explain the constructional features, working principles and safety aspect of Surface grinder
4.2 Explain functional application of different levers, stoppers, adjustment Practice grinding operation

4.3 Identify different lubrication points of surface grinder
4.4 Identify lubricants and their usage for application in surface grinder
4.5 Identify different work and tool holding devices and acquaint with functional application of each device
4.6 Mount the work and tool holding devices with required alignment and check for its functional usage to perform surface grinding operations
4.7 Observe safety procedure during mounting as per standard norms

5. Oxy- Fuel Welding

5.1 Fundamentals of Oxy-Fuel Welding
5.2 Introduction to welding and classification of welding processes.
5.3 Principles of oxy-fuel gas welding.
5.4 Fuel gases: Acetylene, LPG, Hydrogen – properties, selection, applications.
5.5 Oxygen properties and storage.

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2			3			1	3	1	1
CO2	2			3			1	3	1	1
CO3	2			3			1	3	1	1
CO4	2			3			1	3	1	1
CO5	2			3			1	3	1	1
AVG	2			3			1	3	1	1

COURSE CONTENT

1.0 Milling

Perform T-slot cutting on milling machine
Perform Spur gear cutting on milling machine
Perform helical gear cutting on milling machine

2.0 Slotter
Perform keyway cutting on slotting machine

3.0 Shaper
Perform keyway cutting on shaping machine

4.0 Grinding

Perform surface grinding on rectangular block

5.0 Oxy Fuel Welding

Assembly of gear, shaft and key

REFERENCES

1. Workshop Technology Vol–II by Hajra Choudhury
2. Production Technology by P.C. Sharma
3. Manufacturing Processes by R.K. Jain
4. Machine Tools by N.K. Mehta
5. Welding Technology by O.P. Khanna

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From Experiment 1 to 3
Unit Test-II	From Experiment 4 to 6

V SEMESTER

DIPLOMA IN MECHANICAL ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
V SEMESTER

Course Code	Course Title	No. of Periods / Week		Practicum (Y/N)	Total No. of Periods /Semester	Credits	Scheme of Examination			
		Theory	Practical/ Tutorial				Duration (hours)	FA Marks	SA Marks	Total Marks
THEORY COURSES										
26ME501T	Industrial Engineering & Management	6	-	N	90	4	3	30	70	100
26ME502T	Design of Machine Elements	6	-	N	90	4	3	30	70	100
26ME503T	Industrial Automation	6	-	N	90	4	3	30	70	100
ELECTIVE COURSES										
26ME504E	Mechatronics	3	-	N	45	2	3	30	70	100
26ME505E	Additive Manufacturing									
AUDIT COURSE										
26ME506A	Basics of Aerospace Engineering	2	-	N	30	-	-	-	-	-
PRACTICAL COURSES										
26ME507L	CAD/CAM LAB		7	N	105	3	3	40	60	100
26ME508L	Refrigeration & Air Conditioning Lab (Practicum)		6	Y	90	2	3	40	60	100
26ME509P	Project		3	N	45	0.5	3	40	60	100
26ME510L	Student Centric Activities		3	N	45	0.5	-	-	-	-
	TOTAL	**23**	**19**		**630**	**20**		**240**	**460**	**700**
Note 1: 0.5 credits will be awarded for student centric activities based on the participation in the extra Curricular activities like NSS/NCC/Clean and Green or Sports/ Games										

Note 2: 26ME502T is common with 26MR502T, 26ME505E is common with 26MR505E, 26ME506A is common with 26MR506A

INDUSTRIAL ENGINEERING & MANAGEMENT

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME501T	Industrial Engineering & Management	06	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1	Work Study	20	22	2	2	C01
2.	Plant Engineering and Costing.	20	22	2	2	CO2
3	Principles of Management and Organization Structure	15	17	3	1	CO3
4	Production Management	20	22	2	2	CO4
5	Industrial Safety and Engineering Ethics	15	17	3	1	CO5
	Total	**90**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Contribute to improve efficiency, productivity and/or quality of products manufactured or services provided in the organizations.
2	Explain maintenance aspects, plant layouts of various industries and elements of cost
3	Familiarize the concepts of management, organization structures and production management in industries
4	Understand the Industrial Safety, Engineering Ethics and Labour codes

COURSE OUTCOMES

CO1	ME501.1	Explain principle of work study and its contribution in improving the productivity and wage systems.
CO2	ME501.2	Explain Preventive, Predictive and Corrective maintenance and Explain how to estimate the cost of a manufactured product.
CO3	ME501.3	Understand the principles of management applied to industry and Explain types of the industrial organization structures
CO4	ME501.4	Explain the different aspects of production management.
CO5	ME501.5	Understand the Industrial Safety, Engineering Ethics and Labour codes

LEARNING OUTCOMES

Upon completion of the course the student shall be able to

1.0. Work Study

1.1 Define Production, Productivity, Work study, Method Study and Work Measurement
1.2 State objectives of Work study, Method Study and Work Measurement
1.3 Explain the Steps: Define, Record, Critical Examination, Develop, and Install and maintain for conduct of method study to increase the productivity.
1.4 Explain process chart symbols with examples.
1.5 Explain the use of flow diagram and string diagram.
1.6 Explain Cycle graph and Chrono cycle graph.
1.7 Identify various therbligs used in micro motion study and construct SIMO chart.
1.8 Explain Time study Procedure by using a stop watch.
1.9 Compute the standard time for an operation by adding its constituent elements.
1.10 Explain the procedure of Predetermined Motion Time Standards (PMTS)
1.11 Explain the method of conducting work sampling.
1.12 State the terms involved in wage systems.
1.13 List different incentive plans and solve simple numerical problems

2.0 Plant Engineering and Costing.

2.1. Define Plant and Plant layout.
2.2. List the factors to be considered for the selection of site for an industry
2.3. Explain various types of plant layouts with applications.
2.4. State the importance of Plant maintenance.
2.5. Briefly explain Preventive, Predictive and Corrective maintenance.
2.6. State the Principles of material handling equipment.
2.7. Define Estimation and Costing.
2.8. Explain Elements of Cost, Components of Cost
2.9. Solve simple numerical problems to find the selling price of a product.
2.10. Define Depreciation.
2.11. List the causes of depreciation

2.12. List various methods of calculating depreciation.
2.13. Compute depreciation charges by 1) Straight Line method 2) Sinking Fund Method and 3) Sum of Years' Digits method.

3.0 Principles of Management and Organization Structure

3.1 Define Industry, Commerce and Trade.
3.2 Know the need for management.
3.3 Understand functions of Management.
3.4 List the principle of scientific management by F.W. Taylor
3.5 List the principle of modern management by Henri Fayol.
3.6 Define organization structure.
3.7 Explain line, staff and line & staff organization structures

4.0 Production Management

4.1 Define Production, Planning and Control.
4.2 Explain Mass production, Batch production and Job order production.
4.3 Define the terms Routing, Scheduling and Dispatching.
4.4 List applications of network diagrams
4.5 Draw PERT and CPM Network Diagrams – Simple Problems.
4.6 Know the functions of Materials Management.
4.7 Explain ABC analysis of Inventory.
4.8 Explain the concept of Economic Ordering Quantity.
4.9 Explain the meaning of Supply chain management.
4.10 Write processes of Supply Chain Management
4.11 List various SAP modules
4.12 List the functions of Purchase Department.
4.13 Write functions of Stores Department.

5.0 Industrial Safety and Engineering Ethics

5.1 Comprehend the importance of safety at Workplace.
5.2 List Different hazards in the industry.
5.3 State the causes of accidents, costs of accidents and their prevention.
5.4 Definition of Engineering Ethics.
5.5 Understand Core qualities of Professional Engineers.
5.6 Explain Different types of Ethics in Engineering.
5.7 List Activities of Corporate Social Responsibility (CSR).
5.8 State the need of Human values in engineering fields.
5.9 List Salient features of Code on Wages, 2019.

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	1				1	2	1	2
CO2	3	1	1				1	2	1	2
CO3	3					1	1	2	1	2
CO4	3	1	1			1	1	2	1	2
CO5	3				1	1	1	2	1	2
AVG	3	1	1		1	1	1	2	1	2

COURSE CONTENT

1.0 Work Study

Industrial Engineering: Definition of Production and productivity;
Work Study: Definition, objectives of work study.
Method Study: Definition, objectives, procedure of conducting method study.
Process chart symbols – Explanation with Operation process chart, Flow process chart and Two-handed process charts only - Uses of flow diagram and string diagram.
Micro-motion study: Therbligs – Simo chart – Cycle graph and Chronocycle graph
Work Measurement or Time study: Definition, objectives - Work measurement techniques.
Time Study: Procedure by using a stop watch to measure the standard time- Constituents of standard time: Observed time - Normal time- rating factor- allowances.
Standard data method - Determination of standard time by using Predetermined Motion Time Standards (PMTS) - Determination of standard time by using work sampling.
Wage and Incentive plans: Definitions of wage, nominal wage, real wage, living wage, minimum wage, fair wage - Incentives and types - List different incentive plans - Halsey, Rowan and Emerson efficiency plans, solve simple numerical problems.

2.0 Plant Engineering and Costing.

Plant Engineering: Plant – Selection of site for an industry – Plant layout – Types: process, product and fixed position layouts –Importance of Plant maintenance – Preventive, Predictive and corrective maintenance - Principles of material handling equipment.
Costing: Estimation versus Costing - Elements of cost – Components of cost - Procedure for estimation of selling price of the given product - Numerical Problems
Depreciation: Definition – Causes and methods of depreciation - Simple problems on calculation of depreciation Fund by 1) Straight Line method 2) Sinking Fund Method and 3) Sum of Years' Digits method.

3.0 Principles of Management and Organization Structure

Introduction: Industry, Commerce and Trade; Definition of management; Functions of management; Principles of Scientific Management by F.W. Taylor - Principles of

Modern Management by Henri Fayol; Levels of management - Managerial skills - Management Information Systems: Objectives and Characteristics.
Organization Types: Line, Staff and Line & Staff Organizations, their advantages, limitations and applications.

4.0 Production Management

Production, Planning and Control – Types of Production - Routing, Scheduling and Dispatching - PERT and CPM Network Diagrams – Applications –Calculate Project Duration and identify the critical path of the Project – Simple Problems; Functions of Materials Management - ABC analysis of Inventory. - Economic ordering quantity- Meaning of Supply Chain Management – Processes of Supply Chain Management – List various SAP modules - Functions of Purchase Department - Purchasing Procedure -Functions of Stores Department – Bin Card.

5.0 Industrial Safety and Engineering Ethics

Industrial Safety: The importance of safety at Workplace -Hazards and accidents - Different hazards in the industry -The causes of accidents and prevention of accidents - Direct and indirect cost of accidents.
Engineering Ethics: Definition – Classification of Engineering Ethics - Personal and Business ethics –Value based ethics - Environmental ethics - Activities of Corporate Social Responsibility (CSR).
Human values Morals – Values –Character, Caring, Courage, Cooperation, Commitment, Empathy, Honesty, Integrity, Respect for others, Sharing, Service learning - Salient features of Code on Wages, 2019

REFERENCE BOOKS

1.Work study – by Ralph Banes.
2.Work study – by I.L.O.
3. Industrial Engineering & Management Science - by T.R. Banga
4. Industrial Engineering and Management-by O.P. Khanna
5. Production Management-by Buffa.
6. Engineering Economics and Management Science-by Banga & Sharma.
7. Personnel Management by Flippo.
8. Production and Operations Management–S.N.Chary

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 2.13
Unit Test-II	From 3.1 to 5.9

DESIGN OF MACHINE ELEMENTS

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME502T	Design of Machine Elements	06	90	30	70	4

Note: DESIGN DATA BOOKS ARE ALLOWED

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1	Fundamental concepts in Machine Design	10	14	2	1	CO1
2	Screw Joints	16	14	2	1	C02
3	Shafts, Keys and Couplings	20	25	3	2	C03
4	Power Transmission Systems	20	22	2	2	CO4
5	Cams, Flywheel, Governors and Bearings	24	25	3	2	CO5
Total		**90**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Understand the design philosophy and design of basic machine elements viz., bolts, shafts, keys, couplings, belts, chains, gears, cams, flywheels, Governors and Bearings

COURSE OUTCOMES

CO1	ME502.1	Explain basic design procedure and factors affecting the design of Mechanical elements
CO2	ME502.2	Design of Screw joints.
CO3	ME502.3	Design of machine members viz,.1. Shafts,2.Keys,3. Couplings
CO4	ME502.4	Design of belt drives, Gear trains and Chain drives used for transmission of power.
CO5	ME502.5	Explain the functions of Flywheel, Governors and bearings & Draw the Cam profiles.

LEARNING OUT COMES

Upon completion of the course the student shall be able to

1.0 Fundamental Concepts in Machine Design

1.1 Explain the basic procedure of designing of machine members.
1.2 Explain the factors governing the design of machine members.
1.3 Explain the design based on strength and rigidity.
1.4 Explain various theories of failures.
1.5 Explain combined stresses – torsion and bending stresses

2.0 Screwed Joints

2.1 State the advantages, disadvantages and applications of threaded joints.
2.2 Explain Modes of failure and Strength of bolts.
2.3 Design of bolts subjected to tensile load only–Simple problems.
2.4 Design the eye bolt used for lifting the given load.

3.0 Shafts, Keys and Couplings

3.1 Define and state the functions of i) Shaft ii) Axle iii) Spindle
3.2 State the stresses induced in the shafts.
3.3 Write the formula for the power transmitted by the solid and hollow shafts subjected to pure torsion from the torsional equation.
3.4 Design the Solid shaft and hollow shaft subjected to pure bending from bending equation.
3.5 Design the Solid shaft subjected to Combined Torsion and Bending using Rankine and Guest theories of failures based on Strength (for static load only) – Simple Numerical problems.
3.6 Design the hollow shaft subjected to Combined Torsion and Bending using Rankine and Guest theories of failures based on Rigidity (for static load only)– Simple Numerical problems.
3.7 Explain the functions and classification of keys.
3.8 Explain stresses induced and modes of failure of keys.
3.9 List the functions and classification of couplings.
3.10 Design the muff coupling for a shaft of given size using empirical relations. Numerical problems.
3.11 Design the C.I Protected Flange Coupling (Hub, Key, Flange and Bolts) for a shaft of given size using empirical relations.

4.0 Power Transmission Systems

4.1 List the different power drives and compare the flexible drives with the rigid drives
4.2 Classify the belt drives based on different criteria
4.3 Write the expression for calculating the length of open and cross belts.
4.4 Write the expression for calculating the angle of contacts of open and cross belts.
4.5 Write the expression for i) ratio of belt tensions ii) centrifugal tension in

the belt

4.6 Explain the effect of centrifugal tension on power transmission.
4.7 Write the conditions for maximum power transmission.
4.8 Solve the numerical problems related to the lengths, angle of contact, ratio of tensions, maximum power transmitted.
4.9 Numerical problems on cross sectional dimensions of open and crossed belt drives.
4.10 List the advantages and disadvantages of gear drives over flexible or belt drives.
4.11 Define gear train and list different gear trains with applications.
4.12 Write the expression for the velocity ratio / Train value for different gear trains
4.13 Explain the working of simple, compound, Epi-cyclic and reverted gear trains- Solve Simple problems related to simple, compound and reverted gear trains only.
4.14 Explain the nomenclature of spur gear tooth.
4.15 Design the Spur gear based on Lewis bending equation for static load.
4.16 List Types of chain drives, advantages and limitations

5.0 Cams, Flywheel, Governors and Bearings

5.1 Explain the function of cam assembly.
5.2 Classify the cams and followers.
5.3 Define the terms related to cam profile.
5.4 Draw displacement diagram for the following motion of the knife edge followers when the axis of the follower passes through the axis of the cam.
a) Uniform velocity. b) S.H.M. c) Uniform acceleration & retardation
5.5 State the function of flywheel and governor and list their applications.
5.6 Explain the terms related to design of flywheel.
5.7 Write the expression for maximum fluctuation of energy- Simple Problems.
5.8 Classify the governors.
5.9 Distinguish Governor from Flywheel.
5.10 Describe the working of Watt and Porter governor with a legible sketch.
5.11 Write the functions and classification of bearings.
5.12 Design of a simple journal bearing using McKee's equation for loss of power.

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
C01	1	2	2		1		1	2	3	1
C02	1	2	2		1		1	2	3	1
C03	1	2	2		1		1	2	3	1
C04	1	2	2		1		1	2	3	1
C05	1	2	2		1		1	2	3	1
AVG	1	2	2		1		1	2	3	1

COURSE CONTENT

1.0 Fundamental Concepts in Machine Design

Introduction to design process (General sequence of steps in designing a machine element)

Factors influencing the design of machine elements- Selection of materials based on mechanical properties – Types of loading-Direct, Bending and Torsional stress equations -Design based on strength & Rigidity - Theories of failures- Factor of safety-Working stress, yield strength and ultimate strength - Combined Stresses-Torsion and bending stresses.

2.0 Screwed Joints

Types of Fasteners - Advantages, disadvantages and applications of threaded joints – Bolt Materials -Specification of bolt - Stresses induced in the bolted joints – Failure of bolted joints - Design of bolts subjected to initial tightening and external tensile forces - Design of bolts for Cylinder covers – Bolt of Uniform strength - Simple problems.

Design and of an eye bolt for a given tensile load using empirical proportions - Applications of eye-bolt.

3.0 Shafts, Keys and Couplings

Shafts: Define i) Shaft ii) Axle iii) Spindle-Functions of shafts – Stresses induced in shafts – Torque and Bending equations for the Shafts subjected to pure twisting and pure bending.

Design of Solid shaft subjected to both twisting and bending using Rankine's and Guest's theories of failures to transmit a given power at given rpm., based on (a) Strength and (b) Rigidity - Simple problems considering mean and maximum torques.

Keys: Functions of keys–Stresses induced in keys - Failure of keys

Couplings: Functions of coupling – Types of couplings – Design of Muff Coupling and C.I Rigid Protected flange coupling for a given torque using empirical proportions – Simple problems on muff coupling only.

4.0 Power Transmission Systems

Belt Drives: Factors to be considered while selecting the type of power drive – Advantages and Disadvantages of Belt drives - Types of belt drives - Belt materials. Mathematical expressions for the length and angle of contacts of open and crossed belts - Mathematical expression for the limiting ratio of belt tensions, centrifugal tension and initial tension – Conditions and Mathematical expression for the maximum power transmission.

Simple Numerical Problems on finding the length, angle of contact, stresses, cross-sectional dimensions, power transmission and maximum power transmission considering with or without the centrifugal tension for flat belts.

Chain drives - Types of chain drives – Advantages and limitations– Elements of Roller and silent chains.

Gear Drives: Advantages and disadvantages of gear drives over other drives - Gear train - Simple, compound, reverted & Epi-cyclic gear trains. – Applications of gear

trains - Calculating the number of teeth for simple, compound and reverted gear trains for the given speed ratio and sketching the arrangement– Simple problems.
Nomenclature of spur gear tooth – Gear materials – Empirical Proportions of nomenclature in terms of module.
Design of spur gear (calculating the module face width) based on Lewis bending equation by considering static load and neglecting velocity factor.

5.0 Cams, Flywheel, Governors and Bearings

Cams: Functions of cam - Classification of cams and followers – Working principle of plate and cylindrical cams - Nomenclature of radial cam profile.
Time vs displacement diagrams only for the Motions of the followers: Uniform velocity, Uniform acceleration and retardation and Simple harmonic motion.
Construction of Cam profile of a radial cam with Roller follower for all the three types of motions, when the axis of the follower passes through the axis of the cam.
Flywheels: Function and applications of fly wheel-Definition of Coefficient of fluctuation of speed, maximum fluctuation in energy and Coefficient of fluctuation of energy – Mass Moment of Inertia - Mathematical expression for kinetic energy stored in the flywheel - Simple Problems on the above.
Governors: Functions – Differences between Flywheel and Governor - Classification – Working Principle of Watt governor and Porter governor.
Bearings: Functions, Types of bearings - Journal bearing –McKee's Equation, Bearing Modulus - Simple Problems on Power lost in friction and Heat to be removed in journal bearings

REFERENCES

1. Machine Design- R.S. Khurmi., S Chand & Company
2. Design of Machine Elements- Pandya and Shah, Charotar Publishing House.
3 Design of Machine Elements–V B Bhandari, Tata Mc Graw Hill.
4 Machine Design– R.K.Jain, Khanna Publications

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.11
Unit Test-II	From 4.1 to 5.12

INDUSTRIAL AUTOMATION

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME503T	Industrial Automation	06	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1	Introduction to Industrial Automation	15	17	3	1	CO1
2	Computer Integrated Manufacturing Systems	20	22	2	2	CO2
3	CNC Programming	20	22	2	2	CO3
4	Industrial Robotics& Pneumatic power systems	20	22	2	2	CO4
5	3D Printing	15	17	3	1	CO5
	Total	90	100	12	8	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Describe History of Industrial Revolution, Computer Integrated Manufacturing systems, Material handling systems and write CNC Programming.
2	Explain the importance of industrial Robots and Development of 3D Printing.

COURSE OUTCOMES

CO1	ME503.1	Explain the Evolution of Industrial Automation and Need of Industry 4.0.
C02	ME503.2	Describe Computer aided manufacturing, CIMS and Material handling systems
C03	ME503.3	Write CNC part programming by using G codes and M codes and APT language.
C04	ME503.4	Explain the importance of Industrial Robots and their features and pneumatics in automation
C05	ME503.5	Explain the Methods of 3D Printing or Additive Manufacturing.

LEARNING OUTCOMES

Upon completion of the course student shall be able to

1.0 Introduction to Industrial Automation

1.1 Define Industrial Automation.
1.2 State the reasons for implementation of Automated Systems in Manufacturing Industries
1.3 Understand concisely the Features of Industrial Revolutions from First Industrial Revolution to Fourth Industrial Revolution (Industry1.0 to Industry 4.0.)
1.4 Understand the concept and systems integrated with Industry 4.0 or Smart Manufacturing
1.5 Evolution of Industry 4.0 in India
1.6 List the Advantages, Disadvantages and Benefits of Industry 4.0.
1.7 Define Internet of Things (IoT)
1.8 Explain the **f**unctions of Key Components of IoT
1.9 List Advantages, Disadvantages and Applications of IoT.
1.10 Define Cloud computing
1.11 List the key components of Cloud computing.
1.12 Define Industry Internet of Things (IIoT)
1.13 State the Difference between IoT and IIoT
1.14 Explain IIoT Key Technologies
1.15 Advantages and Applications of IIoT.

2.0 Computer Integrated Manufacturing Systems

2.1 Define Computer Aided Design and Computer Aided Manufacturing:
2.2 List Benefits of CAD and CAM.
2.3 Define NC System and explain basic components of NC system
2.4 Define CNC system and explain the functions of basic components of CNC system.
2.5 Define DNC system and explain the functions of basic components of DNC system.
2.6 Differentiate among NC, CNC, DNC systems.
2.7 Describe the layout and Functions of Principal components of Flexible Manufacturing System.
2.8 Write Advantages and Applications of Flexible Manufacturing System.
2.9 Define Computer Integrated Manufacturing system and explain the basic components of CIMS.
2.10 Classification of CNC Machines
2.11 Explain the construction and working principle of CNC Turning Centre.
2.12 Explain the construction and working principle of CNC Machining Centre.
2.13 Write the Advantages, disadvantages and applications of CNC machines.
2.14 Define Material handling system in CIMS environment
2.15 List functions of Material Handling Systems in CIMS environment.
2.16 Define Automated Guided Vehicle system and explain working principle of AGV
2.17 List and explain various types of AGVs
2.18 Explain Automatic storage and retrieval systems (AS/RS)

3.0 CNC Programming

3.1 Define Part Programming and List types of Part Programming.
3.2 Explain the steps involved in Manual Part Programming.
3.3 Define Co-ordinate system and explain absolute and incremental Co-ordinate systems.
3.4 Define Machine co-ordinating system (MCS) and Work piece co-ordinating System (WCS) with respect to NC or CNC machine tools.
3.5 Define NC word and list types of NC words
3.6 Write different preparatory functions (G-codes) and miscellaneous functions (M-Codes) in Part Programming.
3.7 Define Program format.
3.8 List types of Program formats and explain word address format.
3.9 Explain linear interpolation and Circular interpolation with illustrations.
3.10 Write simple Turning programs for the given component.
3.11 Define Computer aided part programming
3.12 Explain the concept and steps involved in Computer Aided Part Programming (CAPP)
3.13 List advantages of CAPP. Differentiate between Manual and Computer aided Part Programming.
3.14 List various Computer Aided Part Programming Languages.
3.15 Explain various statements involved in writing part program using APT language.

4.0 Industrial Robotics & Fluid Power Systems

4.1Define Robotics and Robot.
4.2 Explain the Necessity of Robots in Industries.
4.3 Explain the classification of Robots
4.4 List and explain the basic components of an Industrial Robot.
4.5 Explain degrees of freedom of a robot.
4.6 List Robot programming methods and Languages
4.7 Write Advantages, Disadvantages and Industrial applications of Robots.
4.8 Explain the Importance of Fluid power systems in the design and construction of Industrial robots.
4.8 Understand the concept and definition of Fluid Power system.
4.9 List the Advantages and applications of Pneumatic power systems in CIM environment.
4.9 Know the basic components of Pneumatic Power Systems.
4.10 Explain the working of Components Filter, Regulator and Lubricator.
4.11 Explain the working of Direction Control Valves (DCV), Flow control Valves (FCV) and Pressure Control Valves (PCV)
4.12 list various Types of actuators
4.13 Explain the principle and working of Pneumatic Circuits for single acting and double acting cylinders.

5.0 3D Printing (or) Additive Manufacturing

5.1 Explain the concept, principal and need of Additive Manufacturing
5.2 Define Rapid Prototyping and 3D Printing.
5.3 Compare Additive manufacturing with CNC Machining.
5.4 Explanation of Steps in the 3D Printing Process with a Flow chart.
5.5 List seven types of 3D Printing Technologies or Processes with examples.
5.6 Write Advantages, Limitations and Applications of 3D Printing.
5.7 Explain SLA 3D Printing Process.

5.8 Explain FDM 3D Printing Process.
5.9 Explain Selective Laser Sintering (SLS) Process.
5.10 List the Advantages, Disadvantages and Applications of the above.

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1							3	2	2
CO2		1						3	2	2
CO3			3				2	3	2	2
CO4				2				3	2	2
CO5				3	2	1		3	2	2
AVG	1	1	3	2.5	2	2	2	3	2	2

COURSE CONTENT

1.0 Introduction to Industrial Automation

Industry – Automation – Reasons for implementation of Automated Systems in Manufacturing Industries – Types of Automation – Features of Industrial Revolutions from First Industrial Revolution to Fourth Industrial Revolution (Industry 1.0 to Industry 4.0.)

Concept of Industry 4.0 or Smart Manufacturing – Systems integrated in Industry 4.0 – Certification – Effect of Industry 4.0 on Society – Industry 4.0 in India – Advantages and Disadvantages of Industry 4.0 – Benefits of Industry 4.0.

Internet of Things (IoT): Definition – History - Examples IoT devices –Functions of Key Components of IoT - Advantages and Disadvantages of IoT – Applications of IoT. Cloud Computing – Key components of Cloud Computing.

Industry Internet of Things (IIoT): Concept of IoT in Manufacturing Industries - Definition of IIoT– Difference between IoT and IIoT - Features and Benefits of IIoT – Working of IIoT – Industries using IIoT .

2.0 Computer Integrated Manufacturing Systems

Computer Aided Design: Definition of CAD – CAD Activities –CAD Software Packages.

NC, CNC AND DNC SYSTEMS:NC system definition and explanation of components of NC system – CNC system definition and explanation of functions of components of CNC system - DNC system definition and explanation of functions of components of DNC system – Comparison of NC, CNC and DNC systems.

Computer Aided Manufacturing: Definition of CAM - Functions of CAM – Group Technology- Functions of Principal components of Flexible Manufacturing System – Advantages and Applications of Flexible Manufacturing System.

Computer Integrated Manufacturing Systems: Integration of CAD and CAM - Definition of CIMS – CIMS Hardware and Software – Components of CIMS -Functions of components of CIMS - Benefits of CIMS.

Computer Numerical Control Machines: Classification of NC Machines – Specification of CNC machines - construction and working principle of CNC Turning Centre - Construction and working principle of CNC Machining Centre - Advantages, disadvantages and applications of CNC machines.

Components of CNC machine: Functions of Slide ways, recirculation ball screw Automatic Tool Changer and Tool Magazine, transducers - encoders.

Material Handling Systems in CIM: Material handling system in CIMS environment - Functions of Material Handling Systems in CIMS environment - Automated Guided

Vehicle system and explain working principle of AGV- Explanation various types of AGVs - Automatic storage and retrieval systems (AS/RS) - Working principle –Types – Applications.

3.0 CNC Part Programming

NC Part Programming – Definition and Meaning - Types of Part Programming.

Manual Part Programming: Introduction, Definition, Steps involved in Manual Part Programming - NC Co-ordinate system - absolute and incremental NC Co-ordinate systems - Machine co-ordinating system (MCS) and Work piece co-ordinating System (WCS) with respect to NC or CNC machine tools- Datum points, Machine zero, Work zero, and Tool zero - Reference points – Explanation of Co-ordinate axis system followed in NC or CNC Machine tools - NC word and types of NC words - different preparatory functions (G-codes) and miscellaneous functions (M-Codes) used in Part Programming - Program format - types of Program formats and explanation of word address format – explanation of linear interpolation and Circular interpolation with illustrations - Simple Turning programs for the given component using linear and circular interpolations.

Computer Aided Part Programming (CAPP): Definition, concept and Steps involved in CAPP- Advantages of CAPP – CAPP Languages- Concept of APT language- various statements involved in writing Part program using APT. Commercially available GUI based CAPP programming languages – comparison between manual and Computer aided part programming.

4.0 Industrial Robotics & Fluid Power Systems

Industrial Robotics: Definition of Robotics and Robot – Necessity of Robots in Industries- Characteristics - Classification of Robots: Based on Physical configuration, Type of Power Source, Control Systems and Type of Application - Work envelope, Work Volume and Pay Load Capacity – Brief Layout of an industrial robot - Description of Robot Components: Manipulator, End effector, Driving system, Controllers, Sensors and Grippers – Degrees of freedom: Pitch, Yaw, Roll – Robot programming methods and Languages- Advantages , Disadvantages and Industrial applications of Robots.

Fluid Power Systems: Necessity of Fluid power systems in the design and construction of Industrial robots Definition and concept of Fluid Power – advantages of Pneumatic power - Basic components of Pneumatic Power System -Principle and working of Filter, Regulator and Lubricator – working principle of Direction Control Valves (DCV), Flow control Valves (FCV) and Pressure Control Valves (PCV) – Types of Actuators used in Pneumatic power systems – Pneumatic Circuit for control of Single and double acting cylinders.

5.0 3D Printing (or) Additive Manufacturing

Rapid Prototyping: Definition - 3D Printing or Additive Manufacturing: Definition, principal Need of Additive Manufacturing - Additive manufacturing Vs CNC Machining – Flow chart showing Steps in the 3D Printing Process - Seven types of 3D Printing Technologies or Processes with examples – Materials used in 3D Printing - Advantages, Limitations and Applications of 3D Printing.

3D Printing Methods: Stereo Lithography (SLA), Selective Laser Sintering (SLS), Fused Deposition Modelling (FDM), Three-Dimensional Printing (3DP) Laminated Object Manufacturing (LOM); SLA- Process description, Materials, Advantages and Applications; FDM- Process description, Materials, Advantages and Applications- Selective Laser Sintering (SLS) Process description, Materials, Advantages and Applications.

REFERENCE BOOKS

1. Automation, Production Systems, and Computer-Integrated Manufacturing - Mikell P. Groover
2. Computer aided Design and Manufacturing – Mikell P Groover
3. CAD/CAM Theory and Practice- Ibrahim Zeid
4. CAD/CAM Principles and applications – P. N. Rao

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.15
Unit Test-II	From 4.1 to 5.10

MECHATRONICS

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME504E	Mechatronics	03	45	30	70	2

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1	Introduction to Mechatronics and Sensors	5	14	2	1	CO1
2	Actuators and Signal Conditioning	10	25	3	2	C02
3	Digital Electronics and Microcontrollers	10	22	2	2	CO3
4	System Modelling and Control Systems	10	22	2	2	C04
5	Programmable Logic Controllers (PLCs) and Mechatronics System Design	10	17	3	1	CO5
Total		45	100	12	8	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to
Integrate multidisciplinary fields combining mechanical engineering, electronics, and control systems. It helps in understanding Core Concepts which Alignment with Industry Needs, Promotes Problem-Solving Skills, Encourages Innovation and Creativity, Improves Employability skills and finally Cultivates an Interdisciplinary Mindset.

COURSE OUTCOMES

CO1	ME504.1	Understand the fundamental concepts and scope of Mechatronics
CO2	ME504.2	Describe the basic components of actuators and signal conditioning in Mechatronics systems
CO3	ME504.3	Explain the applications of digital electronics & micro controllers in Mechatronics system
CO4	ME504.4	Understand the basic principles of system modelling and control systems
CO5	ME504.5	Understand the fundamentals of Programmable Logic Controllers (PLCs) and Mechatronics System Design

LEARNING OUT COMES

Upon completion of the course the student shall be able to

1.0 Introduction to Mechatronics and Sensors

1.1 Define mechatronics.
1.2 List the advantages and applications of mechatronics.
1.3 List the components used in a mechatronics system.
1.4 Define a sensor and classify them with examples.
1.5 Differentiate between Analog and Digital sensors.
1.6 Explain the various types of sensors used in mechatronics systems.
1.7 Evaluate the advantages and disadvantages of using mechatronic systems in manufacturing.

2.0 Actuators and Signal Conditioning

2.1 Define actuators and signal conditioning.
2.2 List out different types of actuators
2.3 List out various components of actuators
2.4 List the advantages and disadvantages of actuators
2.5 Explain the working principle of electric, hydraulic, and pneumatic actuators.
2.6 Identify the differences between various actuator types in terms of speed, force, and application.
2.7 Identify the suitability of an actuator type for a specific industrial task
2.8 Explain the working of solenoids and relays.
2.9 List out various components of signal conditioning
2.10 Understand the functions of basic signal conditioning components
2.11 Describe the need for signal conditioning in sensor-based systems.

3.0 Digital Electronics and Microcontrollers

3.1 Define key terms such as logic gates, flip-flops, microcontroller, register, and ALU.
3.2 List the basic logic gates.
3.3 Explain the operation of combinational and sequential logic circuits.
3.4 Describe how microcontrollers differ from microprocessors.
3.5 List the features of the 8051 microcontrollers.
3.6 Interpret timing diagrams of digital circuits and instruction cycles of a microcontroller.
3.7 Apply Boolean algebra to simplify logic expressions and design logic circuits.
3.8 List the Interface input/output devices (e.g., LEDs, switches, LCD) with a microcontroller.
3.9 Compare the functions of different types of memory (RAM, ROM, EEPROM) in microcontrollers.

4.0 System Modelling and Control Systems

4.1 Define terms such as system, model, transfer function, open-loop, closed-loop, stability, and feedback.
4.2 List out the components of control systems
4.3 Identify different types of control systems (e.g., open-loop, closed-loop).
4.4 Explain the procedure of modelling in control system design.
4.5 List out the types of control strategies (P, PI, PID).
4.6 Describe the behaviour of first- and second-order systems using time-domain analysis.
4.7 Construct block diagram models for mechanical, electrical, or electromechanical

systems.
4.8 Use MATLAB or similar tools to simulate control system responses.
4.9 Compare the performance of open-loop vs. closed-loop control systems.
4.10Break down complex system models into subsystems for individual analysis.
4.11Explain the impact of parameter variation on system behaviour and robustness.

5.0 Programmable Logic Controllers (PLCs) and Mechatronics System Design
5.1 Define key terms such as PLC, ladder logic, I/O modules, and scan cycle.
5.2 List various components used in mechatronic systems (sensors, actuators, controllers, interfaces).
5.3 Identify different types of PLCs and programming languages (e.g., Ladder Diagram, Function Block, Structured Text.
5.4 Explain the working principle of a PLC and its role in automation.
5.5 Describe how different mechatronic subsystems interact within a complete system.
5.6 Illustrate the structure of a PLC-based control system with input/output interactions.
5.7 Develop basic ladder logic programs to perform simple automation tasks (e.g., motor
start/stop, light control).
5.8 Interface sensors and actuators with a PLC in a controlled process.
5.9 Break down a mechatronic system into mechanical, electrical, and software subsystems.
5.10 Evaluate the performance and reliability of a PLC-controlled system under different conditions.

CO-PO/PSO MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
C01	2	2	1		1	1	1	3	2	1
C02	2	2	1		1	1	1	2	3	1
C03	2	2	1		1	1	1	2	3	1
C04	2	2	1		1	1	1	2	3	1
C05	2	2	1		1	1	1	1	2	1
AVG	2	2	1		1	1	1	2	2.8	1

COURSE CONTENT

1.0. Introduction to Mechatronics and Sensors
Introduction to Mechatronics: Definition, history, and evolution of Mechatronics-Synergistic integration of mechanical, electrical, electronics, computer, and control systems-Advantages and applications of mechatronic systems (e.g., automatic washing machines, ATMs, robotics, automotive systems)-Key elements of a mechatronic system (sensors, actuators, signal conditioning, controllers, control algorithms, data acquisition, display devices).
Sensors and Transducers: Definition, classification, and characteristics of sensors and transducers-Performance terminology (accuracy, precision, resolution, range, linearity, sensitivity, response time)-Types of sensors: **Mechanical:** Displacement (LVDT, Potentiometer), Position & Proximity (Optical, Inductive, Capacitive), Force, Torque, Pressure. **Thermal:** Temperature (Thermocouple, RTD, Thermistor).**Fluid:**

Flow, Liquid Level. **Light:** Photoresistor, Photodiode, Phototransistor. **Motion:** Velocity (Tachogenerator), Acceleration (Accelerometer), Vibration.

2.1. Actuators and Signal Conditioning

Actuation Systems: Definition and classification of actuators-**Mechanical Actuation:** Gears, cams, levers, linkages, belt and pulley systems-**Hydraulic Actuation:** Principles, components (pumps, valves, cylinders, motors), applications, advantages, and disadvantages-**Pneumatic Actuation:** Principles, components (compressors, valves, cylinders, motors), applications, advantages, and disadvantages-**Electrical Actuation:** DC Motors (types, working principle, control).AC Motors (types, working principle, control).Stepper Motors (working principle, types, control, specifications).Servo Motors (working principle, control).Solenoids, Relays.

Signal Conditioning: Need for signal conditioning-Analog signal conditioning: Amplifiers (Operational Amplifiers - Op-Amps, their configurations and applications), filters (active and passive)-Digital signal conditioning: Analog-to-Digital Converters (ADC) and Digital-to-Analog Converters (DAC) - principles and types-Data Presentation Systems: LEDs, LCDs, Digital Displays.

9.1. Digital Electronics and Microcontrollers

Digital Logic Systems: Introduction to digital electronics: Binary system, logic gates (AND, OR, NOT, NAND, NOR, XOR, XNOR)-Boolean algebra, De Morgan's theorems-Combinational logic circuits: Half-adder, full-adder, multiplexers, demultiplexers, encoders, decoders-Sequential logic circuits: Flip-flops (SR, JK, D, T), registers, counters.

Microprocessors and Microcontrollers: Introduction to microprocessors and microcontrollers: Architecture, basic differences-Introduction to 8051 microcontrollers: Architecture, pin configuration, memory organization-Basic programming concepts for microcontrollers (e.g., introduction to assembly language or C for embedded systems)-Interfacing with input/output devices.

4.0. System Modelling and Control Systems

System Modelling: Need for modelling in Mechatronics-Mathematical modelling of physical systems: Mechanical Systems: Translational and Rotational systems (mass, spring, damper, inertia, stiffness, damping coefficient). Electrical Systems: Resistor, Inductor, Capacitor circuits. Basic Fluid and Thermal System concepts.

Control Systems: Basic control system concepts: Open-loop and closed-loop (feedback) control systems-Components of a control system: Controller, plant, sensor, actuator-Types of control: On-off control, Proportional (P), Integral (I), Derivative (D), and PID controllers-Introduction to stability and steady-state error-Examples of control systems in mechatronics (e.g., temperature control, position control).

4.0. Programmable Logic Controllers (PLCS) and Mechatronics System Design

Programmable Logic Controllers (PLCs): Introduction to PLCs: Architecture, advantages over relay logic-Input/Output (I/O) modules-PLC programming: Ladder diagram, instruction list (mnemonics)-Timers, counters, internal relays, shift registers-Applications of PLCs in industrial automation (e.g., traffic light control, motor control, elevator control, washing machine control)-Selection of PLCs for specific applications.

REFERENCES

1. "Mechatronics: Principles and Applications" by Godfrey C. Onwubolu
2. “Mechatronics Systems Design” by Devdas Shetty
3. "Introduction to Mechatronics and Measurement Systems" by David G.Alciatore and Michael B. Histand
4. "Mechatronics: A Foundation Course" by Clarence W. de Silva
5. "Robotics: Control, Sensing, Vision, and Intelligence" by K.S.Fu, R.C.Gonzalez, and C.S.G. Lee
6. "Programmable Logic Controllers" by W. Bolton

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 3.9
Unit Test-II	From 4.1 to 5.10

ADDITIVE MANUFACTURING

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME505E	Additive Manufacturing	03	45	30	70	2

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions	COs Mapped
1	Introduction to Additive Manufacturing.	5	14	2	1	CO1
2	Materials for AM and Classification of AM Techniques.	12	25	3	2	CO2
3	Process Modeling and Energy sources of AM.	12	22	2	2	CO3
4	Design for Additive Manufacturing (DfAM) and Applications.	8	25	3	2	CO4
5	Post-processing and Quality Assurance in AM.	8	14	2	1	CO5
Total		**45**	**100**	**12**	**08**	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Understand the concept and scope of Additive Manufacturing (AM),get familiarization with major processes, materials, and applications in AM, know basic 3D modelling, slicing, and 3D printing**,** know the application of AM in industries such as automotive, aerospace, healthcare, and design.

COURSE OUTCOMES

CO1	ME505.1	Understand the evolution and difference between AM and Traditional manufacturing.
C02	ME505.2	Explain the different materials used and working principles of different AM Techniques.
C03	ME505.3	Explain the process parameters, energy sources and process modelling of AM parts.
C04	ME505.4	Explain the topology optimization and post processing of AM parts.
CO5	ME505.5	Understand the application areas and case studies of AM.

LEARNING OUTCOMES

1.0 Introduction to Additive Manufacturing

1.1 Explain the principles, history, and evolution of additive manufacturing.
1.2 Distinguish between additive, subtractive, and formative manufacturing processes.

2.0 Materials for AM And Classification of AM Processes

2.1 Describe the properties and uses of AM materials including polymers, metals, ceramics, and composite materials.
2.2 Select suitable materials for a given application or process based on mechanical, thermal, and chemical requirements.
2.3 Identify and describe the seven categories of AM processes as per ISO/ASTM standards.
2.4 Compare the working principles, materials, advantages, and limitations of various AM technologies like FDM, SLA, SLS, SLM, DED, etc.

3.0 Process Modelling and Energy Sources of AM

3.1 Understand how changes in process variables (layer thickness, scan speed, energy intensity, etc.) affect the temperature distribution, residual stresses, microstructure, and overall mechanical properties of printed parts.
3.2 Explain how different AM technologies use various energy sources (e.g., lasers, electron beams, thermal energy) to achieve material consolidation and how these influence the characteristics and applications of each process.
3.3 Understand how AM constraints affect product design and development.
3.4 Identify real-world applications across industries (aerospace, automotive, medical, consumer products, etc.).
3.5 Understand the benefits and challenges of AM in industrial settings.

4.0 Design for Additive Manufacturing (DfAM)

4.1 Apply complex design strategies such as topology optimization, lattice structures, and mass customization.
4.2 Evaluate how AM constraints affect product design and development.

5.0 Post-Processing and Quality Assurance In AM

5.1 Identify various post-processing methods: surface finishing, heat treatment, and support removal.
5.2 Understand the need for quality control, testing, and standardization in AM components.
5.3 Understand inspection and quality assurance practices in AM.

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
C01	3	3	1		3	1	1	2	1	2
C02	2	3	2		3	1	1	3	2	3
C03	2	2	3		2	1	1	2	3	3
C04	1	2	3		1	1	2	3	2	3
C05	2	3	2		2	1	2	2	2	3
AVG	2	2.6	2.2		2.2	1	1.6	2.4	2	2.8

COURSE CONTENTS

1.0 Introduction to Additive Manufacturing

Definition and evolution of additive manufacturing (AM), Distinction between AM and traditional (subtractive) manufacturing such as CNC machining, Steps in the AM process and workflow, from design to finished part Advantages, limitations, and scope of AM across industries.

2.0 Materials for AM and Classification of AM Techniques

Materials for AM: Polymers viz., Thermoplastics (PLA, ABS, Nylon, TPU), thermosets. Metals and Alloys viz., Stainless steel, titanium, aluminium, etc. Ceramics, composites, and functionally graded materials (FGMs). Material properties, selection criteria, and their application in different AM processes.

Classification of AM technologies viz., Vat Photopolymerization (e.g., Stereolithography/SLA), Material Jetting, Binder Jetting, Material Extrusion (e.g., Fused Deposition Modelling/FDM), Powder Bed Fusion (e.g., Selective Laser Sintering/SLS; Selective Laser Melting/SLM), Sheet Lamination (e.g., Laminated Object Manufacturing/LOM), Directed Energy Deposition (DED).

3.0 Process Modelling and Energy Sources of AM

Process Modelling: Understanding process parameters and their impact (temperature, speed, layer thickness), Path planning and modelling in extrusion-based and photopolymerization systems, Data preparation: CAD to STL conversion, slicing, file handling.

Energy sources: Fundamentals of laser, electron beam, and plasma energy sources Material consolidation mechanisms: Sintering, melting, curing, bonding Interaction of energy with material and resultant properties.

4.0 Design for Additive Manufacturing (DFAM) and Applications

Design strategies unique to 3D printing (e.g., lattice structures, topology optimization), Support structures, part orientation, and post-processing requirements.

Applications of AM: Industrial sectors: Aerospace, automotive, medical/dental, architecture, art, prototyping, tooling.Emerging research and development areas, Real-world case studies highlighting AM's benefits and challenges.

5.0 Post-Processing and Quality Assurance In AM

Surface finishing, heat treatment, and other post-build processes, Inspection and testing techniques for AM parts, Standards and quality certification in additive manufacturing.

REFERENCES

1. The 3D printing hand book by Ben Redwood, Filemon Schoffer, Brian Garret.
2. Additive Manufacturing Technologies by Ian Gibson, David W Rosen, Brent Stucker.
3. Anintroductionto3Dprinting by Victoria Zukas, Jonas A Zukas.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning Outcomes to be covered
Unit Test-I	From 1.1 to 2.4
Unit Test-II	From 3.1 to 5.3

BASICS OF AEROSPACE ENGINEERING

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME506A	Basics of Aerospace Engineering	02	30	--	--	No Credits

TIME SCHEDULE

S. No	Chapter/Unit Title	No. of Periods	Weightage of marks	No. of Short Answer Questions	No. of Essay Answer Questions
1	Introduction to Aerospace engineering	10			
2	Aircraft structures& Materials	05	-	-	-
3	Aircraft systems	15	-	-	-
Total		**30**	-	-	-

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to
Understand the fundamental concepts of aerospace vehicles, aircraft parts, materials, systems, propulsion, aviation Regulations and Safety Management

COURSE OUTCOMES

CO1	ME506.1	Explain the basic concepts of aerospace vehicles and their classification
CO2	ME506.2	Describe the components of aircraft and their materials
CO3	ME506.3	Understand the functions of different systems used in aircrafts.

LEARNING OUT COMES

Upon completion of the Course the student shall be able to

1. Introduction to Aerospace Engineering

1.1. Define basic aerospace terms.
1.2. Identify different types of aerospace vehicles and their primary applications.
1.3. Define common aviation terms and air traffic management.

1.4. Describe functions of air traffic control units.
1.5. List various national and international aerospace research organizations, aviation regulatory bodies and historic missions by ISRO.

2. Aircraft Structures & Materials

2.1 Identify the various parts of an aircraft
2.2 Identify control surfaces and structural elements of air craft.
2.3 Explain the functions of main parts of air craft such as fuselage, empennage, ribs, spars, stringers etc.
2.4 Describe the purpose of landing gear.
2.5 Identify important properties of aerospace materials and list out materials used for different air craft parts.

3. Aircraft Systems

3.1 Define various electrical terms used in air craft.
3.2 Identify main components of aircraft electrical systems.
3.3 Explain the procedure of electrical power generation, storage and distribution in air craft.
3.4 Identify various components of hydraulic systems and fuel systems and mention their purpose.
3.5 Explain the operation of hydraulic systems and fuel systems
3.6 Identify the functions of flight control systems.
3.7 List the main components and explain purpose and operation of air conditioning system and pressurization systems of air craft.
3.8 List and Explain different air craft propulsion systems.

COURSE CONTENTS

1. Introduction to Aerospace Engineering

Definition &Classification of aerospace vehicles: Aircraft, Missiles, Drones & Space vehicles-**Airports & Air Traffic Management** (ATM): Air Space Management (ASM), Air Traffic Services (ATS) such traffic control and information, Air Traffic Flow Management (ATFM)-**Aerospace research organizations**: ISRO-NASA-DLR-ONERA-**Aviation regulatory and safety management:** DGCA-ICAO-IATA**-**Four Components

2. Aircraft Structures & Materials

Aircraft Structures: Fuselage, wings, Empennage, propulsion Plant, main control surfaces. Functions of fuselage, ribs, tail and landing gear-**Aircraft Materials:** fiber-reinforced composites, aluminum alloys, titanium alloys, steel and their properties.

3. Aircraft Systems

Electrical system: Generators/Alternators, Busbars (AC/DC Buses), Transformers/Rectifiers, Circuit Breakers/Fuses-Fuel system: tanks, fuel hydrants, feeding pumps, pipes and conducts, valves and filters, sensors, indicators, and control elements-Hydraulic system: Fuel pump - cross feed valve – shutoff valve-Actuators-lines & hoses-accumulators-Flight control systems: Fly-By-Wire system- mechanical system- Hydro mechanical system-Air conditioning & pressurization system: Bleed Air Source-precooler-Air cycle machine-Heat exchangers-mixing chamber-temperature control valves-Propulsion system: Turbo prop, turbofan, ramjet, cryogenic engines.

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
C01	3	3	2		2		1	3	2	1
C02	2	3	3		3		1	2	3	3
C03	2	3	3		3		1	2	3	3
AVG	2.33	3	2.67		2.67		1	2.33	2.67	2.33

REFERENCE BOOKS

1. Fundamentals of aerospace engineering - Manuel soler
2. Introduction to Aerospace Engineering: Basic Principles of Flight – Ethirajan Ratha Krishnan
3. Aerospace Materials and Material Technologies - N. Eswara Prasad
4. Fundamentals of Aerospace Engineering - Rajesh Kumar Arora.

CAD / CAM LAB

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME507L	CAD / CAM LAB	07	105	40	60	3

TIME SCHEDULE

26ME507L (A) - CAD Lab		
Sl No.	**Chapter/Unit Titles**	**No. of periods**
1.	Introduction to CAD	03
2.	Selecting commands & Working with drawing	03
3.	Viewing drawing	03
4.	Working with coordinates	03
5.	Creating simple and complex entities	03
6.	Getting Drawing information	03
7.	Modifying entities	03
8.	Working with text	03
9.	Dimensioning drawing	03
10.	2D Drawing	09
11.	Layers	03
12.	3D Drawings	06
TOTAL		**45**

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Know CAD screen and various tool bars and menus and Apply dimensioning and hatching on the auto CAD drawings
2	Draw 2D drawings and 3D drawings

COURSE OUTCOMES

CO1	ME507(A).1	Demonstrate basic concepts of the CAD software
CO2	ME507(A).2	Apply appropriate command to develop basic drawings
CO3	ME507(A).3	Use edit and plotting techniques to manipulate drawings through editing and plotting technique
CO4	ME507(A).4	Draw 2D drawings for given specifications
CO5	ME507(A).5	Draw 3D drawings for given specifications

LEARNING OUTCOMES

1.0 **Understand about the Computer Aided Drafting and its software**
1.1 Define Computer Aided Drafting
1.2 List the Advantages of CAD
1.3 Explain the importance of CAD software
1.4 Explain the evolution of CAD software up to parametric modelling and direct modelling
1.5 Explain the features of Graphic Work station
1.6 Use CAD Environment: Screen, Various tool bars and menus.

2.0 **Use appropriate selection commands**
2.1 Practice commands using toolbars, menus, command bar
2.2 Practice repeating a command, Nesting a command and modifying a command
2.3 Use prompt history window and scripts
2.4 Practice mouse shortcuts
2.5 Practice the Creating the drawing, Opening existing and damaged Files, saving the drawing
2.6 Practice the setting up a drawing
2.7 Practice the setting and changing the grid and snapping alignment
2.8 Practice the Entity snaps

3.0 **Use viewing tools of CAD**
3.1 Practice the use of Scroll bar, pan command, and rotating view to move around within drawing
3.2 Practice the changing of magnification of drawing
3.3 Practice the displaying of multiple views
3.4 Practice the use of controlling visual elements like Fill, Text, Blips and Line weight

4.0 **Use coordinate systems of the drawing**
4.1 Practice how the coordinate system work
4.2 Practice how the coordinate system displayed
4.3 Practice the Find tool to determine the coordinates of a point
4.4 Practice the Two dimensional coordinates such as Absolute Cartesian, Relative Cartesian and Polar coordinates
4.5 Practice the use of right-hand rule
4.6 Practice the how to enter into x, y, z - coordinates
4.7 Practice the Three dimensional coordinates such as Spherical and Cylindrical coordinates
4.8 Practice the use of filters in two and three dimensions
4.9 Practice defining user coordinate system
4.10 Practice the use of present user coordinate system

5.0 **Create the simple and complex entities**
5.1 Draw the lines, circles, arcs, ellipses, elliptical arcs, rays and infinite lines
5.2 Practice the Creation of point entities
5.3 Practice the Editing of point entities
5.4 Draw the complex shapes like Rectangles, Polygons, Polylines, Splines, Donuts, and Planes
5.5 Practice the adding of hatch pattern

6.0 Use the drawing information retrieving tools Measure, Divide, Calculate, Display, and Track

6.1 Measure the intervals on entities
6.2 Divide the entities in to segments
6.3 Calculate the areas defined by points, of closed entities, and Combined entities
6.4 Calculate the distance between the entities
6.5 Calculate the angle between the entities
6.6 Display the information about the entities and drawing status
6.7 Track time spent working on a drawing

7.0 Use the modifying tools to modify the properties of entities

7.1 Practice the entity selection and deselection methods
7.2 Practice the Deletion of entities
7.3 Practice the Copying of entities within a drawing, between drawings
7.4 Practice the making of parallel copies, Mirroring entities and arraying entities
7.5 Practice the Rearranging of entities by Moving, Rotating and Reordering
7.6 Practice the Resizing of entities by Stretching, Scaling, Extending, Trimming, and
7.7 Editing the length
7.8 Practice the Breaking and joining of entities
7.9 Practice the creating, modifying the groups and ungrouping of Entities
7.10 Practice the Editing of polylines: Opening, Closing, Curving, Decurving, Joining
7.11 Changing width and editing vertices Practice the Exploding of entities
7.12 Practice the Chamfering and Filleting of entities

8.0 Use the Text tool to create and formatting the various types of text fonts and its styles

8.1 Practice the creating, naming and modifying the text fonts
8.2 Practice the Creation of line text, paragraph text
8.3 Practice the Setting of line text style and its alignment
8.4 Practice the Setting of Paragraph text style and its alignment
8.5 Practice the Changing of line text and Paragraph text
8.6 Practice the use of alternate text editor

9.0 **Use Dimensioning concepts to create dimensions, Edit dimensions, Control dimension styles & variables and Adding geometric tolerances**

9.1 Practice the creating of linear, Angular, Diametral, Radial, Ordinate dimensions
9.2 Practice the creating leaders and annotations
9.3 Practice making dimensions oblique
9.4 Edit the dimension text
9.5 Practice the Controlling of dimension arrows and format
9.6 Practice the Controlling of line settings and dimension text
9.7 Practice the Controlling of dimension units, and dimension tolerance

10.0 Create 2D Drawing

10.1 Create 2D drawings of Knuckle Joint
10.2 Create 2D drawings of flange Coupling
10.3 Create 2D drawings of Footstep Bearing
10.4 Lathe Tool Post
10.5 Eccentric

11.0 **Organize the information on layers**
11.1 Practice the setting a current layer, line type, line weight, print style
11.2 Practice the locking and unlocking of layers
11.3 Practice the layer visibility and layer printing
11.4 Practice the setting of current line type
11.5 Practice the loading of additional line types
11.6 Practice the creating and naming of line type
11.7 Practice the editing of line type

12.0 **3D Drawings**
12.1 Explain the concept of 3D
12.2 Create 3D solids using solid tool bar options
12.3 Create 3D Drawings of Standard Mechanical Components (Bolt and Nut, Screw jack)
12.4 Practice of Rendering

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3
CO1	1							3	2	1
CO2	1							3	2	1
CO3		1	3	1				3	2	1
CO4		1	3	1				3	2	1
CO5		1	3	1				3	2	1
AVG	1	1	3	1				3	2	1

COURSE CONTENT

1.0 The Computer Aided Drafting and its software
Definition of Computer Aided Drafting, the Advantages and importance of CAD software, the features of parametric modelling and direct modelling, the features of Graphic Work station, CAD Environment: Screen, Various tool bars and menus.

2.0 Selection of commands
Commands using toolbars, menus, command bar. Repeating a command, Nesting a command and modifying a command. Use of prompt history window and scripts, mouse shortcuts. Creating the drawing. Opening existing and damaged files, saving of drawing, setting up a drawing. Setting and changing the grid and snapping alignment, and the Entity snaps.

3.0 Use of viewing tools of CAD
Use of Scroll bar, pan command, and rotating view to move around within drawing, changing of magnification of drawing. Displaying of multiple views, the use of controlling visual elements like Fill, Text, Blips and Line weight.

4.0 Use of coordinate systems of the drawing

Two dimensional coordinates such as Absolute, Cartesian, Relative Cartesian and Polar coordinates. The use of right-hand rule. Three dimensional coordinates such as Spherical and Cylindrical Coordinates, the use of filters in two and three dimensions, defining user Coordinate system.

5.0 Creating simple and complex entities

Drawing of lines, circles, arcs, ellipses, elliptical arcs, rays and infinite lines. Creating and editing of point entities. Drawing of complex shapes like rectangles, polygons, polylines, Splines, donuts, planes, and adding of hatch pattern

6.0 Use the drawing information retrieving tools Measure, Divide, Calculate, Display, and Track

Measuring the intervals on entities, dividing the entities into segments. Calculation of areas defined by points, closed entities, and combined entities, calculate the distance and angle between the entities. Displaying the information about the entities and drawing status. Tracking time spent working on a drawing.

7.0 Use the Modifying tools to modify the properties of entities

Entity selection and de selection methods, the Deletion of entities. Copying of entities within a drawing, between drawings, parallel copies, Mirroring entities and Arraying entities. The Rearranging of entities by Moving, Rotating and Reordering. The Resizing of entities by Stretching, Scaling, Extending, Trimming, and Editing the length. The Braking and joining of entities.The creating, modifying the groups and Ungrouping of Entities. Editing of polylines: Opening, Closing, Curving, Decurving, Joining, Changing width and editing vertices, The Exploding of entities, the Chamfering and Filleting of entity

8.0 Use the Text tool to create and formatting the various types of text Fonts and its styles

The creating, naming and modifying the text fonts, the Creation of line text, paragraph text, setting of line text style and its alignment. The Setting of Paragraph text style and its alignment, the Changing of line. Text and Paragraph text, the use of alternate text editor.

9.0 Use Dimensioning concepts to create dimensions, Edit dimensions, Control dimension styles & variables and Adding geometric tolerances

The creating of linear, Angular, Diametral, Radial, Ordinate dimensions. The creating leaders and annotations, making dimensions oblique, Editing the dimension text, controlling of dimension arrows and format. The Controlling of line settings and dimension text, the Controlling of dimension units, and dimension tolerance.

10.0 2D Drawings

Using appropriate commands creation of 2D drawings of standard mechanical components.

11.0 Organize the information on layers

Setting a current layer, layers colour, line type, line Weight, print style Locking and unlocking of layers, the layer visibility and layer printing. Setting of current line type. The loading of additional line types, creating and naming of line type, editing of line type.

12.0 3D Drawings

3D drawings of standard components. Rendering of 3D images

REFERENCE BOOKS

4MCAD User Guide- IntelliCAD Technology Consortium (WWW.intellicad.org)
4MCAD Software:

1. 4MCAD Viewer,
2. 4MCAD Classic,
3. 4MCAD Standard,
4. 4MCAD Professional.

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning outcomes to be covered
Unit Test-I	From Experiment 1 to 6
Unit Test-II	From Experiment 7 to 12

TIME SCHEDULE

26ME507L (B) – CAM LAB		
S. No	**Chapter/Unit Titles**	**Periods**
1	CNC Introduction	3
2	Coordinate System and Types	3
3	G–codes and M-codes	6
4	Structure of program	6
5	Simulation software practice	3
6	Turning exercise–Plain turning using canned cycle	3
7	Turning exercise–step turning using canned cycle	3
8	Turning Exercise-Taper turning	6
9	Turning exercise–Circular interpolation CW, CCW	6
10	Turning Exercise-Peck drilling	3
11	Turning exercise–Thread cutting	3
12	Turning exercise–Grooving	3
13	Simple 3D Printing Model	6
14	Assembly Model – 1 using 3D Printing	3
15	Assembly Model – 2 using 3D Printing	3
Total		**60**

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Familiarize with parts and functions of CNC lathe
2	Familiarize in writing the part programming using G-Codes and M-Codes and simulate & execute on CNC Lathe

COURSE OUTCOMES

CO1	ME507(B).1	Identify the parts of a CNC lathe and mention their functions
CO2	ME507(B).2	Practice incremental system and absolute system of dimensioning
CO3	ME507(B).3	Write simple part program using G-Codes and M-Codes.
CO4	ME507(B).4	Edit and execute a part program using CNC lathe machine Simulation software and Produce part as per the drawing using CNC lathe machine.
CO5	ME507(B).5	Produce part using 3D Printing

LEARNING OUT COMES

Upon completion of the course the student shall be able to

1. Identify the parts of CNC lathe and mention their functions
2. Explain incremental system and absolute system of dimensioning.
3. Write simple part program using G-Codes and M-Codes.
4. Edit and execute a part program using CNC lathe machine simulation software.
5. Prepare the part program as per the drawing.
6. Produce part as per the drawing using CNC lathe machine.
7. Produce the part by using 3D Printing Technology

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2							1	1	1
CO2	2							1	1	1
CO3	2	1	1	3			1	2	2	1
CO4	2	1	1	3			1	2	2	1
CO5	2	1	1	3			1	1	1	1
AVG	2	1	1	3			1	1.5	1.5	1

COURSE CONTENT

1. Introduction to CNC machines and programming
2. List Coordinate Systems
3. Explain G–codes and M-codes
4. Explain Structure of program
5. Demonstrate Simulation software practice
6. Turning exercise–Plain turning using canned cycle
7. Turning exercise–Step turning using canned cycle
8. Turning Exercise-Taper turning
9. Turning exercise–Circular interpolation CW, CCW
10. Turning Exercise-Peck drilling
11. Turning exercise–Thread cutting
12. Turning exercise–Grooving
13. Create simple 3D Model (cube, gear, prism, etc.)
14. Create 3D Model (Bolt and Nut Assembly)
15. Create 3D Model Assembly (Screw Jack, Plummer Block, etc.)

REFERENCES

1. CNC Machines and Programming by P. Radhakrishnan
2. CNC Programming and Operation by K. Venkata Reddy
3. Numerical Control and Computer Aided Manufacturing by T.K. Kundra
4. CAD/CAM Principles and Applications by P.N. Rao
5. Mastercam/CAM Software Practice by Valentino & Goldenberg

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning outcomes to be covered
Unit Test-I	From Experiment 1 to 8
Unit Test-II	From Experiment 9 to 15

REFRIGERATION AND AIR CONDITIONING LAB
(PRACTICUM – PRACTICAL)

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME508L	Refrigeration and Air Conditioning Lab	06	90	40	60	2

TIME SCHEDULE

S.No	Chapter/Unit Title	Periods	
		Theory	Practical
1	Perform basic fabrication operations viz., flaring, swaging, bending and brazing on soft copper tubes	3	7
2	Evaluate the C.O.P of a given Vapour Compression cycle test rig	3	7
3	Evaluate the C.O.P of a Domestic Refrigerator	3	7
4	Evaluate the C.O.P of a water cooler	3	7
5	Study of Ice Plant	3	7
6	Perform various types of leak detection methods of a refrigeration system	3	7
7	Evaluate the C.O.P. of given air-conditioning system	3	7
8	Apply the method of Vacuumization and refrigerant charging for a given vapour compression system.	3	7
9	Study of Window Air Conditioning System	7	3
Total		31	59

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Familiarisation with R & AC tools and perform the basic operations on soft copper tube
2	Conduct performance test on Vapour Compression Refrigeration test rig, Domestic Refrigerator, Water Cooler, Ice Plant and Air condition Test Rig
3	Detect the Leakage of Refrigerant and Vacuumization and refrigerant charging for a given vapour compression system.

COURSE OUTCOMES

CO1	ME508.1	Explain various tools used in Refrigeration & Air Conditioning
C02	ME508.2	Conduct the performance test and evaluate the COP of Vapour Compression Refrigeration test rig, Domestic Refrigerator, Water Cooler, Ice Plant.
C03	ME508.3	Calculate the COP of a given Air condition Test Rig.
C04	ME508.4	Conduct the Vacuumization and refrigerant charging for a given vapour compression system.
C05	ME508.5	Study Window Air Conditioning System

LEARNING OBJECTIVES

Upon completion of the course the student shall be able to

1.0. Perform basic fabrication operations viz., flaring, swaging, bending and brazing on soft copper tubes

1.1. Identify various tools used in Refrigeration & Air Conditioning
1.2. Perform flaring, swaging, bending and brazing operations by using Refrigeration & Air conditioning tools

2.0. Evaluate the C.O.P of a given Vapour Compression cycle test rig

2.1. Identify the components of vapour compression system
2.2. Record the values of pressure and temperature when the pressure gauges are stabilized
2.3. Record the energy meter reading
2.4. Read the values from Pressure Vs Enthalpy diagram of the given refrigerant
2.5. Evaluate actual, theoretical and relative C.O.P

3.0. Evaluate the C.O.P of a Domestic Refrigerator

3.1 Identify the components
3.2 Record the values of pressure and temperature when the Pressure gauges are stabilized
3.3 Record the energy meter reading
3.4 Read the enthalpy values from Pressure Vs Enthalpy diagram of the given refrigerant
3.5 Evaluate actual, theoretical and relative C.O.P

4.0. Evaluate the C.O.P of a water cooler

4.1 Identify the components
4.2 Record the values of pressure and temperature when thePressure gauges are stabilized
4.3 Record the energy meter reading
4.4 Read the enthalpy values from Pressure Vs Enthalpy diagram of the given refrigerant
4.5 Evaluate actual, theoretical and relative C.O.P

5.0. Study of Ice Plant

5.1 Identify the components
5.2 Observe the values of pressure and temperature when the Pressure gauges are stabilized

5.3 Observe the energy meter reading
5.4 Read the enthalpy values from Pressure Vs Enthalpy diagram of the given refrigerant
5.5 Evaluate theoretical C.O.P

6.0. Identify various types leak detection methods of a refrigeration system

6.1 Detect the leakages of given vapour compression refrigeration system by using soap solution method.
6.2 Apply the methods of arresting leakages
6.3 Arrest the leakages if any by soldering

7.0. Evaluate the C.O.P. of given air-conditioning system

7.1 Identify the components of given vapour compression air-conditioning test rig.
7.2 Insert thermometers in suction line and discharge line
7.3 Run the given V.C. A.C. system for some time
7.4 Record the pressure and temperature readings when the pressure gauges are stabilized.
7.5 Record the energy meter reading
7.6 Read the enthalpy values from Pressure Vs Enthalpy diagram of the given refrigerant
7.7 Evaluate C.O.P

8.0. Apply the method of vaccumization and refrigerant charging for a given vapour compression system.

8.1 Evacuate the given V.C.R. system using a vacuum pump
8.2 Charge the given V.C.R. system by using suitable refrigerant gas
8.3 Run the system for at least 15 min. and check for the build-up of pressure

9.0 Study of Window Air Conditioning System

9.1 Identify the components of given window A/C
9.2 Understand the functions of the components
9.3 Understand the maintenance procedure and remedies to the common problems encountered.

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	1			3			1	2	1	
CO2	1			3			1	2	1	
CO3	1			3			1	2	1	
CO4	1			3			1	2	1	
CO5	1			3			1	2	1	
AVG	1			3			1	2	1	

COURSE CONTENT

1. Perform Basic operations like flaring, swaging, bending and brazing on soft copper tubes
2. Determination of C.O.P of a given Vapour Compression cycle test rig
3. Determination of the C.O.P of a Domestic Refrigerator
4. Determination of C.O.P of a water cooler

5. Study of Ice Plant
6. Perform various types of leak detection methods of a refrigeration system
7. Determination of C.O.P. of given air-conditioning system
8. Vacuumization and charging, pressure testing of given refrigeration system.
9. Study of Window Air Conditioning System

REFERENCES

1. Refrigeration and Air Conditioning by R.S. Khurmi
2. Refrigeration and Air Conditioning by C.P. Arora
3. A Textbook of Refrigeration and Air Conditioning by Arora & Domkundwar
4. Basic Refrigeration and Air Conditioning by P.N. Ananthanarayanan
5. Modern Refrigeration and Air Conditioning by Althouse, Turnquist & Bracciano

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS

Unit Test	Learning outcomes to be covered
Unit Test-I	From Experiment 1 to 5
Unit Test-II	From Experiment 6 to 9

PROJECT WORK

Course Code	Course Title	No. of Periods / Week	Total No. of Periods	FA Marks	SA Marks	Credits
26ME510P	Project Work	03	45	40	60	0.5

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Integrate and apply the knowledge & Skills acquired to plan, design and execute the practical project

COURSE OUTCOMES

CO1	ME510.1	Apply mechanical engineering concepts and technical skills in design and execution of a project
CO2	ME510.2	Develop problem solving and innovative thinking abilities
CO3	ME510.3	Enhance team work, communication and project management skills.
CO4	ME510.4	Promote professional ethics, documentation practices

LEARNING OUTCOMES

Upon completion of the course the student shall be able to

1.0. PROBLEM SOLVING AND CRITICAL THINKING

1.1. Generate Ideas from mechanical courses.
1.2. Develop these Ideas.
1.3. Gather relevant Information.
1.4. Evaluate Ideas.
1.5. Apply these ideas to a specific task.
1.6. Execute appropriate Laboratory skills
1.7. Draw Appropriate Conclusions

2.0 COMMUNICATION

2.1 Communicate effectively.
2.2 Present Ideas Clearly.
2.3 Present Ideas Coherently.
2.4 Report writing

3.0 COLLABORATION

3.1. Discuss the ideas.
3.2 Coordinate with team members
3.3. Team work in accomplishing the task.

4.0 INDEPENDENT LEARNING

4.1. Demonstrate self-motivation.
4.2. Follow time management and responsibilities in completing task.
4.3. Compares merits and demerits
4.4. Improve professional competence.

5.0 ETHICS

5.1 Give respect and value to all classmates, educators, colleagues, and others
5.2 Understand the health, safety, and environmental impacts of their work
5.3 Recognize the constraints of limited resources
5.4 Develop sustainable products and processes that protect the health, safety, and prosperity of future generations
5.5 Maintain integrity in all conduct and publications and give due credit to the contributions of others

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2	2	2	1	1			2		
CO2		3	2	2			2			
CO3			3		1	3			1	
CO4					1	2				1
AVG	2	2.5	2.33	1.5	1	2.5	2	2	1	1

COURSE CONTENT

1.0 Design/Fabrication/Analysis/ Case Study Projects in the areas of Mechanical Engineering and other related areas

SCHEME OF EVALUATION

The Formative Assessment consisting of 40% of the total marks shall be distributed as follows:

Assessment	To be conducted at	Marks (Evaluated for)
Review-I	After the completion of 4 weeks from the start of the semester	10
Review-II	After the completion of 10 weeks from the start of the semester	15
Review-III	After the completion of 14 weeks from the start of the semester	15

The Summative Assessment consisting of 60% of the total marks shall be distributed as follows:

Assessment	To be conducted	Conducted by	Based on	Max Marks
Summative	After completion of the Project work	1.Project Guide 2.HoS concerned 3.An external examiner	1.Demonstration of skill relevant to the Project	30
			2. Project Report	20
			3. Viva Voce	10
TOTAL				60

Summative assessment shall be done by both internal, external examiners and faculty members who guided the students during project work.

VI SEMESTER

DIPLOMA IN MECHANICAL ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
VI-SEMESTER

Course Title	Course Code	Duration	FA Marks	SA Marks	Credits
Industrial Training	26ME601I	One Semester	240	60	20

Assessment No	Upon completion of	Conducted by	Based on	Max Marks
Pre-Assessment	15 Days to 30 Days from the commencement of training	Mentor faculty member visits the industry one month after commencement of training and will submit a detailed report to the principal outlining each candidate's details and observed work culture		
1 (Formative Assessment)	Mid Semester Assessment (after three months - at industry	1.The mentor faculty member concerned 2. Industry Training In charge	Learning outcomes as given in the scheme of assessment, for Industrial Training	120
2 (Formative Assessment)	Last month of training (at industry)	1. The mentor faculty member concerned 2. Industry Training In charge	Learning outcomes as given in the scheme of assessment, for Industrial Training	120
3 (Summative Assessment)	After completion of the training (at Institution)	1.The faculty member concerned, 2.HoS concerned 3.An external examiner from Industry	1.Demonstration of any one of the skills listed in learning outcomes	30
			2.Training Report	20
			3. Viva Voce	10
			TOTAL	300

The Industrial Training shall carry maximum 300 marks. Pass mark is 50% in first and second assessment put together and also 50% in final summative assessment at the institution level.

INDUSTRIAL TRAINING

Course Title	Course Code	Duration	Marks for FA	Marks for SA	Credits
Industrial Training	26ME601I	One Semester	240	60	20

TIME SCHEDULE

S.NO	Code	TOPICS	Duration
1	26ME601I	1. Practical training in Industry 2. Training Report Preparation Report Preparation: Title Page, Certificate, Acknowledgements, Abstract, Contents (introduction of Industry, Plant Layout, Organization Chart, List of Major Equipment's, List of Processes: Skills Acquired; Conclusions; Bibliography	One Semester

COURSE OBJECTIVES

Upon completion of the course, the student shall be able to	
1	Expose to real time working environment
2	Enhance knowledge and skill already learnt in the institution.

COURSE OUTCOMES

CO1	ME601.1	Apply theoretical knowledge to practical work situations
CO2	ME601.2	Cultivate sense of responsibility and good work habits
CO3	ME601.3	Exhibit the strength, teamwork spirit and self-confidence
CO4	ME601.4	Prepare reports for technical projects

LEARNING OUTCOMES

The student shall be able to display the following skill sets
1) Demonstration Skills
2) Reading drawings and analysing Specifications
3) Recognize and Practice safety Measures
4) Handling Tools/Instruments/Materials/Machines
5) Assess and Control of quality parameters
6) Planning, Organizing and recording Skills

CO-PO/PSO MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	2				2		1	3		2
CO2						3		3		2
CO3						3		3		2
CO4						3		3		2
AVG	2				2	3	1	3		2

SCHEME OF EVALUATION

Assessment No	**Upon completion of**	**Conducted by**	**Based on**	**Max Marks**
Pre-Assessment	15 Days to 30 Days from the commencement of training	Mentor faculty member visits the industry one month after commencement of training and will submit a detailed report to the principal outlining the each candidate's details and observed work culture		
1 (Formative Assessment)	Mid Semester Assessment (after three months - at industry	1.The mentor faculty member concerned 2. Industry Training In charge	Learning outcomes as given in the scheme of assessment, for Industrial Training	120
2 (Formative Assessment)	Last month of training (at industry)	1. The mentor faculty member concerned 2. Industry Training In charge	Learning outcomes as given in the scheme of assessment, for Industrial Training	120
3 (Summative Assessment)	After completion of the training (at Institution)	1.The faculty member concerned, 2.HoS concerned 3.An external examiner from Industry	1.Demonstration of any one of the skills listed in learning outcomes	30
			2.Training Report	20
			3. Viva Voce	10
TOTAL				300