GOVERNMENT OF ANDHRA PRADESH

STATE BOARD OF TECHNICAL EDUCATION AND TRAINING

Andhra Pradesh : Mangalagiri

FUTURE - READINESS

INDUSTRY 4.0/
COMPETENCY 5.0

CURRICULUM (C-26)

For Polytechnic Diploma Courses in Andhra Pradesh

Transforming Learners into Future Technologists

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING

3 YEARS

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3 YEAR DIPLOMA
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CURRICULUM -2026 (C-26)

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ANDHRA PRADESH: MANGALAGIRI

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

- Updated and industry-relevant topics are introduced across all courses at appropriate stages to meet current and future technological demands.
- The number of theory courses is rationalized and limited by restructuring overlapping content and removing repetitive or advanced topics, while laboratories are reorganized to accommodate newly introduced practical components.
- Elective courses are introduced throughout the programme (except in the first year), giving students the flexibility to choose one option from multiple alternatives based on interest and career orientation.
- One audit course is included in every stage of the programme, carrying no credits or grade weightage, with the objective of promoting stress-free, student-friendly, and exploratory learning.
- A new instructional approach termed the Practicum Course is introduced throughout the curriculum, where theory teaching is integrated with live demonstrations of relevant parts, devices, or equipment.
- The practicum approach enables students to visually connect theoretical concepts with real-world applications, thereby improving conceptual clarity and industry readiness.
- The overall curriculum maintains a balanced distribution of theory and practical components in a 50:50 ratio, with enhanced emphasis on laboratory and workshop-based skill development.
- In view of emerging industrial trends, new learning components related to artificial intelligence are incorporated to strengthen analytical thinking and intelligent system awareness.
- Topics related to electric mobility and battery technologies are included to address the growing importance of sustainable and decarbonized transportation systems.
- An exclusive laboratory focusing on connected systems and smart applications is introduced to promote innovation, hands-on experimentation, and problem-solving skills.
- Foundational exposure to connected and intelligent systems is provided through audit learning to prepare students for advanced practical applications.
- Industrial relevance is strengthened by integrating safety practices, environmental responsibility, and sustainability concepts within the curriculum

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	20	Each Unit test shall be

	for Year - UT1+UT2+UT3 for Semester - UT1 + UT2		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	20	Each Unit test shall be conducted for 20 Marks. Average of all the Tests will be taken as Unit Test marks

	for Semester - UT1 + UT2		
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:

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	

Assessment for Practicum theory courses can be done for 30 marks

**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:

	Upon	Conducted by	Based on	Max

Assessment No	completion of			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, 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

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 the 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 develop Electrical & Electronics Engineering professionals competent to face the global challenges in an edifying environment conducive to learn technical knowledge, skills blended with ethics and values, to Coordinate and serve to the society for betterment and comfortable living.

MISSION	
M1	To provide a competitive learning environment, through a need-based curriculum designed in collaboration with industry, conducive for high quality education emphasizing on transfer of knowledge and skill development essential for the profession and the society as well.
M2	To nurture higher order leadership qualities and ethics and values in students to enable them to be leaders in their chosen professions while maintaining the highest level of ethics.
M3	To encourage the spirit of inquisition to promote innovation and entrepreneurship strengthened with life skills to sustain the stress.
M4	To foster effective interactions and networking with all the stake holders so as to work towards the growth and sustainability of the society and environment.

Programme Educational Objectives (PEOs)	
On completion of the Diploma Electrical & Electronics Engineering programme, the students should have acquired the following characteristics.	
PEO1	An ability to apply knowledge of mathematics, Science, engineering and management principles in solving problems in the field of Electrical and Electronics Engineering.
PEO2	To be life-long learners with spirit of enquiry and zeal to acquire new knowledge and skills so as to remain contemporary and possess required professional skills.
PEO3	To enhance entrepreneurial, communication and other soft skills, which will enable them to work globally as leaders, team members and contribute to nation building for the betterment of the society.
PEO4	To make them strongly committed to the highest levels of professional ethics and focus on ensuring quality, adherence to public policy and law, safety, reliability and environmental sustainability in all their professional activities

PROGRAMME OUTCOMES (POs)	
PO1	**Basic and discipline specific knowledge**: Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
PO2	**Problem analysis**: Identify and analyze well-defined engineering problems using standard methods.
PO3	**Design/Development of solutions**: Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs
PO4	**Engineering tools, Experimentation and Testing**: Apply modern engineering tools and appropriate technique 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 analyze individual needs and engaging updating in the context of technological changes.

PROGRAMME SPECIFIC OUTCOMES (PSOs)	
PSO1	An ability to understand the basic concepts of Electrical & Electronics Engineering and to apply them to various areas like Wiring Installations, Lighting Schemes, Static & Rotating machinery, drawing layouts, Power System (Generation, Transmission, Distribution & utilization), Digital electronics, power control devices, Computer programming, managerial skills and the use SMART technologies.
PSO2	An ability to Repair, develop and troubleshooting of Various Electrical & Electronics equipment's by using suitable tools and techniques, to design Customized applications in Electrical & Electronics Engineering at economic and efficient considerations, to develop software & hardware solutions.
PSO3	Wisdom of social and environmental awareness along with ethical responsibility to have a successful career and to sustain passion and zeal in the field of Electrical & Electronics Engineering for real-world applications in the field of Electronics using optimal resources as an entrepreneur.

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
FIRST 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										
26EE101T	English Essentials	3	--	N	90	4	3	30	70	100
26EE102T	Engineering Mathematics – I	6	--	N	180	6	3	30	70	100
26EE103T	Engineering Physics	3	--	N	90	4	3	30	70	100
26EE104T	Engineering Chemistry & Environmental Studies	3	--	N	90	4	3	30	70	100
26EE105T	Basic Electrical & Electronics Engineering	6	--	N	180	8	3	30	70	100
AUDIT COURSE										
26EE106A	Electrical Safety Practices	2	--	N	60	--	--	--	--	--
PRACTICAL COURSE										
26EE107D	Engineering Drawing	--	4	N	120	3	3	40	60	100
26EE108L	Basic Electrical & Electronics workshop	--	6	Y	180	4	3	40	60	100
26EE109L	Physics Laboratory	--	3	N	90	1.5	3	20	30	50
26EE110L	Chemistry Laboratory			N		1.5	3	20	30	50
26EE111L	Computer and Digital skills Laboratory	--	3	N	90	3	3	40	60	100
26EE112C	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: 26EE101T, 26EE102T, 26EE103T, 26EE104T, 26EE109L, 26EE110L, and 26EE111L are common to all programmes

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
THIRD SEMESTER

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										
26EE301T	Electrical Machines - I	6	--	N	90	4	3	30	70	100
26EE302T	Electronics Engineering	6	--	N	90	4	3	30	70	100
26EE303T	Electrical Circuits & Measuring Instruments	6	--	N	90	4	3	30	70	100
ELECTIVE COURSES										
26EE304E	Engineering Mathematics – II	3	--	N	45	2	3	30	70	100
26EE305E	Electrical Installation & Estimation	3	--	N	45	2	3	30	70	100
AUDIT COURSE										
26EE306A	Renewable Energy Sources	2	--	N	30	--	--	--	--	--
PRACTICAL COURSE										
26EE307D	Electrical Engineering Drawing	--	4	N	60	1.5	3	40	60	100
26EE308L	Electrical Machines - I Laboratory	--	6	N	90	1.5	3	40	60	100
26EE309L	Programming in "C" Laboratory	--	3	Y	45	1.5	3	40	60	100
26EE310L	Electronics Engineering Laboratory	--	3	N	45	1	3	40	60	100
26EE311C	Student Centric Activities	--	3	N	45	0.5	--	--	--	--
TOTAL		**23**	**19**		**630**	**20**	--	**280**	**520**	**800**

Note 1: 0.5 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: 26EE304E is common elective to all programmes.

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
FOURTH SEMESTER

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										
26EE401T	Electrical Machines - II	6	--	N	90	4	3	30	70	100
26EE402T	Power Systems - I	6	--	N	90	4	3	30	70	100
26EE403T	Digital Electronics & Micro Controllers	6	--	N	90	4	3	30	70	100
ELECTIVE COURSES										
26EE404E	Industrial Automation	3	--	N	45	2	3	30	70	100
26EE405E	Electrical Vehicle Technology	3	--	N	45	2	3	30	70	100
AUDIT COURSE										
26EE406A	Internet of Things in EEE	2	--	N	30	--	--	--	--	--
PRACTICAL COURSE										
26EE407L	Electrical Machines -II Laboratory	--	6	N	90	1.5	3	40	60	100
26EE408L	Communication and Employability skills Laboratory	--	4	Y	60	2	3	40	60	100
26EE409L	Digital Electronics & Micro Controllers Laboratory	--	3	N	45	1	3	40	60	100
26EE410L	Auto CAD & Simulation Tools Laboratory	--	3	Y	45	1	3	40	60	100
26EE411C	Student Centric Activities	--	3	N	45	0.5	--	--	--	--
TOTAL		**23**	**19**		**630**	**20**	--	**280**	**520**	**800**

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

Note 2: 26EE408L is common laboratory to all programmes.

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
FIFTH SEMESTER

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										
26EE501T	Electrical Utilization & Traction	6	--	N	90	4	3	30	70	100
26EE502T	Power Systems - II	6	--	N	90	4	3	30	70	100
26EE503T	Power Electronics	6	--	N	90	4	3	30	70	100
ELECTIVE COURSES										
26EE504E	Basics of Artificial Intelligence	3	--	N	45	2	3	30	70	100
26EE505E	Industrial Management & Smart Technologies	3	--	N	45	2	3	30	70	100
AUDIT COURSE										
26EE506A	Smart Grid Technology	2	--	N	30	--	--	--	--	--
PRACTICAL COURSE										
26EE507L	Power Electronics Laboratory	--	3	N	45	1.5	3	40	60	100
26EE508L	PLC & SCADA Laboratory	--	3	Y	45	1	3	40	60	100
26EE509L	IOT Laboratory	--	6	N	90	1.5	3	40	60	100
26EE510P	Project Work	--	4	N	60	1.5	3	40	60	100
26EE511C	Student Centric Activities	--	3	N	45	0.5	--	--	--	--
TOTAL		**23**	**19**		**630**	**20**	--	**280**	**520**	**800**

Note: 0.5 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

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
SIXTH SEMESTER (INDUSTRIAL TRAINING)

Course Code	Name of the Course	Duration	Scheme of Valuation			Remarks / credits
			Item	Nature	Max Marks	
26EE601I	Industrial Training	One Semester	First assessment	Assessment of Learning Outcomes by both the faculty and training mentor of the industry.	120	20
			Second assessment	Assessment of Learning Outcomes by both the faculty and training mentor of the industry.	120	
			Final Assessment	Training Report	20	
				Demonstration	30	
				Viva -Voce	10	
TOTAL					**300**	**20**

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FIRST YEAR

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING

SCHEME OF INSTRUCTIONS AND EXAMINATIONS

FIRST 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										
26EE101T	English Essentials	3	--	N	90	4	3	30	70	100
26EE102T	Engineering Mathematics – I	6	--	N	180	6	3	30	70	100
26EE103T	Engineering Physics	3	--	N	90	4	3	30	70	100
26EE104T	Engineering Chemistry & Environmental Studies	3	--	N	90	4	3	30	70	100
26EE105T	Basic Electrical & Electronics Engineering	6	--	N	180	8	3	30	70	100
AUDIT COURSE										
26EE106A	Electrical Safety Practices	2	--	N	60	--	--	--	--	--
PRACTICAL COURSE										
26EE107D	Engineering Drawing	--	4	N	120	3	3	40	60	100
26EE108L	Basic Electrical & Electronics workshop	--	6	Y	180	4	3	40	60	100
26EE109L	Physics Laboratory	--	3	N	90	1.5	3	20	30	50
26EE110L	Chemistry Laboratory			N		1.5	3	20	30	50
26EE111L	Computer and Digital skills Laboratory	--	3	N	90	3	3	40	60	100
26EE112C	Student Centric Activities	--	3	N	90	1	--	--	--	--
TOTAL		**23**	**19**		**1260**	**40**	--	**310**	**590**	**900**

Note 1: 1.0 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: 26EE101T, 26EE102T, 26EE103T, 26EE104T, 26EE109L, 26EE110L, and 26EE111L are common to all programmes.

ENGLISH ESSENTIALS

Course code	Course Title	No. Of periods/ week	Total No. of periods /Year	FA Marks	SA Marks	Credits
26EE101T	ENGLISH ESSENTIALS	3	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay 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	
(i)	To inculcate knowledge of functional English and enrich vocabulary
(ii)	To impart effective listening, speaking, reading, and writing skills
(iii)	To sensitize the students on themes related to personality, technological advancements, sustainability, and human values

COURSE OUTCOMES

CO1	EE101T.1	Learn and apply various English grammatical concepts to communicate in academic, professional, personal, and social contexts.
CO2	EE101T.2	Use appropriate vocabulary in academic, professional and business correspondence, and on social media platforms.
CO3	EE101T.3	Listen/read and comprehend diverse academic, professional, and general listening and reading materials.
CO4	EE101T.4	Communicate effectively and fluently in oral and written forms in various life situations.
CO5	EE101T.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 course-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.

55. 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 Mapping

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					3	2	Programme Specific Outcomes are branch-specific with		
CO2						3	2			

CO3	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	technical aspects that are not directly applicable to the English Language course.		
CO4						3	2			
CO5					2		2			
Average					2	3	2			

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in CO and PO mapping will be met by one or more appropriate activities from the following:
(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (iv) Library Visits etc.,

COURSE CONTENT

1.0 Exploring English

Reading – Roleplay – 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.

REFERENCES

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 – 1	From 1.1 to 3.5
Unit Test – 2	From 4.1 to. 6.5
Unit Test – 3	From 7.1 to 9.5

ENGINEERING MATHEMATICS-I

Course code	Course Title	No. Of periods/ week	Total No. of periods/ Year	FA Marks	SA Marks	Credits
26EE102T	Engineering Mathematics-I	6	180	30	70	6

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay 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	

COURSEOBJECTIVES

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

COURSEOUTCOMES

CO1	EE102.1	Resolve partial fractions and solve problems on matrices and determinants.
CO2	EE102.2	Use the concept of trigonometric functions, their inverses and complex numbers.
CO3	EE102.3	Find the equations and properties of straight lines, circles and conic sections in coordinate system.
CO4	EE102.4	Evaluate the limits and derivatives of various functions and apply to engineering problems.
CO5	EE102.5	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 engineeringapplications.

4.7 Find the derivatives of standard algebraic, logarithmic, exponential andtrigonometric 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 – MAPPING

	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

3 = Strongly mapped (High), **2 =** moderately mapped (Medium), **1 =** slightly mapped (Low)

Note: The gaps in CO/PO mapping can be met with appropriate activities as follows:

For PO5: Appropriate quiz programmes may be conducted at intervals and duration as decided by concerned faculty.

For PO6: Seminars on applications of mathematics in various engineering disciplines are to be planned and conducted.

For PO7: Plan activities in such a way that students can visit the Library to refer standard books on Mathematics and access the latest updates in reputed national and international journals. Additionally, encourage them to attend seminars and learn mathematical software tools.

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:** 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, Exponential 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.

TEXTBOOK

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

REFERENCES

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'sSeries.
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–1	From1.1to 2.11
Unit Test–2	From 2.12 to 3.8
Unit Test–3	From 4.1 to 5.14

103-ENGINEERING PHYSICS

Course code	Course Title	No. Of periods/week	Total No. of periods/Year	FA Marks	SA Marks	Credits
26EE103T	Engineering Physics	3	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay 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	
(i)	To understand the basic concepts of physics for various Engineering applications as required for industries.
(ii)	To equip the students with the scientific advances in technology and make the student suitable for any industrial organization.

COURSE OUTCOMES

CO1	EE103.1	Familiarize with various physical quantities, their SI units and errors in measurements; Understand the concepts of vectors for solving engineering problems.
CO2	EE103.2	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	EE103.3	Familiarize with the knowledge of various forms of energy, thermal physics and concepts of acoustics in relevance to the societal requirements.
CO4	EE103.4	Familiarize with the basic knowledge of electricity, magnetism and advances in Modern Physics such as photoelectric cell, optical fibers, superconductors and nanotechnology.

LEARNING OUTCOMES

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 MAPPING

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

3 = strongly mapped, 2 = moderately mapped, 1 = slightly mapped

Note: The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following.

(i) Seminars (ii) Viva-voce (iii) Assignments (iv) Quiz competitions (v) Industrial visits (vi) Techfest (vii) Mini project (viii) Group discussions (ix) Virtual labs

(x) Library visit for e-books

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 - 1	From 1.1 to 3.12
Unit test - 2	From 4.1 to 6.17
Unit test - 3	From 7.1 to 8.12

ENGINEERING CHEMISTRY AND ENVIRONMENTAL STUDIES

Course code	Course Title	No. Of periods/week	Total No. of periods/Year	FA Marks	SA Marks	Credits
26EE104T	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 Questions	No. of Essay 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

Upon completion of the course the student shall be able
(i) To develop a fundamental understanding of core chemical principles and their relevance to a wide range of engineering applications. (ii) To explore and analyze natural and Anthropogenic environmental challenges through an interdisciplinary lens, incorporating physical, chemical and socio - cultural perspectives. (iii) To reinforce theoretical concepts by conducting relevant experiments/exercises.

COURSE OUTCOMES

EE104.1	Explain the basics of atomic structure, chemical bonding, oxidation-reduction, mole concept, concentration expressing methods of solutions, acids-bases, pH and buffer solutions.
EE104.2	Explain electrolysis, Galvanic cell, batteries and corrosion.
EE104.3	Explain the chemistry involved in the treatment of hardness in water.
EE104.4	Explain the preparation and applications of polymers, and understand the composition and uses of alloys, nanomaterials and green fuels.
EE104.5	Explain environmental concepts, pollution types, global issues, green chemistry principles and sustainable development goals.

CO-PO MAPPING

	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	-	-	-

3 = Strongly mapped 2 = Moderately mapped 1 = Slightly mapped

Note: The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:

(i) Seminars (ii) Tutorials (iii) Guest Lectures (iv) Assignments (v) Quiz Competitions, (vi) Industrial Visit (vii) Tech Fest (viii) Mini Project (ix) Group Discussions (x) Virtual Classes and (xi) Library Visit for e-books.

LEARNING OUTCOMES

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

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.

1. 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.

2. 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.

3. 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.

4. 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).

5. 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.

6. 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.

7. 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.

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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 –1	From 1.1 to 2.9
Unit Test –2	From 3.1 to 5.10
Unit Test –3	From 6.1 to 8.10

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BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Course code	Course Title	No. Of periods/ week	Total No. of periods/ Year	FA Marks	SA Marks	Credits
26EE105T	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	06	180	30	70	8

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
1	Basics of Electrical Engineering	35	25	3	2	CO1
2	Circuit Analysis	40	27	1	3	CO2
3	Electromagnetism	45	17	3	1	CO3
4	Electrostatics	30	17	3	1	CO4
5	Basics of Electronics Engineering	30	14	2	1	CO5
TOTAL		**180**	**100**	**12**	**8**	

COURSE OBJECTIVES

	Upon completion of the course the student shall be able
(i)	To understand the basic principles of electricity and analysing resistive circuits
(ii)	To comprehend the magnetic effects of electric current and electromagnetic induction
(iii)	To understand electrostatics, capacitance, and insulating materials
(iv)	To understand the fundamentals of basic electronics

COURSE OUTCOMES

CO1	EE105.1	Understand basic principles of electricity, including conductors, insulators, and semiconductors, and solve problems related to Ohm's Law and resistance.
CO2	EE105.2	Familiarize with various laws and analysis of resistive circuits, including series, parallel, and star-delta transformations.
CO3	EE105.3	Understand magnetic effects of electric current and electromagnetic induction, including magnetic circuits, Faraday's laws, and magnetic materials.
CO4	EE105.4	Understand electrostatics, capacitance, and insulating materials, including Coulomb's laws, capacitance calculations, and dielectric properties.
CO5	EE105.5	Understand basic electronics, including semiconductor materials, diodes.

LEARNING OUTCOMES

1. Basics of Electrical Engineering

1.1 Define Electrical Engineering and state its importance in Engineering.
1.2 Define Electric Current, Resistance, Potential difference, EMF.
1.3 State Ohm's Law and solve problems
1.4 List the limitations of Ohm's Law
1.5 Define the terms i) Specific resistance ii) Conductance iii) Conductivity
1.6 Derive the relation R =$\rho l/a$ and solve the problems
1.7 Explain the effects of temperature on resistance
1.8 Develop the expression for resistance at any temperature as $R_t = R_o (1+\alpha_o t)$
1.9 Define temperature Co-efficient of resistance and give its unit
1.10 Write the formula for Co-efficient of resistance at any temperatures $\alpha_t = \frac{\alpha_0}{1+\alpha_0 t}$
1.11 Define and list the conducting materials
1.12 Mention the properties and list the applications of copper and aluminium conductors.
1.13 List the applications of Nichrome, Tungsten and Carbon
1.14 Explain the thermocouple materials
1.15 List the Bi-metals

2. Circuit Analysis

2.1 State the need for analyzing the circuits in electrical engineering.
2.2 Develop the expressions for equivalent Resistance with simple SERIES and PARALLEL connections
2.3 Solve problems on equivalent resistance in case of Series - Parallel networks
2.4 State the concept of division of current when two/three Resistors are connected in parallel and solve the problems
2.5 Explain the concept of star and delta circuits and state the expression for star-delta transformations and vice-versa.
2.6 Solve problems on Star Delta Transformation.
2.7 Distinguish between the active and passive circuits.
2.8 Define junction, branch, mesh and loop in circuits
2.9 State (i) Kirchhoff's current law (KCL), (ii) Kirchhoff's voltage law (KVL)
2.10 Solve problems by applying branch current method only
2.11 Define electric Power and electrical Energy and state its Units.
2.12 Calculate Electricity bill of domestic consumers as per the Electricity Tariff and solve simple problems.
2.13 Define Joule's law and state its expression.
2.14 Define Thermal efficiency.
2.15 List the applications of heat produced due to Electric current.

3. Electromagnetism

3.1 What is meant by electromagnetism.
3.2 State Coulomb's laws of Magnetism
3.3 Define the terms lines of force, magnetic field, Absolute and Relative Permeability of medium.
3.4 Explain and derive the expression for Mechanical force on a current carrying Conductor placed inside a Magnetic field.
3.5 State Fleming's Left-Hand rule
3.6 Define the terms MMF, Flux and Reluctance
3.7 State the concept of the Magnetic circuit and compare Magnetic circuit with Electric circuit in different aspects.

3.8 State Faraday's laws of Electro-Magnetic Induction
3.9 Explain Dynamically and Statically induced E.M.Fs
3.10 State Fleming's Right-Hand rule and Lenz's law.
3.11 Define Self-inductance, Mutual inductance and co-efficient of coupling
3.12 State the expression for the energy stored in a magnetic field
3.13 Draw (i) B-H Curve (ii) Hysteresis loop
3.14 Explain Hysteresis loop
3.15 Classify the Magnetic Materials (i)Ferro (ii) Para (iii) Dia-Magnetic materials with examples

4. Electrostatics

4.1 What is meant by electrostatics.
4.2 State Coulomb's laws of Electrostatics and solve the problems
4.3 Define the following terms (i) Unit Charge (ii) Absolute permittivity (iii) Relative permittivity (iv) Electric Flux (v) Flux Density (vi) Field intensity
4.4 Define Capacitance and state factors affecting the capacitance of a capacitor
4.5 Derive the formula for capacitance of a parallel plate capacitor
4.6 Derive an expression for equivalent capacitance
i) When two Capacitors are connected in series-
ii) When two Capacitors are connected in parallel
4.7 Derive an expression for the Energy stored in a capacitor
4.8 Define Di-electric strength and Di-electric constant
4.9 List the applications of Di-electrics
4.10 Define Insulating Materials.
4.11 Define Insulation resistance and explain factors affecting insulation resistance
4.12 Classify insulating materials
4.13 State the properties and applications of (i) Mica (ii) Ceramics

5 **Basics of Electronics Engineering**

5.1 What is meant Electronics engineering and state its importance in engineering.
5.2 Define Semi-conductor Materials, Intrinsic and Extrinsic semiconductors.
5.3 Explain the formation of P-type and N-type Semi-conductors
5.4 Define P-N Junction Diode
5.5 Explain the working of P-N junction Diode with a) No bias, b) Forward bias and c) Reverse bias
5.6 Draw the V-I Characteristics of P-N junction Diode
5.7 Explain the working of Zener Diode
5.8 Explain Light emitting Diode (LED)
5.9 List the materials used in construction of LED's
5.10 Give applications of various diodes.
5.11 State the need of Filters in Power Supply
5.12 List different types of filters used in Power Supply
5.13 Explain the working of voltage regulated Power Supply using Zener Diode

CO-PO/PSO MAPPING

CO.No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PS02	PS03
CO1	3	-	-	-				2		
CO2	3	1	-		1			2	2	1
CO3	3	3	-	3	1	1	1	2	2	1
CO4	1		2	3			1	2	2	
CO5	-	2	3	3				2	2	1
Average	2.5	2	2.5	3	1	1	1	2	2	1

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following: (i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

HYPHENATED COURSE CONTENTS:

1. **Basics of Electrical Engineering:** Electrical engineering - Conductors, Insulators, Semi-conductors - Electric current – Electric Potential, Potential difference, voltage and EMF - Ohm's law and its limitations – Resistance– Specific Resistance – Conductance - Conductivity – effects of temperature on resistance - Temperature coefficient of Resistance - Conducting materials - Properties of Copper and Aluminum – Applications of Nichrome, Tungsten, Carbon - Thermocouple materials - Bi-metals.
2. **Circuit Analysis:** Need for circuit analysis - Resistances in series, parallel and series-parallel combinations - concept of division of current - star and delta circuits - star-delta transformations - active and passive circuits - junction, branch, mesh and loop – KCL & KVL - Electric Power and Electrical Energy - Electricity bill calculation - Joule's law - Thermal efficiency - Applications of heat produced by electric current.
3. **Electromagnetism:** Electromagnetism – Coulomb's laws of Magnetism - lines of force & magnetic field , Absolute and Relative Permeability - Mechanical force on a current carrying Conductor - Fleming's Left-Hand rule - MMF, Flux and Reluctance - Magnetic circuit concept and comparison with Electric circuit - Faraday's laws of Electro-Magnetic Induction - Dynamically and Statically induced E.M.Fs - Lenz's law - Fleming's Right-Hand rule - Self and Mutual inductance - Co-efficient of coupling - Energy stored in magnetic field - B-H Curve, Hysteresis loop - Classification of Magnetic Materials (Ferro, Para, Dia-Magnetic).
4. **Electrostatics:** Electrostatics - Coulomb's laws of Electrostatics - Unit Charge, Absolute permittivity, Relative permittivity, Electric Flux, Flux Density, Field intensity - Capacitance and factors affecting it - Capacitance of a parallel plate capacitor - Equivalent capacitance (series/parallel) - Energy stored in a capacitor - Di-electric strength and Di-electric constant - Applications of Di-electrics - Insulating Materials - Insulation resistance and factors affecting it - Classification of insulating materials - Properties and applications of Mica, Ceramics.
5. **Basics of Electronics Engineering:** Electronics engineering - Semi-conductor Materials - Intrinsic and Extrinsic semiconductors - P-type and N-type Semi-conductors - Junction Diode (working, V-I Characteristics) - Zener Diode - Light

emitting Diode (LED) - Filters in Power Supply - Voltage regulated Power Supply using Zener Diode.

REFERENCES:

1. B.L.Theraja – Electrical Technology, Vol.-1 – S.Chand & Co. Publications
2. V. K .Mehta-Introduction to Electrical Engg
3. J.B.Gupta –A course in Electrical Technology – KATSON BOOKS
4. G.B. Bharadhwajan & A. SubbaRao -Elements of Electrical Engineering.
5. William H. Hayt – Engineering Circuit Analysis – Tata McGraw - Hill

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

Unit Tests	Learning Outcomes to be Covered
Unit Test – I	From 1.1 to 2.10
Unit Test – II	From 2.11 to 4.8
Unit Test – III	From 4.9 to 5.13

ELECTRICAL SAFETY PRACTICES

Course code	Course Title	No. Of periods/ week	Total No. of period s/Year	FA Marks	SA Marks	Credits
26EE106A	ELECTRICAL SAFETY PRACTICES	02	60	-	-	_

TIME SCHEDULE

S.No	Chapte/Unit Title	No. of Periods	COs Mapped
1	Fundamentals of Electrical Hazards	12	CO1
2	Protection Systems for Safe Electrical Installations	12	CO2
3	Personal Protective Equipment (PPE)	12	CO3
4	Emergency Response	12	CO4
5	Electrical Safety Regulations	12	CO5

COURSE OBJECTIVES

Upon completion of the course the student shall be able	
(i)	To impart fundamental knowledge on electrical hazards, their causes, physiological effects and preventive practices to ensure safe handling of electrical equipment.
(ii)	To develop competency in identifying, selecting and applying appropriate protection systems, safe installation practices, personal protective equipment (PPE) and tools used in electrical work.
(iii)	To equip students with essential emergency response skills, first aid procedures, and understanding of electrical safety regulations for effective compliance and safe workplace behavior.

COURSE OUTCOMES

CO1	EE106.1	Identify different types of electrical hazards, explain their effects on the human body, and apply basic safety precautions while working with electrical systems.
CO2	EE106.2	Select appropriate protective devices, interpret their ratings and demonstrate understanding of safe electrical installation practices including proper earthing.
CO3	EE106.3	Choose suitable PPE and insulated tools for electrical work, inspect them for safe condition and demonstrate correct usage of testing instruments and fire extinguishers.
CO4	EE106.4	Provide safe and effective emergency response during electrical accidents, including rescue procedures, first aid, CPR and evacuation in case of fire or explosion.
CO5	EE106.5	Explain key electrical safety regulations, responsibilities of workers and employers, and the importance of inspection, testing, documentation, and legal compliance in electrical installations.

LEARNING OUTCOMES

Chapter 1: Fundamentals of Electrical Hazards

1.1 Define basic terms such as electric current, voltage, resistance, power.
1.2 Define electrical hazards such as electric shock, arc flash/blast and electrical fire.
1.3 Describe the factors affecting the severity of an electric shock.
1.4 Explain the physiological effects of different current levels on the human body.
1.5 List the common causes of electrical hazards.
1.6 Describe the conditions that lead to electrical fires and explosions in domestic and industrial installations.
1.7 Define electrical safety and explain its importance in the industries.
1.8 List the basic safety precautions to be followed while working near electrical equipment.

Chapter 2: Protection Systems for Safe Electrical Installations

2.1 State the need for electrical protection and safety devices.
2.2 Describe working principles of fuses, MCBs, MCCBs, ELCBs/RCCBs, relays and earthing.
2.3 Identify protection against overload, short circuit, leakage and earth faults.
2.4 List unsafe conditions in electrical panels, wiring and household/industrial installations.
2.5 State the importance of proper earthing in electrical installations.
2.6 Explain different types of earthing systems in electrical installation.
2.7 Explain with simple wiring diagrams to identify protective devices and earthing arrangements.
2.8 Explain nameplates and ratings of protective devices to understand their application limits.
2.9 State the need for periodic inspection, testing and maintenance of electrical installations.

Chapter 3: Personal Protective Equipment (PPE)

3.1 List the different types of Personal Protective Equipment (PPE) used in electrical installation and state the purpose and proper use of the equipment.
3.2 List different classes of insulating gloves and their voltage ratings.
3.3 Explain the concept of Arc Flash Boundary and the importance of flame-resistant (FR) clothing.
3.4 List different types of insulated hand tools to be used in electrical installation.
3.5 State the proper selection, inspection and maintenance of Insulated Hand Tools.
3.6 Explain the safe use of testing instruments such as multimeters, testers, clamp meters.
3.7 List different types of fire extinguishers used for electrical fires.
3.8 Explain proper use (PASS technique) of and safety precautions for using fire extinguisher.
3.9 State the need for periodic testing and certification of above Personal Protective Equipment (PPE).

Chapter 4: Emergency Response

4.1 Describe the steps to safely rescue a victim from an energized electrical source without endangering oneself.

4.2 State the immediate actions to take in the event of an electric shock incident.
4.3 Describe the basic steps for providing First Aid to an electric shock victim.
4.4 Explain the proper technique for administering Cardiopulmonary Resuscitation (CPR) relevant to electrical accidents to the electric shock victim.
4.5 Explain the types of electrical burns and the appropriate first aid treatment for each to preventing infection.
4.6 Explain safe evacuation procedures in the event of an electrical fire or explosion.
4.7 Identify common signs and symptoms of electrical injuries such as burns, breathing difficulty, muscle spasms, and unconsciousness.
4.8 State the importance of calling emergency medical services and reporting the incident to concerned authorities.
4.9 List the emergency response equipment such as first-aid kit, fire blankets etc and explain the correct method of using emergency response equipment.

5 Chapter 5: Electrical Safety Regulations

5.1 State the need for electrical safety regulations in workplaces and industries.
5.2 List major electrical safety acts, IE rules and standards applicable in India.
5.3 Explain important provisions of the Indian Electricity Rules related to electrical safety.
5.4 State the responsibilities of employers and employees in maintaining electrical safety.
5.5 State the requirements for periodic inspection, testing and certification of electrical installations as per regulations.

CO-PO/PSO MAPPING

CO.No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PS02	PS03
CO1	3	-	-	-				2		
CO2	3	1	-		1			2	2	1
CO3	3	3	-	3	1	1	1	2	2	1
CO4	1		2	3			1	2	2	
CO5	-	2	3	3				2	2	1
Average	2.5	2	2.5	3	1	1	1	2	2	1

Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following: (i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

COURSE CONTENT

Chapter 1: Fundamentals of Electrical Hazards

Definitions of electrical terms - Major electrical hazards - Factors influencing severity of electric shock - Physiological effects of current on human body - Common causes of electrical hazards - Conditions leading to electrical fires and explosions - Meaning and

importance of electrical safety - Basic safety precautions near electrical equipment.

Chapter 2: Protection Systems for Safe Electrical Installations

Need for electrical protection devices - Working principles of fuses, MCBs, MCCBs, RCCBs/ELCBs, relays, earthing - Protection against overload, short circuit, leakage, earth faults - Unsafe conditions in panels, wiring, installations - Importance of proper earthing - Types of earthing systems - Simple wiring diagrams for protection and earthing - Reading nameplates and ratings of protective devices -Need for inspection, testing and maintenance of installations.

Chapter 3: Personal Protective Equipment (PPE)

Types and uses of PPE for electrical work - Classes of insulating gloves and voltage ratings - Arc flash boundary and FR clothing - Types of insulated hand tools - Selection, inspection and maintenance of hand tools - Safe use of multimeters, testers, clamp meters - Fire extinguishers for electrical fires - PASS method and safety precautions for extinguisher use - Need for periodic testing and certification of PPE.

Chapter 4: Emergency Response

Safe rescue from energized electrical source - Immediate actions during electric shock - Basic first aid steps for shock victim - CPR technique for electrical accidents - Types of electrical burns and first aid care - Safe evacuation during electrical fire/explosion - Symptoms of electrical injuries - Importance of calling emergency services - Use of first-aid kit, fire blanket and emergency equipment.

5 Chapter 5: Electrical Safety Regulations

Need for electrical safety regulations - Major electrical safety acts, IE rules and standards in India - Key provisions of Indian Electricity Rules - Responsibilities of employers and employees - Requirements for inspection, testing and certification of installations.

REFERENCES:

1 John Cadick, Mary Capelli-Schellpfeffer & Dennis K. Neitzel. Electrical Safety Handbook, McGraw-Hill, 4th Ed., 2012.
2 James R. White. Electrical Safety: A Practical Guide to OSHA and NFPA 70E, 2024 Edition, ATP / Safety-industry press, 2024.
3 W. Fordham-Cooper (revised by D.A. Dolbey Jones). Electrical Safety Engineering, Butterworth (Elsevier), latest revision. Elsevier Shop.
4 S. Rao & H. L. Saluja. Electrical Safety, Fire Safety and Safety Management, Khanna Publishers (used in many Indian institutions).
5 Mohamed El-Sharkawi. Electric Safety: Practice and Standards, CRC Press / technical-safety publications. (Often recommended in curricula covering standards & safe-work practices).

ENGINEERING DRAWING

Course code	Course Title	No. Of periods/week	Total No. of periods/Year	FA Marks	SA Marks	Credits
26EE107D	ENGINEERING DRAWING	4	120	40	60	3

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
1	Dimensioning Practice	15	10	2	--	CO1
2	Principles of Geometric Constructions	24	15	1	1	CO2
3	Projections of points, lines, planes and solids	27	25	1	2	CO3
4	Sectional Views	27	10	--	1	CO4
5	Orthographic projection	27	20	--	2	CO5
	Total	120	80	4	6	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able	
(i)	To develop fundamental skills in engineering drawing through the proper use of drawing instruments, freehand lettering, dimensioning, and principles of geometric constructions.
(ii)	To enhance visualization and interpretation abilities by learning projections of points, lines, planes, and solids, along with sectional views.
(iii)	To enable accurate representation of engineering objects using orthographic projection techniques for effective communication in technical fields.

COURSE OUTCOMES

CO1	EE107.1	Practice the use of engineering drawing instruments and Familiarise with the conventions to be followed in engineering drawing as per BIS.
CO2	EE107.2	Construct the i) basic geometrical constructions ii) engineering curves.
CO3	EE107.3	Visualise and draw the projections of i) Points ii) Lines iii) Regular Planes iv) Regular Solids .
CO4	EE107.4	Visualise and draw the sectional views of components.

CO5	EE107.5	Visualise and draw the orthographic projections of components.

LEARNING OUTCOMES

1.0 Dimensioning Practice

1.1 State the importance of drawing as an engineering communication medium.
1.2 Select the correct instruments to draw the different lines / curves.
1.3 Use correct grade of pencil and other instruments to draw different types of lines and for different purposes
1.4 Identify the steps to be taken to keep the drawing clean and tidy.
1.5 Write titles using vertical and slop (inclined) lettering and numerals of 7mm, 10mm and 14mm height.
1.6 Acquaint with the conventions, notations, rules and methods of dimensioning in engineering drawing as per the B.I.S.
1.7 Dimension a given drawing using standard notations and desired system of dimensioning.

2.0 **Principles of Geometric Constructions**

2.1 Practice the basic geometric constructions like i) dividing a line into equal parts i) Exterior and interior tangents to the given two circles ii) Tangent arcs to two given lines and arcs.
2.2 Draw any regular polygon using general method when i) side length is given i) Inscribing circle radius is given ii) describing circle radius is given.
2.3 Draw the engineering curves like i) involute ii) cycloid

1.0 Projections of points, lines, planes and solids (All in first quadrant only)

1.1 Explain the basic principles of the orthographic projections
1.2 Visualise and draw the projection of a point with respect to reference planes (HP & VP)
1.3 Visualise and draw the projections of straight lines with respect to two reference Planes (up to lines parallel to one plane and inclined to other plane)
1.4 Visualise and draw the projections of planes (up to planes perpendicular to one plane and inclined to other plane)
1.5 Visualise and draw the projections of regular solids like Prisms, Pyramids, Cylinder, Cone (up to axis of solids parallel to one plane and inclined to other plane)

4.0 Sectional Views

4.1 Identify the need to draw sectional views.
4.2 Draw sectional views of regular solids by applying the principles of hatching.

5.0 Orthographic projection

5.1 Draw the orthographic views of an object from its pictorial drawing.
5.2 Draw the minimum number of views needed to represent a given object fully.

Competencies and Key competencies to be achieved by the student

S.No	Major topic	Key Competency
1.	Dimensioning Practice	• Explain the linkages between Engineering drawing and other courses of study in Diploma course.
		• Select the correct instruments to draw various entities in different orientation
		• Write titles using sloping and vertical lettering and numerals as per B.I.S (Bureau of Indian standards)
		• Dimension a given drawing using standard notations and desired system of dimensioning
2.	Geometrical construction	• Dividing a line into equal parts, tangents to circles, Construct involute, cycloid from the given data.
3.	Projection of points, Lines, Planes & Solids	• Draw the projections of points, straight lines, planes & solids with respect to reference planes (HP& VP)
4.	Sectional Views	• Differentiate between true shape and apparent shape of section • Apply principles of hatching. • Draw simple sections of regular solids
5.	Orthographic Projection	• Draw the minimum number of views needed to represent a given object fully.

COURSE CONTENT

NOTES: 1. B.I.S Specification should invariably be followed in all the topics.

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

1.0 Dimensioning Practice

Explanation of the scope and objectives of the course 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 - Basic Tools, tools for drawing– 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,

Importance of lettering – Types of lettering -Guide Lines for Lettering Practicing of letters & numbers of given sizes (7mm, 10mm and 14mm)-Advantages of single stroke or simple style of lettering - Use of lettering stencils- 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 unidirectional 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.

2.0 Geometric Constructions

Division of a straight line into given number of equal parts –Drawing interior and exterior tangents to two circles of given radii and centre distance-Drawing tangent arc of given radius to touch two lines inclined at given angle (acute, right and obtuse angles), 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 any regular polygon by general method for given side length, inscribing circle radius and describing/superscripting circle radius - Involute, Cycloid, explanations as locus of a moving point, their engineering application, viz., Gear tooth profile, screw threads, springs etc. – their construction

3.0 Projection of points, lines and planes and Solids (All in first quadrant only)

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 -Projections of straight line –(a) Parallel to both the planes, (b)Perpendicular to one of the planes and (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- Projections of regular solids- (a) Axis perpendicular to one of the planes, (b) Axis parallel to VP and inclined to HP and vice versa.

4.0 Sectional Views

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

5.0 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 engineering 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 meter 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.

REFERENCES

1 Engineering Graphics by P I Varghese – (McGraw-hill)
2 Engineering Drawing by Basant Agarwal & C.M Agarwal - (McGraw-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.
5 SP-46-1998 – Bureau of Indian Standards.

CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
CO1	3	2	2		1		1	2	3	1
CO2	3	2	2			2	1	2	3	1
CO3	3	2	2	1	1		1	2	3	1
CO4	3	2	2	1		2	1	2	3	1
CO5	3	2	2	1	1	2	1	2	3	1
AVERAGE	3	2	2	1	1	2	1	2	3	1

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following: (i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

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 2.3
Unit Test – II	From 3.1 to 3.5
Unit Test – III	From 4.1 to 5.2

BASIC ELECTRICAL AND ELECTRONICS WORKSHOP
(PRACTICUM -PRACTICAL)

Course code	Course Title	No. Of periods/ week	Total No. of periods /Year	FA Marks	SA Marks	Credits
26EE108L	BASIC ELECTRICAL AND ELECTRONICS WORKSHOP	06	180	40	60	04

TIME SCHEDULE

S.No	Chapter /Unit Title	No. of Periods	COs Mapped
1	Wiring tools and Accessories	35	CO1
2	Electrical Wiring Joints and Lamp Circuits	70	CO2
3	Test and repair of domestic appliances	35	CO3
4	Electronic devices and soldering practice	40	CO4
TOTAL		180	

COURSE OBJECTIVES

Upon completion of the course, the student shall be able	
(i)	To familiarise with the knowledge of different wiring tools used in electrical wiring
(ii)	To know the etiquette of working in the domestic wiring
(iii)	To identify and rectify the simple faults that can occur in domestic appliances
(iv)	To familiarize with basic electronic devices and soldering procedure

COURSE OUTCOMES

CO1	EE108.1	Understanding various tools and know their usage
CO2	EE108.2	Perform different joints and perform various lamp control methods
CO3	EE108.3	Understand the test procedure and able to repair domestic appliances
CO4	EE108.4	Illustrating the characteristics of various electronic devices and perform soldering of electronic components.

LEARNING OUTCOMES

1. Wiring Tools and Accessories

Theory:

1.1. Explain and demonstrate to identify the following electrical wiring tools with respect to i) Size ii) Shape iii) Purpose iv) Speed v) Use
- a) Screw drivers
- b) Pliers
- c) Drilling machines & Drilling Bits.
- d) Rawl plug jumper, and poker
- e) Voltage/line tester
- f) Splicers (insulation remover)
- g) Standard Wire gauge

1.2. Explain and demonstrate to identify different types of Electrical Wiring accessories with respect to
i) Size ii) Shape iii) Purpose iv) Use.
- a) Switches
- b) Ceiling roses
- c) Lamp Holders and Adopters
- d) Sockets
- e) Plug
- f) Fuses

1.3. Explain and demonstrate to identify different types of main switches with respect to
i) Rating ii) Purpose iii) Use.
SP, DP mains, TP, ICDP, ICTP, SPDT, DPDT, TPDT, Changeover-Knife type, Rotary, Micro, Modular switches, 2-pole and 3-pole MCBs

2. Electrical Wiring Joints and Lamp Circuits

Practical:

2.1. Study different types of wires and cables (1/18,3/20,7/20) with respect to sizes rating, purpose and use etc
- a) Prepare Straight joint/ Married joint
- b) Prepare T joint
- c) Prepare Western union joint
- d) Prepare Pigtail joint

2.2. Make a circuit with One lamp controlled by one switch using PVC surface conduit system.

2.3. Make a circuit with Two lamps controlled by two switches using PVC surface conduit system.

2.4. Make a circuit with One lamp controlled by one switch and provision of 2/3-pin socket.

2.5. Make a circuit for Stair-case wiring.

2.6. Make a circuit for Go-down wiring.

2.7. Control two Lamps by Series - Parallel connection using one 1-way switch & two 2-way switches with PVC surface conduit system.

2.8. Control two sub-circuits through Energy - meter, MCB's and two1-way switches.

2.9. Prepare switch board with star delta starter, MCB, Pilot lamps for 3 phase

motor.

2.10. Control and practice the wiring for Fluorescent Lamp.
2.11. Connect Computer by main switch board with a miniature circuit breaker.
2.12. Practice Series and Parallel connection of Lamps.
2.13. Practice Bright and Dim light arrangement

3. Test and repair of the Domestic appliances

Theory:

3.1. Explain the working of electric heater
3.2. Explain the working of iron box.
3.3. Explain the working of electric kettle.
3.4. Explain the working of electric cooker.
3.5. Explain the working of electric geyser

Practical:

3.6. Testing and repair of electric heater
3.7. Testing and repair of iron box.
3.8. Testing and repair of electric kettle.
3.9. Testing and repair of electric cooker.
3.10. Testing and repair of electric geyser

4. Electronic devices and soldering practice

Practical:

4.1. Identify different types of Resistors.
4.2. Calculate resistance by its color code.
4.3. Measuring the resistance using multimeter.
4.4. Connecting resistors in series and parallel and measuring the resistance using multimeter.
4.5. Practice rheostat connections
4.6. Find the value and specifications of capacitor from color code and value printed.
4.7. Testing the capacitor using multimeter.
4.8. Identify different electronic components
4.9. Familiarize with breadboard.
4.10. Plot the V-I characteristics of P-N junction diode.
4.11. Plot the V-I characteristics of Zener diode.
4.12. Plot the V-I characteristics of photo diode.
4.13. Plot the V-I characteristics of LDR.
4.14. Familiarization to use soldering tools and components.
4.15. Soldering simple electronic circuits on PCB.

COURSE CONTENT

1. Electrical-Wiring-Tools: Explanation and identification of screw drivers, pliers, drilling-machines and bits, Rawl-plug, jumper and poker, voltage/line-tester, splicers (insulation-remover) and standard- wire-gauge. Electrical-Wiring-Accessories: Identification of switches, ceiling-roses, lamp-holders and adapters, sockets, plugs and fuses. Main-Switches-and-Protective-Devices: Identification of SP, DP mains, TP, ICDP, ICTP, SPDT, DPDT, TPDT, Changeover-Knife type, Rotary,

Micro, Modular switches, 2-pole and 3-pole MCBs.

2. Wires-and-Cables: Study of different types of wires and cables (e.g.,-1/18,-3/20,-7/20).Make a circuit with One lamp controlled by one switch using PVC surface conduit system. circuit with Two lamps controlled by two switches - circuit with One lamp controlled by one switch and provision of 2/3-pin socket - circuit for Stair-case wiring - Go-down wiring - Control two Lamps by Series - Parallel connection using one 1-way switch & two 2-way switches - Control two sub-circuits through Energy - meter, MCB's and two 1-wayswitches – Preparation of switch board with star delta starter, MCB, Pilot lamps for 3 phase motor - Fluorescent Lamp wiring - Connect Computer by main switch board with a miniature circuit breaker - Series and Parallel connection of Lamps - Bright and Dim light arrangement

3.Test and repair of the Domestic appliances: Explanation and Testing and repair of electric heater, iron box, electric kettle, electric cooker, electric geyser

4.Electronic devices and soldering practice: Types of Resistors – Calculation of resistance by its color code - Measuring the resistance using multimeter–Rheostat connections – Capacitor color coding – Capacitor measurement by Multimeter – Bread board familiarization – V-I characteristics of PN junction diode, Zener Diode, Photo Diode and LDR–Soldering tools and Soldering procedure.

CO-PO/PSO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1				1		3		
CO2	3		1	1	1.5		1	3	1.5	
CO3	3	1					1	3	1.5	1
CO4	3					1		3	1.5	
Average	3	0.5	1	1	1.5	1	1	3	1.5	1

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

COMPETENCIES TO BE ACHIEVED BY THE STUDENT

S.No	Competencies	Key Competencies
1	Handle the different wiring tools and accessories a) Select switches and MCB's b) Identify wires and cables as per the requirements of the load.	• Identify the size and specifications of various tools used for electrical wiring. • Understand the usage of the standard wire gauge. • Identify the type, size and specifications of DP mains,

2.1	To prepare a Straight joint/Married joint using a 7/20 Al. Cable	• Identify the size of the cable • Perform splicing of Insulation properly. • Perform Straight joint/Married joint
2.2	To prepare a T joint using a 7/20 Al. Cable	• Insert the leads of the wires properly as per the sketches. • Twist the wires properly.
2.3	To prepare a Western union joint using a single strand Al. Cable	• Overlap the two wires properly • Twist the binding wires properly
2.4	To prepare a Pig tail joint using a single strand Copper Cable	• Place the wires in V-shape. • Twist the wires in clock wise direction.
2.5	To control one lamp by one 1- way switch with PVC surface conduit wiring system	• Draw wiring diagram • Identify the size of cable, PVC pipe, type of1-way switch and lamp holder. • Make Connections as per Wiring Diagram
2.6	To control two lamps by two 1- way switches with PVC surface conduit wiring system	• Draw wiring diagram • Handle the screw driver, electrician Knife, line tester to fix the PVC pipe using saddles and junction boxes. • Select colour and length of wire for phase and neutral • Switch on the supply after making of the connections
2.7	To control one lamp and 2/3 pin socket by two1-way switches with PVC surface conduit wiring system	• Connect 2/3 pin socket properly with respect to phase, neutral and earth. • Connect phase wire through switches.
2.8	Stair-case wiring	• Select two 2-wayswitches • Connect 2- way switches as per circuit diagram. • Test with 1-phase, 230V, 50 Hz supply to the circuit connected through ICDP switch.
2.9	Go-down wiring scheme	• Draw wiring diagram • Connect the circuit as per the diagram. • Observe sequence of operation of switches • Test with 1-phase,230 V,50 Hz supply to the circuit, neutral wire to the bottom point of the 1- way switch and phase to the first point of lamp holder
2.10	Series-Parallel connection	• Select colour and length of wire for phase and neutral. • Make connections as per wiring diagram. • Draw wire through PVC pipe properly • Observe glow intensity of lamps for series and parallel connections

2.11	Control two sub circuits through Energy meter, MCB'sandtwo1- way switches	● Draw wiring diagram. ● Identify the size of cable,1-way switch, PVC pipe, MCB, capacity of Inverter and Socket ● Read the specifications of MCB, capacity of Inverter and Socket ● Make connections as per wiring diagram. ● Draw wire through PVC pipe properly. ● Connect supply to Inverter through MCB properly. ● Select appropriate socket with switch control. ● Make earth wire connections for required points.
2.12	Prepare switch board with star delta starter, MCB, Pilot lamps for 3 phase motor	● Select the size of cable, PVC pipe, star-delta starter, MCB and lamp holder ● Make connections as per wiring diagram. ● Draw wire through PVC pipe properly. ● Draw wire of the 3-phase to the motor through star- delta starter. ● Test with 3-phase, 415 V, 50 Hz supply to the circuit connected through ICDP switch. ● Test by changing any two phases of input supply
2.13	Wiring practice of fluorescent lamp	● Make connections as per wiring diagram. ● Connect top point and bottom point of the choke to tube light properly. ● Note the importance and working of starter.
2.14	Connect computer by main switch board with a miniature circuit breaker.	● Draw wiring diagram. ● Identify the size of cable, 1-way switch, PVC pipe, MCB and Sockets ● Read the specifications of MCB and Sockets ● Make connections as per wiring diagram. ● Connect supply to Computer through MCB properly. ● Select appropriate sockets with 1-way switch control. ● Make earth wire connections for require points.
3.1	Testing and repair of domestic appliances	● Inspect the appliance visually. ● Check for any discrepancies. ● Perform the disassembling operation ● Test the inner parts for any faults ● Rectify the faults if any. ● Replace the parts if necessary. ● Perform the assembling. ● Test the Domestic appliance for proper functioning.
4.1	Familiarize with resistance colour coding	● Able to identify and calculate the resistor values by using colour coding.
4.2	Measurement of Resistance and Capacitance.	● Able to measure the resistance and capacitance by using Multimeter.

4.3	To Familiarize various soldering tools and components	• Identifying Soldering gun, flux, lead
4.4	VI Characteristics of Semiconductor Devices	• Understand the connection patterns in bread board • Identify diode, the correct rating of voltage sources and meters • Connection of circuit diagram on bread board with proper input sources and meters • Interpreting the responses of the various semiconductor devices. • Connection of devices with exact ratings as per circuit diagram in bread board • Ability to plot the VI characteristics of various semiconductor devices (PN junction diode, Zener diode, photo diode, LDR) and to plot input/output characteristics of NPN transistor in CE configuration
4.5	To solder simple electronic circuits on PCB	• Draw the layout of circuit • Carefully Soldering the circuit on PCB.

Note:

1. Every student has to bring insulated tool kit and follow the general safety precautions throughout the lab sessions
2. Should not touch the live terminals.

REFERENCES

1. Mittle, V.N. & Mittle, A. "Basic Electrical Engineering", McGraw Hill Education, 3rd Ed., 2022.
2. Theraja, B.L. "Basic Electrical Engineering", S. Chand Publications, Revised Ed., 2019.
3. Boylestad, Robert L. & Nashelsky, Louis. "Electronic Devices and Circuit Theory", Pearson, 11th Ed., 2020.
4. Floyd, Thomas L. "Electronics Fundamentals: Circuits, Devices & Applications", Pearson, 8th Ed., 2021.
5. Online Resources
    i. NPTEL – Basic Electrical Circuits (IIT Kharagpur)
    ii. NPTEL – Basic Electronic Circuits (IIT Madras)

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 2.6
Unit Test – II	From 2.7 to 3.3
Unit Test – III	From 3.4 to 4.15

PHYSICS LABORATORY

Course code	Course Title	No. Of periods/week	Total No. of periods/Year	FA Marks	SA Marks	Credits
26EE109L	Physics Laboratory	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	Chapter/Unit Title	No. of Periods	Cos Mapped
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

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

COURSE OUTCOMES

CO1	EE109.1	Apply measurement techniques to improve accuracy; Explain forces maintaining equilibrium in physical systems.
CO2	EE109.2	Determine acceleration due to gravity experimentally; Investigate refraction of light at curved surfaces; Relate the gas pressure to volume variations at constant temperature.
CO3	EE109.3	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	EE109.4	Apply Kirchhoff's laws to compute the resistivity of a wire; Examine the projectile motion parameters; Observe and Interpret beat generation phenomenon.

LEARNING OUTCOMES

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 using the 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 MAPPING

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	0.5	1

3 = strongly mapped, 2 = moderately mapped, 1 = slightly mapped

Note: The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following.

(i) Seminars
(ii) Viva-voce
(iii) Assignments
(iv) Quiz competitions
(v) Industrial visits
(vi) Techfest
(vii) Mini project
(viii) Group discussions
(ix) Virtual labs
(x) Library visit for e-books, etc.

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	• Interpret directions and angles of forces • Evaluate force

	• Measure angles between forces • Analyze data to verify theorem	relationships • Validate Lami's Theorem using experimental data
4. Simple Pendulum	• Arrange the pendulum properly • Measure the time taken for 20 oscillations • Compute time period and acceleration due to gravity • Plot L–T^2 graph	• Measure oscillation intervals accurately • Calculate g using experimental data • 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 XII.
3. Experiments in Physics: A Laboratory Manual by Daryl W. Preston, Joseph W. Kane, Morton M. Sternheim

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

Unit test	Experiments to be covered
Unit test – 1	From 1 to 3
Unit test – 2	From 4 to 6
Unit test – 3	From 7 to 9

CHEMISTRY LABORATORY

Course code	Course Title	No. Of periods/ week	Total No. of periods/Year	FA Marks	SA Marks	Credits
26EE110L	Chemistry Laboratory	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.	Chapter/Unit Title	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 the students shall be able	
(i)	To Perform fundamental analytical chemistry techniques, identify chemical substances using sensory cues and accurately prepare standard solutions.
(ii)	To Evaluate and judge the neutralization point in acid base titration.
(iii)	To Evaluate the endpoint of reduction and oxidation reaction.
(iv)	To Judge the stable end point of complex formation, stable precipitation.
(v)	To Determine the pH of compounds, demonstrate copper deposition using electrolysis, and the working of a galvanic cell.

COURSE OUTCOMES

CO1	EE110.1	Perform fundamental analytical chemistry techniques, identify chemical substances using sensory cues and accurately prepare standard solutions.
CO2	EE110.2	Evaluate and judge the neutralization point in acid base titration.
CO3	EE110.3	Evaluate the endpoint of reduction and oxidation reaction.
CO4	EE110.4	Judge the stable end point of complex formation, stable precipitation.
CO5	EE110.5	Determine the pH of compounds, demonstrate copper deposition using electrolysis, demonstrate the working of a galvanic cell.

LEARNING OUTCOMES

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 MAPPING

	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			

3 = Strongly Mapped 2 = Moderately Mapped 1 = Slightly Mapped

Note:

The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:

(i) Assignments (ii) Tutorials (iii) Guest Lectures (iv) Seminars (v) Quiz Competitions (vi) Industrial Visit (vii) Tech Fest (viii) Mini Projects (ix) Group Discussions (x) Virtual Classes and (xi) Library Visits.

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.
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	• Making standard solutions. • Measuring accurately the standard solutions and titrants. • Effectively controlling the flow of the titrant. • Identifying the
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)	stand • Effectively controlling the flow of the titrant. • Identifying the endpoint. • Making accurate observations. • Calculating the results.	endpoint. • Making accurate observations.
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, and the function of the 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, and the function of the salt bridge.
Open Ended Experiments /Micro Projects – I. (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	• 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).

Open Ended Experiments/ Micro Projects – II. (03)	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.	

SCHEME OF EVLUATION

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

REFERENCES

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.

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

Unit Test	Learning Outcomes to be Covered
Unit Test – 1	From Experiment 1 to 3
Unit Test – 2	From Experiment 4 to 6
Unit Test – 3	From Experiment 7 to 9

COMPUTER & DIGITAL SKILLS LAB

Course code	Course Title	No. Of periods/ week	Total No. of periods /Year	FA Marks	SA Marks	Credits
26EE111L	COMPUTER & DIGITAL SKILLS LAB	3	90	40	60	3

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions
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	
(i)	To familiarize with basics of Computer Hardware and Software
(ii)	To familiarize operating systems
(iii)	To familiarize with Microsoft word
(iv)	To familiarize with Microsoft Excel
(v)	To familiarize with Microsoft Power point
(vi)	To familiarize with AI, ML, Quantum Computing Tools

COURSE OUTCOMES

CO1	EE111 .1	Identify hardware and software components
CO2	EE111 .2	Prepare documents with given specifications using word processing software
CO3	EE111 .3	Use Spread sheet software to make calculation and to draw various graphs/charts.
CO4	EE111 .4	Use Power point software to develop effective presentation for a given theme or topic.
CO5	EE111 .5	To use basic AI ,ML& Quantum Computing Tools

LEARNING OUTCOMES

I. Computer Hardware and Software Basics

1. a) 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

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

III. MS-WORD

1. To get familiarized with Ribbon layout of MSWord.
2. To perform basic word processing
3. To use basic formatting techniques
4. To insert a table of required number of rows and columns
5. To insert Objects, Clipart and Hyperlinks
6. To use Mail Merge feature of MS Word
7. To use Equations and symbols features

IV. MS-EXCEL

1. To get familiarized with MS-EXCEL ribbon layout
2. To access and enter data in the cells
3. To edit a spread sheet-Copy, Cut, Paste, and selecting Cells
4. To use built in functions and Data Formatting
5. To create Excel Functions, use auto fill feature

6. To enter a Formula for automatic calculations
7. To sort and filter data in sheet.
8. To present data using Excel Graphs and Charts.
9. To format a Work sheet in Excel for printing using Page layout
10. To develop lab report formats of respective discipline.

V. Practice with MS-POWERPOINT

1. To get familiarized with Ribbon layout features of Power Point.
2. To create a simple Power Point Presentation
3. To set up a Master Slide in Power Point
4. To insert Text and Objects
5. To insert Flow Charts
6. To insert Tables
7. To insert Charts/Graphs
8. To insert video and audio
9. To animate text, objects and slides.
10. To Review Presentations

VI. AI, ML & Quantum Computing Tools

1. To get familiarized with AI Tools
2. To get familiarized with working of Chat GPT
3. Identify Objects using AI Tools based on CNN, YOLO, SSD, R-CNN
4. To paraphrase text using AI Tools (PEGASUS, GPT, T5)
5. To use text-to-Image Generation AI Tools (DALL-E, MID JOURNEY)
6. To use voice command simulation AI Tools (SPEECH-TO-TEXT)
7. To get familiarized with ML Tools
8. To get familiarized with Quantum Computing Tools
9. To familiarize with quantum bits (qubits) using Dirac notation
10. To familiarize the behavior of single and multiple qubit gates.
11. To familiarize with Qubit as a Coin / Spin Analogy

CO – PO/PSO MAPPING

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

3 = Strongly Mapped 2 = Moderately Mapped 1 = Slightly Mapped

Note:

The gaps in CO and PO mapping will be achieved by one or more appropriate activities

from the following:

(i) Assignments (ii) Tutorials (iii) Guest Lectures (iv) Seminars (v) Quiz Competitions (vi) Industrial Visit (vii) Tech Fest (viii) Mini Projects (ix) Group Discussions (x) Virtual Classes and (xi) Library Visits.

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
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 d. 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 and save in the required format	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 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 c. 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 g. 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 – 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	Using Mail merge feature	a. Using mail merge to prepare individually addressed letters b. Using mail merge to print envelopes.
12.	Use Equations and symbols features.	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 b. 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, Italicize, and Underline f. Working with Long Text, Change a Column's Width

16.	Use built in functions andFormat 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 **e.** 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 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 Excel, use page setup	Format Excel sheet Insert headers &footers and print	a. Shading alternate rows of data b. Adding currency and percentage symbols c. Changing height of a row and width of a column d. Changing data alignment e. Inserting Headers and Footers Set Print Options and Printing.
22.	Develop lab report formats of respective discipline	Use Headers/Footers /Page Numbers for preparing reports	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 g. Review
24.	Create a simple Power Point Presentation	a. Create simple Power Point presentation with photographs /Clip Art and text boxes b. 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
26.	Insert Text and Objects	a. Insert Text and Objects b. Use3dfeatures	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 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 c. 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/Gr aphs	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 d. 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 Insert Hyperlinks

31.	Create Animation effects	a. Add animation effects	a. Applying transitions to slides b. Using special animation effects like Entrance, Emphasis, Motion Paths &Exit as per requirement.
32.	Reviewing presentation	a. Use Spell and Grammar check feature b. Setup slideshow c. Add timing to the slides d. 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.).	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, generating content, and solving problems.	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. 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, Robo flow, 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. 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) • 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.	a) Learn how to write and read quantum states using the ket ($\|\rangle$) 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 behavior 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: o Pauli-X (NOT): flips $\|0\rangle \leftrightarrow \|1\rangle$ o Hadamard (H): creates superposition o Pauli-Z: applies a phase flip • Multi-qubit gates: o CNOT: flips target qubit based on control o Toffoli (CCNOT): controlled-controlled NOT o 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)

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2. Introduction to computers, Peter Norton, 7th Edition, McGrawHill.
3. Microsoft Office (Office 2021 & Microsoft 365) – Joan 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, Technology series.

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

Unit Test	Learning outcome to be covered
Unit test-1	From 1 to 12
Unit test-2	From 13 to 32
Unit test-3	From 33 to 43

III SEMESTER

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
THIRD SEMESTER

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										
26EE301T	Electrical Machines - I	6	--	N	90	4	3	30	70	100
26EE302T	Electronics Engineering	6	--	N	90	4	3	30	70	100
26EE303T	Electrical Circuits & Measuring Instruments	6	--	N	90	4	3	30	70	100
ELECTIVE COURSES										
26EE304E	Engineering Mathematics – II	3	--	N	45	2	3	30	70	100
26EE305E	Electrical Installation & Estimation	3	--	N	45	2	3	30	70	100
AUDIT COURSE										
26EE306A	Renewable Energy Sources	2	--	N	30	--	--	--	--	--
PRACTICAL COURSE										
26EE307D	Electrical Engineering Drawing	--	4	N	60	1.5	3	40	60	100
26EE308L	Electrical Machines - I Laboratory	--	6	N	90	1.5	3	40	60	100
26EE309L	Programming in "C" Laboratory	--	3	Y	45	1.5	3	40	60	100
26EE310L	Electronics Engineering Laboratory	--	3	N	45	1	3	40	60	100
26EE311C	Student Centric Activities	--	3	N	45	0.5	--	--	--	--
TOTAL		**23**	**19**	**--**	**630**	**20**	--	**280**	**520**	**800**

Note 1: 0.5 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: 26EE304E is common elective to all programmes.

ELECTRICAL MACHINES-I

Course code	Course Title	No. Of periods/week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE301T	ELECTRICAL MACHINES-I	6	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
1	Fundamentals of D.C Generators	20	25	3	2	CO1
2	Fundamentals of DC motors	14	14	2	1	CO2
3	Speed Control of D.C Motors	12	11	1	1	CO3
4	Single phase transformers	30	25	3	2	CO4
5	Three phase transformers	14	25	3	2	CO5
Total		90	100	12	8	

COURSE OBJECTIVES

Upon completion of the course the student shall be able	
(i)	To Familiarise knowledge on construction, working principle and Characteristics of DC machines.
(ii)	To know different methods of speed control and testing of D.C motors.
(iii)	To use different D.C generators and D.C motors for specific Applications.
(iv)	To familiarise with the knowledge of single-phase transformers, three phase transformers and auto transformers.

COURSE OUTCOMES

CO1	EE301.1	Describe the parts of a DC machine, its usages and analyse armature reaction and commutation for its effects.
CO2	EE301.2	Describe the working of a D.C motor and analyse the characteristics for its performance
CO3	EE301.3	Familiarise the usage of starter and selecting specific methods of speed control and to analyse various tests on D.C motors.
CO4	EE301.4	Explain the working of single transformers and understand equivalent circuit parameters, efficiency and regulation.
CO5	EE301.5	Familiarise the three phase transformers, types and cooling methods.

LEARNING OUTCOMES

1. Fundamentals of D.C Generators

1.0 Introduction.
1.1 Explain electro mechanical energy conversion.
1.2 Define DC Generator.
1.3 Describe the constructional features of a D.C generator with a legible sketch and list the various materials used for each part.
1.4 Explain the working principle of D.C generator.
1.5 State the types of armature windings.
1.6 Derive the E.M.F equation of D.C generator in terms of Φ, Z, N, P & A and solve problems.
1.7 Classify D.C Generators based on excitation and draw their equivalent circuits.
1.8 State various losses incurred in a D.C Generator and draw the power flow diagram.
1.9 Define the mechanical, electrical and overall efficiencies of DC Generator.
1.10 Define Armature reaction and state its effects.
1.11 State Commutation and list the different methods of improving commutation.
1.12 Plot Open Circuit Characteristics, Internal characteristics and external characteristics of the following types of D.C. Generators: (i) Separately excited ii) Shunt (iii)Series
1.13 List the applications of above D.C generators.

2. Fundamentals of D.C Motors

2.0 Introduction.
2.1 Define DC motor
2.2 Explain the working of D.C motor.
2.3 Explain the significance of back E.M.F.
2.4 Classify DC motors and draw their equivalent circuits.
2.5 Define Torque and derive Torque equation of a D.C motor.
2.6 Simple problems on torque equation.
2.6 Plot the Electrical characteristics and Mechanical characteristics of (a) D.C Shunt (b) D.C Series Motors
2.7 List the applications of the various D.C motors.

3. Speed Control of D.C Motors

3.1 Explain the different methods of speed Control of D.C shunt motors.
3.2 Explain the different methods of speed control of D.C series motor.
3.3 State the necessity of a starter and List different types of Starters used for DC motors.
3.4 Explain the working of 3-point starter with legible sketch.
3.5 List different tests on D.C Motors.
3.6 State different direct and indirect methods of testing of DC motors.
3.7 Explain the method of conducting brake test on DC Shunt motors.

4. Single phase transformers

4.1 Define Transformer and Explain its working principle.
4.2 Classify the transformers based on
(i) number of phases (ii) construction (iii) function.
4.3 Explain the constructional details of transformers with legible Sketch..
4.4 Distinguish between shell type and core type transformers.
4.5 Derive the E.M.F equation of a single phase transformer and solve problems.
4.6 Define 'transformation' ratio.
4.7 Draw Vector diagram of a transformer working on no load.
4.8 Develop the vector diagram of a transformer on load for
(i) Unity power factor (ii) Lagging power factor (iii) Leading power factor
4.9 Draw the equivalent circuit of a transformer by approximation.
4.10 Determine the equivalent circuit constants from no-load test and short circuit test data and solve problems.
4.11 Define efficiency and regulation of a transformer.
4.12 List the losses taking place in a transformer.
4.13 State the reason to mention transformer rating in KVA.
4.14 Define all-day efficiency.
4.15 Differentiate between distribution transformer and power transformer.

5. Three Phase Transformers

5.1 State the advantages of 3 phase transformer over single phase transformer.
5.2 List the different types of three phase transformers by giving their symbolic representation and voltage, current and phase relationships.
5.3 State the applications of (i) star-star (ii) delta-star (iii) star-delta
(iv) delta- delta connected transformers.
5.4 State the need for parallel operation of three phase transformers.
5.5 State the conditions for parallel operation of 3 phase transformers.
5.6 List the special transformers.
5.7 Explain the construction and working of single-phase auto transformer with legible sketch.
5.8 State the advantages, disadvantages and applications of auto transformers.
5.9 State the necessity of cooling of power transformers.
5.10 List different methods of cooling of power transformer.
5.11 Draw a legible sketch of a power transformer and explain the function of each part.
5.12 State the need for Tap changing in power transformer and explain `on load' and `off load' tap changing.

CO-PO/PSO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3							3	2	
CO2	3	3						3		
CO3	3		2		2			3	2	1
CO4	3							3	2	
CO5	3	2		1	1			3		
Average	3	2.5	2	1	1.5			3	2	1

Note:

The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:

(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii)Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

COURSE CONTENT

1. Fundamentals of D.C Generators

Electromechanical energy conversion – Constructional features of D.C generator with legible sketches - Principle of D.C generator - windings (i) Lap (ii) Wave - E.M.F equation -Classification of DC generators based on excitation- Losses incurred in the D.C Generators-Mechanical, electrical and overall efficiencies of DC Generators - Armature reaction — Commutation and list of methods for improving commutation –Open circuit, internal and external characteristics of Separately excited, Shunt and Series DC Generators - Applications of D.C generators.

2. Fundamentals of D.C Motors

Definition of DC motor-Working of D.C motors-Classification - Significance of back E.M.F-Formula for back E.M.F for different D.C motors- Torque equation of DC motor – problems on torque equation - Electrical and mechanical characteristics of D.C Shunt and Series motors - Applications of D.C motors.

3. Speed Control of D.C Motors

Methods of speed control of D.C shunt motors - Different methods of speed control of series motors - Necessity of starter - Types of starters - 3-point starter - Direct and indirect methods of testing of DC motors - List of different tests - Brake test on shunt motor.

4. Single Phase Transformers

Introduction to Transformer-Classification of transformers- Construction of transformers-Theory of an ideal transformer - Emf equation derivation – Transformation ratio and turns ratio and relation between them - Voltage ratio and current ratio – Transformer on no load - No load current components and no load power factor -Transformer on load – Equivalent circuit of transformer from O.C. and S.C. tests data - Define Regulation and efficiency of transformer - Losses in transformer– Rating of transformer- All-day efficiency definition- Differentiation between distribution transformer and power transformer.

5. Three- phase transformers

Advantages of 3 phase transformer over single phase transformer-Symbolic representation of star-star, delta-delta, star-delta and delta-star of three phase transformers , voltage ,current and phase relation for the above groups- and their applications- Need and conditions to be fulfilled for paralleling 3 phase transformer- Open delta working of 3 phase transformers- Auto-transformers – advantages, disadvantages and applications, Necessity of cooling for power transformers - Methods of cooling - Sketch of power transformer indicating parts and explain their functions - Tap changing necessity for power transformers - On load and off load tap changing in power transformer.

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1. B.L. Theraja -Electrical Technology - Vol –II -S.Chand&co .
2. P.S. Bhimbhra –Electrical machines
3. M.G Say –AC machines-Pitman publishers
4. D.P.Kothari, I.J.Nagrath – Electrical Machines-McGraw.Hill
5. J.B.Gupta-Theory and performance of electrical machines-KATSON BOOKS

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 3.7
Unit Test - II	From 4.1 to 5.12

ELECTRONICS ENGINEERING

Course code	Course Title	No. Of periods/ week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE302T	ELECTRONICS ENGINEERING	6	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
1	Semiconductor devices and PCBs	25	25	3	2	CO1
2	Power Supplies	15	22	2	2	CO2
3	Amplifiers	15	14	2	1	CO3
4	Oscillators and A/D &D/A converters	20	25	3	2	CO4
5	Linear Integrated Circuits	15	14	2	1	CO5
Total		**90**	**100**	**12**	**8**	

COURSE OBJECTIVES

Upon completion of the course the student shall be able	
(i)	To understand the concepts of BJTs and FETs and to familiarize with PCB making process
(ii)	To familiarize students to the principle of operation, design and synthesis of different electronic circuit and integrated circuits, and their applications.
(iii)	To provide strong foundation for further study of electronic circuits and integrated circuits.

COURSE OUTCOMES

CO1	EE302.1	Understand the concepts of BJTs and FETs and to familiarize with PCB making process
CO2	EE302.2	Explain the rectifiers and voltage regulators.
CO3	EE302.3	Analyze the concept of amplifier, small signal amplifier, large signal amplifier and feedback amplifier.
CO4	EE302.4	Analyze various oscillators and A/D &D/A converters.
CO5	EE302.5	Analyze the op-amp application circuits.

CO-PO /PSO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	2	1				3	2	
CO2	3	3	2	1	2			3		
CO3	3	3	2	1	2			3		
CO4	3	3	2	1	2			3	1	
CO5	3	3	2	1	2			3		
Average	3	3	2	1	2			3	1.5	

3 strongly mapped, 2 moderately mapped, 1=slightly mapped

LEARNING OUTCOMES

1. Semiconductor devices and PCBs

1.1 Explain the formation of transistor.
1.2 Draw the circuit symbol of transistor (NPN, PNP).
1.3 Explain the working of PNP and NPN Transistors.
1.4 Draw the different transistor configurations.
1.5 Sketch the input/output characteristics of CB, CE and CC configurations.
1.6 Identify the cut off, saturation and active regions in output characteristics of CB, CE and CC Configurations.
1.7 Classify Field Effect Transistors.
1.8 Describe the construction and principle of operation of n channel JFET.
1.9 Draw and explain the drain characteristics of JFET.
1.10 List the advantages of JFET over BJT.
1.11 Explain the construction & working of N Channel Enhancement type MOSFET.
1.12 Draw the Drain Characteristics of N channel depletion MOSFET.
1.13 Compare JFET and MOSFET.
1.14 Explain the need of PCB in electronic equipment.
1.15 Classify PCBs and list the types of laminates used in PCBs.
1.16 List the methods of transferring layout on to the copper clad sheet.
1.17 List the materials used in screen-printing.
1.18 List the steps involved in screen-printing for making PCBs.
1.19 Describe the methods of etching, cleaning and drilling of PCB.
1.20 Describe the steps involved in making double-sided PCB.
1.21 Explain Surface Mount Technology and its uses.
1.22 List the materials used in soldering.
1.23 List the soldering methods of PCBs.

2. Power Supplies

2.1 Define Rectifier.
2.2 Explain the working and draw the circuit diagrams and waveforms of:
a) Half Wave Rectifier (b) Full Wave Rectifier (c) Bridge Rectifier
2.3 State the need of filter in power supplies.
2.4 List the different types of filters used in power supplies.
2.5 Explain working of a RC, CRC, CLC filters used for full wave rectifier.
2.6 Define voltage regulator.
2.7 Explain the working of Zener diode as a Voltage regulator in a power supply.
2.8 Explain the working of voltage regulated power supply.
2.9 List the types of IC regulators
2.10 Give the advantages of IC regulators
2.11 Explain the operation of adjustable voltage regulator

3 Amplifiers

3.1 Define an Amplifier
3.2 Explain the operation of transistor as an amplifier.
3.3 List the applications of amplifiers.
3.4 List the different types of coupling methods in amplifiers
3.5 Explain the working and frequency response curves of RC coupled amplifier with neat circuit diagram.
3.6 Explain the working of two stage transformer coupled amplifier with circuit diagram.
3.7 State the need of negative feedback
3.8 Explain the negative feedback amplifier with block diagram.
3.9 Explain the need of power amplifier.
3.10 Explain the working of class-A, Class-B, Class-C and Class-AB amplifier With waveforms
3.11 Explain the working of class-B push-pull amplifier

4 Oscillators and A/D & D/A Converters

4.1 Define Oscillator and classify different types of oscillators.
4.2 State the conditions required for sustained oscillations
4.3 State the need of (a) AF Oscillator (b) RF Oscillator (c) Square Wave Oscillator.
4.4 Draw the circuit diagram and explain the working of RC Phase Shift Oscillator.
4.5 Draw the circuit diagram and explain the working of Colpitts's Oscillator.
4.6 Draw the circuit diagram and explain the working of Crystal Oscillator.
4.7 List the applications of oscillators.
4.8 State the need for A/D and D/A conversion.
4.9 Explain D/A conversion using R-2R Ladder network.
4.10 Explain A/D conversion using conversion method.
4.11 Explain A/D Conversion using successive approximation method.
4.12 List IC numbers of any three ADC's and DAC's

5 Linear Integrated Circuits

5.1 Define Integrated Circuit.
5.2 List the advantages of Integrated Circuits over Discrete Circuits.

5.3 Explain the operation of Differential Amplifier.
5.4 List the characteristics of an Ideal Operational Amplifier.
5.5 Explain the working of Operational Amplifier.
5.6 Explain the working of Op-Amp Inverting Amplifier.
5.7 Explain the working of Op-Amp non-Inverting Amplifier.
5.8 State the concept of virtual ground.
5.9 Explain the Operational Amplifier as
a) Summer (b) Integrator (c) Differentiator (d) Inverter.
5.10 Draw the Pin Diagram of 741 IC and state its important specifications and function of each pin.

COURSE CONTENT

1. Semiconductor devices and PCBs

Working principles of BJTs, FETs, MOSFETs and PCB making process.

2. Power supplies

Half wave, Full wave and Bridge rectifiers, Types of Filters, Voltage regulated power supply using Zener Diode - IC regulators, adjustable voltage regulators.

3. Amplifiers

Principles of Operation- Classification of Amplifiers, coupling methods, Frequency Response of R.C coupled amplifier – applications - Power amplifier – feedback amplifier.

4. Oscillators and A/D &D/A converters

Oscillator - types of oscillators - AF Oscillator - RF Oscillator - Square wave Oscillator - RC phase shift Oscillator - Colpitt's oscillator – Crystal oscillators, applications of oscillators, R-2R ladder network, counter method, successive approximation method.

5. Linear Integrated circuits.

Differential Amplifier - advantages of ICs - Operational Amplifier – Gain – summer – integrator – differentiator - scale changer – inverter -741 IC.

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3. G.K. Mithal -Applied Electronics-Khanna publishers
4. G.K.Mithal - Electronic devices and circuits-Khanna publishers
5. J.B.Gupta-A textbook of Electronics Engineering-KATSON BOOKS

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

Unit Test	Learning out comes to be covered
Unit Test - I	From 1.1 to 3.7
Unit Test - II	From 3.8 to 5.10

ELECTRICAL CIRCUITS & MEASURING INSTRUMENTS

Course code	Course Title	No. Of periods/ week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE303T	ELECTRICAL CIRCUITS & MEASURING INSTRUMENTS	6	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
1	DC Network Theorems	22	25	3	2	CO1
2	Single Phase AC Circuits	27	25	3	2	CO2
3	Polyphase AC Circuits	10	11	1	1	CO3
4	Fundamentals of Measuring Instruments	15	17	3	1	CO4
5	Basic digital Instruments	16	22	2	2	CO5
Total		90	100	12	8	

COURSE OBJECTIVES

Upon completion of the course the student shall be able
(i) To understand the basic concepts, laws, and behavior of DC and AC electrical circuits and their associated electrical quantities. (ii) To analyze and solve electrical circuits using fundamental methods and network theorems, and apply these concepts to single-phase and polyphase systems. (iii) To learn the principles, operation, and proper use of electrical and electronic measuring instruments, including error sources, calibration, and instrument selection.

COURSE OUTCOMES

CO1	EE303.1	Analyze and solve DC circuits using fundamental laws, various network theorems, and source transformation techniques.
CO2	EE303.2	Understand and apply the concepts of AC fundamentals and single-phase AC circuits, including power and power factor calculations.
CO3	EE303.3	Apply principles of polyphase systems to analyze Star (Y) and Delta (Δ) connected loads, and determine three-phase power using the two-wattmeter method.
CO4	EE303.4	Explain the fundamental principles of electrical measurement, describe the construction and operation of analog measuring instruments (PMMC, MI, Electrodynamometer Wattmeter), and apply methods for resistance measurement.
CO5	EE303.5	Describe the working principles and applications of electronic and digital measuring instruments (e.g., CRO, DVM, DMM) and various transducers.

CO-PO /PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	3	1	1	-	1	1	3		
CO2	3	3	1	1	-	1	2	3	1	1
CO3	3	3	1	1	-	1	2	3		
CO4	3	2	1	3	1	1	2	3	1	1
CO5	3	2	1	3	1	1	1	3	1	
Average	3	2.6	1	1.8	1	1	1.6	3	1	1

LEARNING OUTCOMES

Unit 1: DC Network Theorems

1.1 State ideal voltage source and ideal current source, practical voltage and current sources.
1.2 Explain Source transformation technique.
1.3 Solve simple problems on Source transformation technique.
1.4 State Superposition theorem
1.5 State the steps involved in solving superposition theorem
1.6 Solve simple problems on superposition theorem
1.7 State Thevenin's theorem
1.8 State the steps for finding V_{Th} and R_{Th},
1.9 Solve simple Problems on Thevenin's theorem.

1.10 State Norton's theorem
1.11 State the steps for finding I_N and R_N
1.12 Solve simple Problems on Norton's theorem
1.13 State Maximum Power Transfer Theorem
1.14 Derive conditions for maximum power transfer to a load.
1.15 State Reciprocity theorem

Unit 2: Single Phase AC Circuits

2.1 Advantages of AC over DC.
2.2 Define amplitude, instantaneous value, peak value, peak-to-peak value, average value, RMS value, form factor, peak factor. Periodic Time, Frequency, Angular velocity
2.3 Explain the concepts of Phase-and-Phase-Difference: Leading, lagging, in-phase concepts
2.4 Mathematical representation of AC Quantities as $v=V_m\sin(\omega t+\phi)$, $i=I_m\sin(\omega t+\phi)$.
2.5 Solve simple problems on above
2.6 Understand j-operator
2.7 Convert polar quantities into rectangular quantities and Vice-versa. Solve simple problems
2.8 Obtain voltage -current relationships with phasor diagrams for Resistance (R) in in AC circuits
2.9 Obtain voltage -current relationships with phasor diagrams for Inductance (L) in AC Circuits
2.10 Define inductive reactance XL
2.11 Obtain voltage -current relationships with phasor diagrams for Capacitance (C) in AC Circuits
2.12 Define capacitive reactance Xc
2.13 State Power in AC Circuits as Instantaneous Power, Average Power (Active Power (P)), Reactive Power (Q) , Apparent Power (S)
2.14 Draw Power Triangle and establish Relationship between P, Q and S.
2.15 Define Power factor.
2.16 State its significance as lagging and leading power factor.
2.17 Understand the concepts of impedance, power, and power factor in R-L, R-C, and R-L-C series AC circuits.
2.18 Solve simple problems to calculate impedance, current, voltage drops, power, and power factor for R-L, R-C, and R-L-C series AC circuits.
2.19 Construct accurate phasor diagrams for R-L, R-C, and R-L-C series AC circuits.
2.20 Analyze the characteristics of series R-L-C resonant circuits, including resonant frequency, Q-factor, and bandwidth, and solve related problems.
2.21 Define Admittance (Y), Conductance (G) and Susceptance (B).

Unit 3: Polyphase AC Circuits

3.1 State the advantages-of-Polyphase-Systems-over-Single-Phase-Systems.
3.2 Define phase sequence and a balanced system related to polyphase circuits.
3.3 Explain the relationships between line and phase values of voltages and currents for both balanced Star (Y) and Delta (Δ) connected systems.
3.4 Calculate the power in balanced three-phase loads for both Star (Y) and Delta (Δ)

connections.

3.5 Solve simple problems on above

3.6 Explain the basic principle of the two-wattmeter method for measuring three-phase power.

Unit 4: Fundamentals of Measuring Instruments

4.1 State the need for accurate measurements in various engineering applications.

4.2 Classify measuring instruments based on their operational principles (Absolute vs Secondary, Analog vs. Digital) and functional types (Indicating, Recording, Integrating).

4.3 State and explain how different controlling torques in indicating instruments are obtained.

4.4 Describe the construction, working principle, advantages and disadvantages of Permanent Magnet Moving Coil (PMMC).

4.5 Describe the construction, working principle, advantages and disadvantages of attraction type and repulsion type moving iron instrument.

4.6 Describe the construction and working principle of an Electrodynamometer type Wattmeter.

4.7 List different methods for resistance measurement.

4.8 Describe the principle and operation of series and shunt type ohmmeters.

4.9 Explain the construction and working of a Megger.

Unit 5: Basic Digital Instruments:

5.1 State the need for electronic and digital instruments.

5.2 Describe the working of rectifier type electronic voltmeter with a block diagram.

5.3 Explain the working of Cathode-Ray-Oscilloscope (CRO) with a block diagram.

5.4 State various applications of CRO in different fields.

5.5 State the advantages of digital instruments over conventional analog instruments.

5.6 Explain the working of Digital Multimeter (DMM) with block diagram.

5.7 Explain the working of Digital Energy meter with block diagram.

5.8 Define and classify transducers

5.9 Explain the working of LVDT with a diagram.

5.10 Define Thermistor and state its applications.

5.11 State the applications of Thermocouple.

COURSE CONTENT

Unit 1: DC Network Theorems

Ideal voltage source & ideal current source- practical voltage and current sources - source transformation-- superposition theorem -Thevenin's Theorem - Norton's theorem -Maximum transfer theorem- Reciprocity theorem

Unit 2: Single Phase AC Circuits

Advantages of AC over DC- Definition of Alternating quantity, cycle, period, frequency, amplitude, instantaneous value and angular velocity **-** Average value - effective value/R.M.S- Phase-and-Phase-Difference- Mathematical-Representation of AC Quantities- simple problems-`J' notation-polar quantities into rectangular quantities and Vice-versa- simple problems- voltage -current

relationships with phasor diagrams for -Resistance(R)- Inductance(L)- Capacitance(C)- Concept of reactance-power triangle-- Derivation of voltage , current, power relations including phase relationships, wave forms and phasor diagrams **-** R-L, R-C , L-C & R-L-C series circuits- Problems-Definition of Resonance in series circuits and expression for resonant frequency- Q-factor-Importance of Q- factor- Problems on series circuits and series resonance- conductance, susceptance and admittance.

Unit 3: Polyphase Circuits

Definition of Poly phase - Advantages of poly-phase systems over single-phase systems - phase sequence and a balanced system- Method of connection of star and delta - phasor diagram showing relation between phase and line quantities, Relation between phase and Line values of voltages and currents -power equation-problems- two wattmeter method.

Unit 4: Fundamentals of Measuring Instruments

Definition of measurement, importance - Classification-of-Instruments- Deflection, Controlling and Damping torques in the indicating Instruments - working of Permanent magnet moving coil-advantages, disadvantages - working moving iron instruments – advantages and disadvantages – Dynamometer type wattmeter – Ohm meters - construction & working of Megger.

Unit 5: Basic Digital Instruments

Electronics and digital instruments - block diagram and working of rectifier type electronic voltmeter – working of Cathode-Ray-Oscilloscope (CRO) – applications - Working of Digital Multimeter (DMM) – Working of digital energy meter - Define and classify transducers - Working of LVDT – Application of Thermistor and Thermocouple.

REFERENCES

1. B.L. Theraja -Electrical Technology - Vol – I, S. Chand & co.
2. V.K. Mehta and Rohit Mehta - Principles of Electrical Engineering -S Chand.
3. A.K. Sawhney- Electrical and Electronic Measurements and Instrumentation- Dhanpat Rai & Co.
4. J.B. Gupta - A Course in Electrical and Electronic Measurements and Instrumentation- , S.K. Kataria & Sons.
5. Albert D. Helfrick and William D. Cooper- Modern Electronic Instrumentation and Measurement Techniques- Pearson Education.

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

Unit Test	Learning Outcomes to be Covered
Unit Test - I	From1.1 to 3.3
Unit Test - II	From3.4 to 5.11

ENGINEERING MATHEMATICS-II

Course code	Course Title	No. Of periods/week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE304T	Engineering Mathematics-II	3	45	30	70	2

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay 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	
(i)	To apply integral techniques to solve various engineering problems.
(ii)	To solve first-order and first-degree differential equations and second-order homogeneous and non-homogeneous linear differential equations.
(iii)	To analyse data using the concepts of probability and statistical techniques.

COURSE OUTCOMES

CO1	EE304.1	Apply definite integrals in engineering applications.
CO2	EE304.2	Solve first-order and first-degree differential equations and second-order homogeneous and non-homogeneous linear differential equations.
CO3	EE304.3	Apply various probability and statistical techniques for data analysis.

LEARNING OUTCOMES

1.0 Apply definite integrals in engineering applications.

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.

2.0 Solve first-order and first- degree differential equations and second-order homogeneous and non-homogeneous linear differential equations.

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 $\frac{dy}{dx}+\mathrm{P}y=\mathrm{Q}$, where P and Q are functions of x only or constants.
2.6 Solve Differential equations of the type $(a\mathrm{D}^2+b\mathrm{D}+c)y=0,$ 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 $f(\mathrm{D})y=e^{ax}$, where $f(\mathrm{D})$ is a polynomial of second order.

3.0 Apply various probability and statistical techniques for data analysis.

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 MAPPING

	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

Note: The gaps in CO/PO mapping can be met with appropriate activities as follows:

ForPO5: Appropriate quiz programmes may be conducted at intervals and duration as decided by concerned faculty.
For PO6: Seminars on applications of mathematics in various engineering disciplines are to be planned and conducted
For PO7: Plan activities in such a way that students can visit the Library to refer standard books on Mathematics and access the latest updates inreputed national and international journals. Additionally, encourage them to attend seminars and learn mathematical software tools.

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 $\frac{dy}{dx} + \mathrm{P}y = \mathrm{Q}$. 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.

REFERENCES

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.

REFERENCE BOOKS:

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 L.O 1.1 to L.O 2.5
Unit Test-II	From L.O 2.6 to L.O 3.14

ELECTRICAL INSTALLATION AND ESTIMATION

Course code	Course Title	No. Of periods/week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE305E	ELECTRICAL INSTALLATION AND ESTIMATION	3	45	30	70	2

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
1	Electrical Wiring Systems	6	20	4	1	CO1
2	Estimation of Electrical Loads	16	30	2	3	CO2
3	Estimation of Over Head Lines	13	33	3	3	CO3
4	Departmental Tests	10	17	3	1	CO4
Total		45	100	12	8	

COURSE OBJECTIVES

Upon completion of the course the student shall be able

(i) To understand different wiring systems, service mains
(ii) To estimate the cost of domestic installations, industrial installations of electrical equipment and earthing
(iii) To know the Calculation of Transformer ratings for Rural electrification

COURSE OUTCOMES

CO1	EE305.1	Describing the specifications of various wiring accessories and different components of wiring system
CO2	EE305.2	Estimate the materials required and their cost in domestic installation and power wiring installation.
CO3	EE305.3	Estimate the electrical materials required for OH lines, Earthing systems.

CO4	EE305.4	Extending the knowledge on Calculation of Transformer ratings for Rural electrification

LEARNING OUTCOMES

1.0 Electrical Wiring systems

1.1 Define wire and cable and list different types of cables.
1.2 List different types of wiring systems.
1.3 List different types of wiring Accessories in conduit wiring system.
1.4 Explain (i) Surface conduit system (ii) Concealed wiring system.
1.5 State merits and demerits of (i) Surface conduit system (ii) Concealed wiring system.
1.6 List different types of knife switches.
1.7 State the purpose of MCB and List different types of MCBs.
1.8 List different types of fuses and specify the materials used.
1.9 List different ratings of fuses and state their applications.
1.10 State the reasons for not using fuse in Neutral wire.

2.0 Estimation of Electrical Loads

2.1 Define service mains and list different types of service mains.
2.2 List the electrical material used in wiring the service mains.
2.3 List the schedule of rates used in preparing estimate for house wiring and service mains.
2.4 Problems on estimating the material requirement with cost for (i) PVC conduit wiring and (ii) PVC casing Capping wiring for the given plan of a building.
2.5 Draw the wiring layout for a big office building, workshop/ Electrical Laboratory
2.6 Problems on estimating the materials for complete installation of machines in a work Shop/ laboratory as per standard practice.
2.7 Select the type of wiring and service mains used for the irrigation pump set.
2.8 Problems on estimating the materials for electrifying an irrigation pump set scheme.

3.0 Estimation of Over Head Lines

3.1 List the types of insulators to be used for over headlines.
3.2 Problems on calculating the total number of insulators required for the given OH Line.
3.3 List different types and sizes of cross arms used for the over headline.
3.4 Problems on calculating the size and total length of overhead conductor required for the line giving due consideration for the sag to be allowed.
3.5 Problems on estimating the quantity of complete materials required for given 11 kV and 400V overhead lines.
3.6 Draw and list the quantity of materials required for the given plinth and Pole Mounted Transformer substations.
3.7 State the purpose of Earthing and mention its types that are normally used.
3.8 Select the suitable type of Earthing for a given installation.
3.9 Draw and list the complete materials required for pipe and plate

earthing.

4.0 Departmental Tests

4.1 State the insulation resistance desirable for a given electrical installation.
4.2 State the value of earth resistance to be maintained for a given electrical installation.
4.3 List different tests to be conducted before energizing a newly constructed electrical installation.
4.4 Describe the test procedure for continuity of wiring in an electrical installation.
4.5 Explain the procedure for conducting insulation test of domestic wiring.
4.6 State the need for load survey in rural electrification.
4.7 Problems on calculation of the capacity of a transformer required for the given load assuming suitable diversity factor.
4.8 Define voltage regulation of OH line and problems on calculating the tail end voltage regulations from the given load particulars.

CO-PO/PSO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	2			2	3	2	1
CO2	3	3	3	2		2	2	3	2	1
CO3	3	2	2	3	2	2	2	3	2	1
CO4	3	2	1	1	2	2	2	3	2	1
Average	3	2.25	2	2	1	1.5	2	3	2	1

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note:

The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:

(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

COURSE CONTENT

1. Electrical Wiring Systems

Introduction – Wires and cables - Types of wires – Types of wiring systems - Various wiring accessories – Knife switches – Types of MCBs – Types of fuses, materials, ratings and applications.

2. **Estimation of Electrical Loads**

Service main – Types - Estimation and selection of interior wiring system suitable to a given building - Number of sub circuits - Calculation of length of wire and quantity of accessories required – Drawing wiring layout for a big office building, electrical laboratory - Estimates of materials for execution of Power wiring installation – Estimation of Irrigation pump set

installation and to Calculation of size and quantity of wire and other components required - Estimation of quantity of materials for irrigation pump set installation.

3. Estimation of Over Head Lines

Insulators – types - Distribution lines of 11 kV and 400 Volt OH lines estimation only - Quantity of materials required for OH lines - Number of poles - Cross arms - Insulators - Conductor length and size - Distribution transformer erection- Estimation of quantity of materials required for structures, isolators - HG fuse isolators, lightening arrestors for pole mounted substation and plinth mounted substations – Purpose of Earthing - Suitable type of Earthing - Quantity estimation for materials required in electrical Earthing for pipe Earthing and plate Earthing

4. **Departmental Tests**

Insulation resistance - Electrical installation testing - desirable insulation resistance for domestic and power circuits – Tests for newly constructed electrical installation - Procedure for conducting continuity tests and insulation test - Load survey - determination of capacity of transformer - Determination of tail end voltage regulations.

REFERENCES

1. G.C Garg & S. L. Uppal-Electrical Wiring , Estimating & costing Electrical wiring,
2. J.B. Gupta -Estimating &costing
3. BVS Rao -Maintenance and Operation of Electrical Equipment – Vol-I-TMH
4. S. Rao -Testing, Commissioning Operation & Maintenance of Electrical equipment – TMH
5. V.K Mehta- Electrical Estimating & costing

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 2.8
Unit Test - II	From 3.1 to 4.8

RENEWABLE ENERGY SOURCES

Course code	Course Title	No. Of periods/week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE306A	RENEWABLE ENERGY SOURCES	2	30	--	--	--

TIME SCHEDULE

S.No	Chapter / Unit Title	No. of periods	COs Mapped
1.	Introduction to Renewable Energy	04	CO1
2.	Solar Energy	08	CO2
3.	Wind Energy	06	CO3
4	Biomass Power	06	CO4
5.	Other Energy Source	06	CO5
	Total	30	

COURSE OBJECTIVES

Upon completion of the course the student shall be able
(i) Understanding the need for Renewable, Introduce Fundamental Concepts of Renewable Energy.
(ii) Analyze Solar Energy Systems, Examine Wind Energy Conversion, Explore Biomass Energy Technologies
(iii) Review Other Renewable Energy Sources, Promote Sustainable Energy Practices.

COURSE OUTCOMES

CO1	EE 306.1	Explain the significance of renewable energy
CO2	EE 306.2	Describe the working principles, components, and applications of solar energy systems
CO3	EE 306.3	Analyze the fundamentals of wind energy conversion systems
CO4	EE 306.4	Evaluate the various biomass energy conversion techniques
CO5	EE 306.5	Identify and summarize other renewable sources

LEARNING OUTCOMES

1. Introduction to Renewable Energy

1.1 Introduction
1.2 Energy Crisis and Environmental concerns
1.3 Classification of energy sources: renewable vs non-renewable
1.4 Importance of renewable energy in Sustainable development
1.5 Overview of global and Indian renewable energy potential

1.6 Activity1: Videos on global warming
1.7 Activity2: Discussion on Impact of fossil fuels

2. Solar Energy

2.4 Introduction
2.5 Define Solar radiation – concepts and measurements
2.6 List different types of Solar collectors
2.7 State Solar photovoltaic (PV) systems – types of panels, components
2.8 State Advantages and limitations of Photovoltaic systems
2.9 State the recent trends in solar systems
2.10 Activity1: Case Study: Solar parks in India
2.11 Activity2: Site visiting of nearest solar power plant and observe the operation of PV cells and solar panels.

3. Wind Energy

3.1 Introduction
3.2 Basics of wind – speed, direction, measurement
3.3 Define Wind energy conversion systems and list different types of wind turbines
3.4 State site selection for wind farms
3.5 Comparison of Grid – connected and standalone wind systems
3.6 State Challenges, Advantages and Limitations of wind farms
3.7 Activity1: Video on How wind turbines work
3.8 Activity2: Site visiting of nearest wind power plant

4. Biomass Power

4.1 Define Biomass and list the different types of biomass sources
4.2 State Biomass conversion technologies
4.3 State the operation of biomass power plant
4.4 State Environmental and economic benefits
4.5 State Government policies and incentives of biomass plant
4.6 Activity1: Video on working of biomass plant
4.7 Activity2: Biomass usage in rural India

5. Other Energy Sources

5.1 Define hydro power and list different types of hydro power plants in India
5.2 What is thermal power and list different thermal plants in India
5.3 State Geothermal energy – principles, plants, Challenges
5.4 State Tidal and wave energy – concepts, technologies
5.5 State Hydrogen and fuel cells- basics, applications
5.6 Activity1: Group Presentation on each source
5.7 Activity2: Site visiting of nearby hydro/thermal/any other power plant

CO PO/PSO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	3	2	3	2	1
CO2	3	3	2	2	2	2	2	3	3	2
CO3	3	3	2	2	2	2	2	3	3	2
CO4	3	2	2	2	2	2	2	3	2	2
CO5	3	2	2	1	2	3	3	3	2	3
Average	3.0	2.4	1.6	1.4	2	2.4	2.2	3.0	2.4	2.0

Strength Levels:

3 = Strong 2 = Moderate 1 = Low

Note: The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:

(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions(vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects

COURSE CONTENT

1. Introduction to Renewable

Energy crisis, Environmental concerns, Classification of energy sources, Renewable energy and sustainable development, Global renewable energy scenario, Indian renewable energy potential, video-based learning, Impact of fossil fuels group discussion

2. **Solar Energy**

Solar radiation, Statement of Solar systems, Solar photovoltaic (PV) systems, advantages and Limitations of solar energy, recent trends, case study analysis

3. Wind Energy

Basics of wind, Wind energy conversion systems, Site selection for wind farms, Grid-connected vs standalone systems, Challenges, advantages and limitations, Video demonstration, Site Visiting to Wind energy plant.

4. Biomass Power

Biomass sources, biomass conversion technologies- Combustion, Gasification, Anaerobic digestion, Biomass plants, Environmental benefits, Economic benefits, Government policies and Incentives, video on working of biomass power plant

5. Other Energy Sources

Hydro power – Principle, types, benefits and limitations, Geothermal energy – Principle, types, Geological and technical challenges, Tidal and wave energy – Technologies used, environmental impact, Future of Hydrogen vs Solar

REFERENCES

1. Godfrey Boyle – Renewable Energy: Power for a Sustainable Future – Oxford University Press
2. G.D Rai-Non-Conventional Energy Sources- Khanna Publishers
3. John Twidell and Tony Weir- Renewable Energy Resources- Routledge
4. James F. Manwell, Jon G. McGowan, Anthony L. Rogers Wind Energy Explained: Theory, Design and Application.
5. Bent Sorensen- Hydrogen and Fuel Cells: Emerging Technologies and Applications

ELECTRICAL ENGINEERING DRAWING

Course code	Course Title	No. Of periods/week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE307D	ELECTRICAL ENGINEERING DRAWING	4	60	40	60	1.5

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
1	Graphical symbols, couplings, and Guarding systems	12	10	2	0	CO1
2	D.C. Machines	18	25	1	1	CO2
3	Induction Motors	15	20	0	1	CO3
4	Transformers	15	25	1	1	CO4
Total		**60**	**80**	**4**	**3**	

COURSE OBJECTIVES

(i) To familiarise with the different electrical symbols, couplings and guarding systems.
(ii) To draw the views of D.C. machine and induction motors.
(iii) To draw different views of single phase Transformers.

COURSE OUTCOMES

CO1	EE307.1	Understand different types of symbols, couplings and guarding system in electrical drawing.
CO2	EE307.2	Comprehend and draw different views of DC machine.
CO3	EE307.3	Comprehend and draw different views of Induction motors.

CO4	EE307.4	Comprehend and draw different views of single-phase Transformer.

LEARNING OUTCOMES

1. Graphical symbols, couplings and Guarding systems.

1.1 Draw the standard symbols of electrical components and fixtures.
1.2 Draw sectional elevation and end views of a Protected type and Unprotected type shaft couplings.
1.3 Draw the views of the guarding systems in the following cases. (i) Telephone lines under power lines (ii) H.V. line over L.V. line crossing (iii) H.V. Line over L.V. line on same supports (iv) H.V. Line crossing over railway lines.

2. DC machines.

2.1 Draw the assembled sectional views of Pole and Field coils.
2.2 Draw the half sectional end view of armature of DC machine with the given data.
2.3 Draw the half sectional end view of commutator of DC Machine with the given data.
2.4 Draw the Half sectional End view and Elevation of a D.C machine with the given data.

3. Induction Motors.

3.1 Draw the Half - sectional end view and elevation of an assembled 3-phase squirrel cage induction motor from the given data.
3.2 Draw the Half - sectional end view and elevation of an assembled 3-phase slip ring induction motor from the given data.

4. Transformers.

4.1 Draw different plan and elevational views of core stepping sections (one, two, three and four stepped cores) of a Transformer.
4.2 Draw sectional plan and elevation of a 1-phase core type transformer from the given data.

CO-PO/PSO MAPPING

CO.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3
CO1	3		2					3		
CO2	3	2					1	3	1	
CO3	3	2			1	1		3	1	1
CO4	3			1		1	1	3		
Average	3	2	2	1	1	1	1	3	1	1

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note:

The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:

(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits.

COURSE CONTENT

1. Graphical symbols, couplings and Guarding systems

Graphical symbols as per ISI standards, Shaft coupling (Protected and unprotected type) - Guarding Systems employed for the Poles while crossing the Roads and Railway Lines.

2. **DC machines**

Stator pole and field coil assembly, Armature of a small DC machine, Commutator of DC machine - Half sectional end view and elevation of D.C machine.

3. **Induction Motors**

Sectional elevation and end views of 3 - phase Squirrel Cage Induction Motor and 3 - Phase Slip Ring Induction motor.

4. Transformers

Core stepping sections - Sectional views of single-phase core type transformers.

REFERENCES

1. Simpson - Electrical Engineering Drawing
2. Dargon. - Electrical Engineering Drawing
3. K.L.Narang - Electrical Engineering Drawing
4. Surjit singh - Electrical Engineering Drawing
5. Dr. SK Bhattacharya - Electrical Engineering Drawing

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 4.2

ELECTRICAL MACHINES - I LABORATORY

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
26EE308L	Electrical Machines – I Laboratory	6	90	40	60	1.5

TIME SCHEDULE

S. No	Unit Title	No. of Periods	COS Mapped
1	Characteristics of DC Generators	18	CO1
2	Testing and Speed control of DC motors	42	CO2
3	Performance and testing of Transformers	30	CO3
Total		90	

COURSE OBJECTIEVS

Upon completion of the course the student shall be able	
(i)	To enable students to plan, organize, and conduct experiments on D.C. generators, evaluate their performance, and represent the characteristics graphically.
(ii)	To develop the ability to analyze experimental results of D.C. machines in order to select suitable D.C. motors and operate them at different speeds for specific applications.
(iii)	To impart practical knowledge on transformer testing, including determination of polarity, transformation ratio, dielectric strength of transformer oil, and parallel operation of single-phase transformers.

COURSE OUTCOMES

CO1	EE308.1	Demonstrate the skill of planning and organizing experimental setup for D.C Generators, performing operations for investigating performance and to sketch graphically.
CO2	EE308.2	Analyse the experimental results to draw inferences, to make recommendations for selection of DC motor and to run at various speeds for different applications and plotting various characteristics.
CO3	EE308.3	Able to determine the polarity of Transformer terminals and its transformation ratio, Understand the testing procedure of single phase transformers to determine its parameters, able to find dielectric strength of transformer oil and parallel operation of transformers.

LEARNING OUTCOMES

1. Characteristics of DC Generators

1.1 Identify the terminals of the following DC Machines i) DC Shunt Machine and ii) DC Series

Machine

1.2 Obtain OCC of a DC shunt Generator at below, rated and above rated speeds.

1.3 Obtain Internal and External characteristics of DC Shunt Generator.

2. Testing and Speed Control of D.C Motors

2.1 Study the parts of DC 3 - point starter and 4 - point starter.

2.2 Obtain performance characteristics by conducting Brake Test on DC Shunt Motor

2.3 Obtain performance characteristics by conducting Brake Test on DC Series Motor.

2.4 Speed control of DC Shunt Motor by i) Rheostatic control method ii) Field control method

2.5 Obtain the performance of a DC Shunt Motor by conducting Swinburne's test.

2.6 Analyze speed control of BLDC motor using PWM Technique. (Running & Reversing phenomenon and electric braking of BLDC Motor).

2.7 Analyze Regenerative charging and braking phenomenon of PMDC Motor**.**

3. Performance and testing of Transformers

3.1 Determination of the polarity and voltage transformation ratio of a single phase transformer.

3.2 Conduct load test on 1-phase Transformer and calculate efficiency and regulation.

3.3 Conduct O.C. and S.C. tests on 1-phase transformer and from the result Calculate efficiency at various loads and power factor.

3.4 Conduct Oil testing using oil testing kit to know the dielectric strength of given transformer oil.

3.5 Conduct Parallel operation of two single phase Transformers.

COURSE CONTENTS

1. Characteristics of DC Generators

Identify the terminals of DC machine: DC shunt and DC series -OCC of a DC shunt Generator at below, rated and above rated speeds- Internal and External characteristics of DC Shunt Generator

2. Testing and Speed Control of D.C Motors

Parts of DC 3 point starter and 4 point starter- Brake Test on DC Shunt Motor- Brake Test on DC Series Motor-Methods of Speed control of DC Shunt Motor-Swinburne's test on DC Shunt Motor- BLDC motor- PMDC Motor.

3. Performance and testing of Transformers

Determination of - Polarity of terminals - Voltage transformation ratio – Direct load test on 1-phase Transformer – Calculation of efficiency and regulation - O.C. and S.C. tests on 1-phase transformer - Equivalent circuit - Efficiency at various loads and power factor -Load at which maximum efficiency occurs - Test to know the dielectric strength of transformer oil- Parallel operation of two single phase transformers.

Competencies to Be Achieved By The Student

S.No	Experiment title	Competencies	Key Competencies
1	Identify the terminals of the following DC Machines DC Shunt Machine, DC Series Machine	Note down the name plate details. Locate the different terminals of a DC Shunt Motor / DC Series Motor Measure the resistance across different terminals using multi meter. Record the resistance values of the terminals. Identify the armature and shunt field / series field resistance according to resistance values observed.	Measure the resistance across different terminals using multi meter. Identification of armature and shunt field / series field resistance according to resistance values observed.
2	OCC of a DC shunt Generator at below, rated and above rated speeds.	Draw the relevant circuit diagram for OCC test. Select the proper DC supply voltage. Choose the proper range of voltmeter, ammeter and rheostat. Make the connections according to circuit diagram. Ensure that all the instruments are connected in proper polarity. Check the speed and maintain it constant by means of field regulator before taking every reading. Observe and note the readings in a tabular form. Draw the graph between I_fVs $E_{g.}$	Make the connections according to circuit diagram. Observe and note the readings in a tabular form. Draw the graph between I_f Vs $E_{g.}$
3	Internal and External characteristics of DC shunt generator	Draw the relevant circuit diagram Select the proper DC supply voltage. Choose the proper range of voltmeter, ammeter and rheostat. Make the connections according to circuit diagram. Ensure that all the instruments are connected in proper polarity.	Make the connections according to circuit diagram Observe and note the readings in a tabular form. Draw the graph between I_a Vs E_g , I_l Vs V_l

		Check the speed and maintain it constant by means of field regulator before taking every reading. Apply load in steps up to rated current Observe and note the readings in a tabular form. Draw the graph between I_a Vs E_g , I_l Vs V_l	
4	Study the parts of DC 3-point starter & 4 - point starter.	Locate the Line, Armature, Field terminals of the starter (L-A-F) Locate NVR coil and OLR coils. Know the purpose of NVR and OLR coils. Properly connect Starter and motor terminals Properly handle the Starter terminals. Properly start the motor.	Know the purpose of NVR and OLR coils. Properly handle the Starter terminals.
5,6	Performance characteristics of DC Motor (Shunt, Series) by conducting Brake Test	Select the proper DC supply voltage Choose the proper range of voltmeter, ammeter and rheostat. Connect the circuit as per the circuit diagram. Ensure that all the instruments are connected in proper polarity. Start the Motor with the starter. Note the readings of speed N, current I and spring balance for a particular load. Pour water in the break drum carefully. Check the speed and maintain it constant by means of field regulator before taking every reading. Note readings by varying loads on the motor upto rated current. Calculate the torque, input, output and efficiency.	Connect the circuit as per the circuit diagram. Note readings by varying loads on the motor upto rated current. Calculate the torque, input, output and efficiency. Draw performance curves of motor

		Draw performance curves of motor	
7	Speed control of DC Shunt Motor by (a) Rheostatic control method (b)Field control Method	Select the proper DC supply voltage Choose the proper range of voltmeter, ammeter and rheostat. Connect the circuit as per the circuit diagram. Ensure that all the instruments are connected in proper polarity. Handle the 3- point Starter Set the Field Resistance of the motor by gradually moving the knob on the rheostat coil. Record the readings of Ammeter and Tacho meter by gradually increasing the resistance in the Field rheostat. Draw the graph speed Vs Field current. Observe the graph and write the conclusions.	Connect the circuit as per the circuit diagram. Record the readings of Ammeter and Tacho meter by gradually increasing the resistance in the Field rheostat. Draw the graph speed Vs Field current. Observe the graph and write the conclusions.
8	Performance of a DC Shunt Motor by conducting Swinburne's test.	Select the proper DC supply voltage Choose the proper range of voltmeter, ammeter and rheostat. Connect the circuit as per the circuit diagram. Ensure that all the instruments are connected in proper polarity. keep the rheostat in maximum position in armature so that minimum voltage is applied to armature Adjusting the field rheostat to minimum position Adjust the speed of the motor to its rated value by using its Field Rheostat. Taking the readings of Ammeter and Voltage by opening the Field switch Taking the readings of Voltage and current by	Connect the circuit as per the circuit diagram. Calculate the efficiency of the DC Machine as a Generator and as a Motor at various loads. Draw the conclusions

		closing the field switch and gradually decreasing the resistance in the Rheostat. Calculate the efficiency of the DC Machine as a Generator and as a Motor at various loads. Draw the conclusions Adjusting the field rheostat to minimum position Adjust the speed of the motor to its rated value by using its Field Rheostat. Taking the readings of Ammeter and Voltage by opening the Field switch Taking the readings of Voltage and current by closing the field switch and gradually decreasing the resistance in the Rheostat. Calculate the efficiency of the DC Machine as a Generator and as a Motor at various loads. Draw the conclusions	
9	Analyze speed control of BLDC motor using PWM Technique.	Connect the battery terminals to the corresponding DC input terminals. Connect the supply to the Motor Connect hall sensor terminals from BLDC controller outputs to the corresponding hall sensor terminals of motor. · Connect acceleration terminals from BLDC output terminals to the corresponding acceleration terminals. · Switch towards forward direction. f. Apply load to the motor (Make sure not to overload as motor will not rotate and will get overheated.) · Record the values of voltage and current at different speed mode.	By applying load on motor analyze different operating conditions Observation of outputs like voltage, current and speed.

10	Analyze Regenerative charging and braking phenomenon of PMDC Motor.	Connect the DC supply to the Motor terminals Connect the the required meters Switch on DC supply By varying voltage find change in motor speed Observe the Voltage, current at respective terminals and measure the corresponding speed. Now turn the toggle switch at braking mode Observe the readings during regenerative braking and charging	Observe the regenerative charging and braking procedure.

11,12, 13,14 & 15	Performance, testing and parallel operation of Transformers	Conduct polarity test and ascertain the relative polarities of secondary windings. Interpret the name plate details of transformer By selecting proper range and type of meters the circuit diagram to determine voltage transformation ratio is to be connected Make connections as per circuit diagram with appropriate range and type of meters to conduct load test, O.C. test and S.C. test Follow the precautions to be taken (ex: Check for loose and/or wrong connections if any and rectify) Perform the tests as per standard procedure and make a note of test results Calculate the efficiency and regulations from test data Plot the efficiency curve and indicate the maximum efficiency point Conduction of transformer Oil testing using oil testing kit to know the dielectric strength of transformer oil.	Identifying the polarity of transformer terminals Ability to find transformation ratio of transformer Calculation of efficiency and voltage regulation by performing O.C., S.C. and load tests Ability to determine dielectric strength of transformer oil

CO-PO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1		3		3	2	3		
CO2	3	1		3		3	2	3		
CO3	3	1		2		3	2	3		3
Average	3	1	0	2	0	3	2	3	0	3

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note:

The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:

(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

REFERENCES

1. Nagrath, I.J. & Kothari, D.P. "Electric Machines", McGraw Hill, 5th Ed., 2022.
2. Bhimbra, P.S. "Electrical Machinery", Khanna Publishers, 8th Ed., 2021.
3. Sen, S.K. "Principles of Electrical Machines", Wiley Eastern, 2007.
4. Online Resources
   i) NPTEL – Electrical Machines I (IIT Kharagpur)

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 3.5

PROGRAMMING IN C LABORATORY
(PRACTICUM -PRACTICAL)

Course code	Course Title	No. Of periods/ week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE309L	PROGRAMMING IN CLABORATORY	3	45	40	60	1.5

TIME SCHEDULE

S.No	Chapter/Unit Title	No. of periods	COs Mapped
1.	C Programming Basics	9	CO1
2.	Decision & Loop Control Statements	9	CO2
3.	Exercises on functions	9	CO3
4	Arrays, Strings and Pointers in C	9	CO4
5.	Structures and Unions	9	C05
	Total	45	

COURSE OBJECTIVES

Upon completion of the course the student shall be able
(i) To impart adequate knowledge on the need of programming languages and problem solving techniques.
(ii) To develop programming skills using the fundamentals and basics of C language.
(iii) To enable effective usage of arrays, structures, functions, pointers and to implement the memory management concepts.

COURSE OUTCOMES

CO1	EE309.1	Design problems solving with flow chart and algorithm.
CO2	EE309.2	Practice conditional and iterative statements to write C programs.
CO3	EE309.3	Execute C programs that use functions.
CO4	EE309.4	Execute C programs using arrays and strings
CO5	EE309.5	Practice on structures, unions.

LEARNING OUTCOMES

1. C Programming Basics

Theory:

1. Introduction to C-language and its importance

2. Explain the basic structure of the C-program

3. Know the programming style with sample programmers.

Practical:

1. Editing and executing simple programs (using printf and scanf functions).
2. Exercises on operators in C.

2. Decision & Loop Control Statements

Theory:

1. State the importance of conditional expressions.

2. List and explain the various conditional statements.

Practical:

1. Exercises on conditional statements (if, if – else, else if statements).
2. Exercises on switch statements and conditional operator.
3. Exercises on looping statements (while, do – while and for statements).

3. Exercises on functions

Theory:

1. Define function.
2. Understand the need for user defined functions.

Practical:

1. Exercises on functions to demonstrate prototyping, parameter passing, function returning values
2. Exercises on recursion.

4. Arrays, Strings and Pointers in C

Theory:

1. Define 1 D and 2 D arrays.
2. Know how to initialise above arrays and access array elements.
3. Define string and know how to declare and initialise string variables.
4. Define pointer and declare pointer, assign pointer and initialise pointer.

Practical:

1. Exercises on one dimensional arrays and two dimensional arrays.
2. Exercises on Strings handling functions comparison, copying and concatenation.
3. Exercises to demonstrate use of Pointers, pointers as function arguments, functions returning pointers.

5. Structures and Unions

Theory:

1. Define structure and describe about structure variable.
2. Define union and illustrate the use of union.

Practical:

1. Exercise on structures.
2. Exercises on unions.

CO-PO/PSO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	1					3		
CO2	3		1					3		
CO3	3		1	1				3		
CO4	3	1	1					3		
CO5	3	1	1	1				3		
Average	3	1	1	1				3		

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note : 1. This Lab is to be handled by Computer Engg. faculty
2. Paper setting and paper evaluation is also to be done by Computer Engg Faculty.

COURSE CONTENT

1. C Programming Basics

Editing, compiling and executing simple programs (using printf and scanf functions) - Exercises onoperators in C.

2. Decision & Loop Control Statements

Exercises on conditional statements (if, if – else, else if statements) , switch statements and conditional operator) - Exercises on looping statements (while, do – while and for statements).

3. Exercises on functions

Exercises on functions to demonstrate prototyping, parameter passing, function - returning values and recursion.

4. Arrays, Strings and Pointers in C

Exercises on one dimensional arrays and two dimensional arrays, Strings handling functions comparison, copying and concatenation - Exercises to demonstrate use of Pointers, pointers as function arguments, functions returning pointers

5. **Structures, Unions**

Exercise on structures and unions.

Competencies & Key competencies to be achieved by the student

Sl. No.	Experiment Title	Competencies	Key Competencies
1	C Programming Basics	• Opening of Turbo C • Understand about work space • Procedure to open new file in Turbo C • Able to write simple programs • Understanding the procedure to save file. • Understand about different tabs in Turbo C • To know about Execution of program in Turbo C • Understand to see ouput file	• Perform simple mathematics related programs by using Turbo C • Familiarization with work space of Turbo C
2	*Decision & Loop Control Statements*	• Opening of new file in Turbo C • Understand about different looping statements like if, if-else, while, do-while and for loop • Understand about SWITCH statements • Executing different programs related to loop control statements. • Save program file Turbo C • Understand about output of program	• Writing of different programs using loop control statements • Observation of outputs
3	*Exercises on functions*	• Opening of new file in Turbo C • Understand to use function in C program • Understand to use recursive functions in C • Understand to use Function call technique in C program • Save the program file • Understand about output of program	• Usage of recursive functions • Usage of External and internal variables • Usage of function call technique • Observation of outputs
4	*Exercises on Arrays, Strings and Pointers in C*	• Opening of new file in Turbo C • Understand about arrays and their usage • Understand about strings and their usage	• Usage of one dimensional and multi dimensional arrays • Usage of string handling functions

		• Understand about pointers and their usage • Writing of C programs using arrays , strings and pointers • Save the program file • Understand about output of a program	• Usage of pointers • Writing program using arrays, strings and pointers • Observation of outputs
5	Structures, Unions	• Opening of new file in Turbo C • Understand about Structures • Understand about unions • Usage of structures, unions and pointers in C program • Save the program file • Understand about output of a program	• Usage of structures in program • To know the difference between structures and unions • Writing of programs using structures • Observation of outputs

REFERENCES

1. Kernighan, Brian W. & Ritchie, Dennis M. "The C Programming Language", Prentice Hall, 2nd Ed., 2021 Reprint.
2. Balagurusamy, E. "Programming in ANSI C", McGraw Hill, 8th Ed., 2020.
3. Yashavant Kanetkar. "Let Us C", BPB Publications, 16th Ed., 2023.
4. Online Resources
    i) NPTEL – Introduction to Programming in C (IIT Bombay)

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 3.1
Unit Test – II	From 3.2 to 5.2

ELECTRONICS ENGINEERING LABORATORY

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
26EE310L	ELECTRONICS ENGINEERING LABORATORY	3	45	40	60	1.0

TIME SCHEDULE

S.No	Title	No. of periods	CO's Mapped
1.	Semiconductor devices and PCBs	12	CO1
2.	Power Supplies	9	CO2
3.	Amplifiers	6	CO3
4.	Oscillators and A/D &D/A converters	9	C04
5	Linear Integrated Circuits	9	CO5
	Total	45	

COURSE OBJECTIVES

(i) To impart adequate knowledge on BJTs, FETs and PCBs
(ii) To impart adequate knowledge on power supplies and circuits.
(iii) To develop skills of using amplifier and oscillators and A/D & D/A converters
(iv) To enable effective usage of linear integrated circuits.

COURSE OUTCOMES

CO1	EE310.1	Acquire knowledge on BJTs, FETs and PCBs
CO2	EE310.2	Developing Power Supply Circuits.
CO3	EE310.3	Designing amplifier and using them in various applications.
CO4	EE310.4	Practice on various oscillator and A/D & D/A converter circuits.
CO5	EE310.5	Practicing linear integrated circuits to develop various applications.

LEARNING OUTCOMES

1. Semiconductor devices and PCB making

1.1 Draw the I/O characteristics of CB configuration
1.2 Draw the I/O characteristics of CE configuration
1.3 Draw the Drain characteristics of JFET

1.4 Draw the Transfer characteristics of JFET
1.5 Prepare PCBs for given circuits

2. Power Supplies

2.1 Implement Half Wave rectifier with and without filter.
2.2 Implement Full Wave rectifier with and without filter.
2.3 Implement Bridge Wave rectifier with and without filter.
2.4 Build a regulated power supply with (a) Zener Diode and (b) Voltage Regulator IC.

3. **Amplifiers**

a. Plot the frequency response characteristics of RC coupled amplifier.
b. Plot the frequency response characteristics of transformer coupled amplifier.
c. Study the working of different power Amplifiers

4. Oscillators and A/D & D/A converters.

4.1 Measure the frequency of RC-Phase shift oscillator
4.2 Measure the frequency of Colpitts oscillator.
4.3 Measure the frequency of Crystal oscillator.
4.4 Implement D/A conversion using R-2R ladder network and observe the output.
4.5 Implement A/D converter using successive approximation method and observe the output.

5. Linear Integrated Circuits

5.1 Implement Inverting Amplifier with IC 741 OpAmp.
5.2 Implement non-Inverting with IC 741 OpAmp.
5.3 Implement summer with IC 741 OpAmp
5.4 Implement differentiator with IC 741 OpAmp
5.5 Implement integrator with IC 741 OpAmp

COURSE CONTENT

1. Semiconductor devices and PCB making

V-I characteristics of BJT, V-I characteristics of FET, Preparation of PCBs for different circuits

2. Power Supplies

Half Wave rectifier with and without filter - Full Wave rectifier with and without filter - Bridge rectifier with and without filter - Regulated power supply with (a) Zener Diode and (b) Voltage Regulator IC.

3. Amplifiers

Frequency response characteristics of RC coupled amplifier, Transformer coupled amplifier and working of power amplifiers

4. Oscillators and A/D &D/A Converters

Measure the frequency of RC Phase shift oscillator - Measure the frequency of Colpitts oscillator- Measure the frequency of Crystal oscillator. Measure the output of A/D & D/A converters.

5. Linear Integrated Circuits

Inverting Amplifier with IC 741 Op Amp – Non- Inverting amplifier with IC 741 Op Amp – summer, differentiator and integrator with IC 741 OP-Amp

CO-PO/PSO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	1	2		3	1	2
CO2	3	2	2	1	1	2		3	1	2
CO3	3	2	2	1	1	2		3	1	2
CO4	3	2	2	1		2	2	3	3	3
Average	3	2	2	1	1	2	2	3	1.5	2.25

REFERENCES

1. Floyd, Thomas L. “Electronic Devices”, Pearson, 10th Ed., 2021.
2. Boylestad & Nashelsky. “Electronic Devices and Circuit Theory”, Pearson, 2020.
3. David A. Bell. “Electronic Devices and Circuits”, Oxford University Press, 6th Ed., 2018.
4. Online Resources
    i) NPTEL – Analog Electronics Laboratory (IIT Kharagpur)

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 3.1
Unit Test – II	From 3.2 to 5.6

IV SEMESTER

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING

SCHEME OF INSTRUCTIONS AND EXAMINATIONS

FOURTH SEMESTER

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										
26EE401T	Electrical Machines - II	6	--	N	90	4	3	30	70	100
26EE402T	Power Systems - I	6	--	N	90	4	3	30	70	100
26EE403T	Digital Electronics & Micro Controllers	6	--	N	90	4	3	30	70	100
ELECTIVE COURSES										
26EE404E	Industrial Automation	3	--	N	45	2	3	30	70	100
26EE405E	Electrical Vehicle Technology	3	--	N	45	2	3	30	70	100
AUDIT COURSE										
26EE406A	Internet of Things in EEE	2	--	N	30	--	--	--	--	--
PRACTICAL COURSE										
26EE407L	Electrical Machines -II Laboratory	--	6	N	90	1.5	3	40	60	100
26EE408L	Communication and Employability skills Laboratory	--	4	Y	60	2	3	40	60	100
26EE409L	Digital Electronics & Micro Controllers Laboratory	--	3	N	45	1	3	40	60	100
26EE410L	Auto CAD & Simulation Tools Laboratory	--	3	Y	45	1	3	40	60	100
26EE411C	Student Centric Activities	--	3	N	45	0.5	--	--	--	--
TOTAL		**23**	**19**		**630**	**20**	--	**280**	**520**	**800**

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

Note 2: 26EE408L is common laboratory to all programmes.

ELECTRICAL MACHINES-II

Course code	Course Title	No. Of periods/week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE401T	ELECTRICAL MACHINES-II	6	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
1	3- Phase Induction Motors	25	25	3	2	CO1
2	1-Phase Induction Motors	15	14	2	1	CO2
3	Alternators	20	25	3	2	CO3
4	Parallel operation of Alternators	15	11	1	1	CO4
5	Synchronous motors	15	25	3	2	CO5
		90	100	12	08	

COURSE OBJECTIVES

Upon completion of the course the student shall be able
(i) To familiarize with the knowledge of Induction Motors and Fractional Horse Power Motors (ii) To understand the working of Alternators and its parallel operation (iii) To Understand the working of Synchronous motors

COURSE OUTCOMES

CO1	EE401.1	Explain the working of 3-phase induction motors and understand equivalent circuit parameters, power, torque, efficiency.
CO2	EE401.2	Explain the working of fractional Horse power motors
CO3	EE401.3	Describe construction and working principle of Alternator.
CO4	EE401.4	Manipulate paralleling and synchronisation methods of Alternators.
CO5	EE401.5	Explain the working of Synchronous motors

LEARNING OUTCOMES

1. Three-phase Induction Motors

1.1 Principle of Production of Rotating Magnetic Field in 3-phase System.

1.2 Explain the construction of Induction motor- slipring and squirrel cage
1.3 Compare Slip ring & Squirrel cage Induction motors.
1.4 State the working principle of 3 phase induction motor.
1.5 State relations for effect of slip on rotor parameters.
1.6 Derive the expression relating to TORQUE, POWER and SLIP and solve simple problems.
1.7 Draw Torque – Slip curves.
1.8 State the Starters used for different ratings of induction motors.
1.9 Explain the working of the following starters with the help of circuit diagram.
(i) D.O.L. starter (ii) Star/Delta Starter
(iii) Auto – Transformer starter (iv) Rotor resistance starter
1.10 Explain the speed control of induction motors by
(i) Frequency changing method (ii) Pole changing method (iii) Injecting voltage in rotor circuit
1.11 State the advantages of induction motors.
1.12 List the applications of induction motors.

2. Single-Phase Induction Motor

2.1 List the types of 1- phase motors.
2.2 Explain why a Single-phase Induction motor is not a Self-starting motor.
2.3 Explain the working principle of 1 – phase Induction motor.
2.4 Explain the working of the following 1-phase induction motors with legible sketch (i) Split phase motor (ii) capacitor start motor (iii) shaded pole motor
2.5 Explain the working of the universal motor.
2.6 Explain the working of Stepper motor and list different types.
2.7 Explain the working of Servo motor.
2.8 List the applications of single-phase induction motors and special A.C. Motors.

3. Alternators

3.1 Explain the working principle of Alternators.
3.2 Describe the Constructional details of Alternators with legible sketch.
3.3 Classify the Alternators based on rotor construction.
3.4 State the advantage of Stationary Armature.
3.5 Define Chording and Distribution factor
3.6 Derive EMF equation of an alternator taking into account distribution factor and pitch factor and solve problems
3.7 State the need for an exciter in an Alternator and list various types of exciters.
3.8 Define the term synchronous impedance and state its effects on operation of an alternator.
3.9 Define voltage regulation of an alternator
3.10 List the different methods of finding the regulation of alternator.

4. Parallel operation of Alternators

4.1 Explain the necessity for parallel operation of alternators
4.2 State the conditions for synchronisation
4.3 Explain the procedure of synchronisation by using two bright and one dark lamp method.
4.4 Explain the procedure of synchronisation by using synchroscope methods.

5. Synchronous motors

5.1 Explain the working principle of synchronous motors.
5.2 Explain synchronous motor with i) no load and ii) load
5.3 Explain 'V' and inverted 'V' curves with neat sketch.
5.4 Explain how a Synchronous motor can be used as a Synchronous condenser for improving power factor

5.5 Explain the phenomenon of HUNTING and how HUNTING can be prevented.
5.6 List the applications of synchronous motor.
5.7 Compare synchronous motors with induction motors.

CO-PO/PSO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2		2				3	2	
CO2	3		1	1		2		3		1
CO3	3	2	1	1	1	2		3		1
CO4	3		1	1	1	1		3		1
CO5	3			1	1	2		3		
Average	3	2	1	1.2	1	1.75		3	2	1

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note:
The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:
(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

COURSE CONTENT

1. **Three Phase Induction Motors**

Introduction – Rotating Magnetic field - Construction of Induction motors – Comparison – working principle of three phase Induction motor – working of Induction motor at different conditions (Starting and Running) - Derive the relationship between Torque, Power and slip of Induction motor, problems – Torque-slip characteristics - Types of starters – Methods of speed control of Induction motor – Advantages and applications of Induction motors.

2. Single Phase Induction Motors

Types of 1-phase motors – Reasons for not self-starting -working principle of 1-phase induction motors- Working of split phase, capacitor start and shaded pole types – principle of working – Universal motor- principle of working- Stepper motor – principle of working – Servo motor - Types-Applications of 1-phase motors and special A.C motors.

3. Alternators

Classification of alternators - Brief description of parts with sketches and function of each part, construction, Exciter and pilot exciter – Stationary armature type – Advantages**,** Concentrated and distributed windings - short pitch and full pitch coils - Effect of chording and distribution factors - EMF equation - Derivation – Problems- Synchronous impedance concepts - phasor diagram for unity, lagging and leading power factor loads - Regulation definition - Different methods of finding regulation.

4. Parallel operation of alternators

Necessity for parallel Operation - condition to be fulfilled for synchronisation - Synchronisation by lamps & synchroscope methods.

5. Synchronous Motors

Introduction - synchronous speed – Excitation of rotor - working Principle-synchronous motor with no-load and load condition- V – Curves and inverted V –curves– Synchronous motor as

synchronous condenser - Hunting phenomenon – prevention of Hunting- Applications of synchronous motor - Comparison with Induction motor.

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3. DP Kothari, IJ Nagrath – Electric Machines-Mc.Graw.Hill
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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 2.8
Unit Test - II	From 3.1 to 5.7

POWER SYSTEMS – I

Course code	Course Title	No. Of periods/ week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE402T	POWER SYSTEMS – I	6	90	30	70	4

S. No.	Chapter/ Unit Title	No. of Periods	Weigh tage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
1.	Non-renewable energy sources of power generation	24	25	3	2	CO1
2.	Renewable energy sources of power generation	18	11	1	1	CO2
3.	Power System Operation with Economic Aspects	16	25	3	2	CO3
4.	Switchgear in Power Systems	16	25	3	2	CO4
5.	Power System Protection	16	14	2	1	CO5
Total		90	100	12	8	

COURSE OBJECTIVES

Upon completion of the course the student shall be able
(i) To analyse the working of various power generation stations of Non-Renewable energy sources. (ii) To understand the need for Renewable energy sources. (iii) To familiarise the fundamental concepts of Integrated operation and economics of Power station. (iv) To understand the role of circuit Breakers, relays and lightning arresters in power system protection and to analyse the protection of Alternators and Transformers.

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CO1	EE402.1	Analyse the working of Thermal, Hydro, Nuclear and Gas power stations
CO2	EE402.2	Understand the significance and working of renewable energy power generation methods
CO3	EE402.3	Understand the concept of load dispatching and analyse various tariffs.
CO4	EE402.4	Analyse the applications of relays and the working of various circuit breakers
CO5	EE402.5	Analyse Protection schemes used for protection of alternators and transformers.

LEARNING OUTCOMES

1.Non-Renewable energy sources of power generation

1.1 Know the different sources of energy and classify them into Renewable energy sources and non-Renewable energy sources.
1.2 State working principle of Thermal power plant.
1.3 State the factors required for selection of site for Thermal power plant.
1.4 Draw the detailed line diagram of a condensing type thermal power station and explain the working of each component of thermal power station.
1.5 State the advantages of (i) Pulverisation (ii) Cooling towers.
1.6 State the causes of pollution and methods to control them.
1.7 State the advantages and disadvantages of Thermal power plants.
1.8 State the principle of working of Hydro power station.
1.9 State the factors required for selection of site for Hydro power station.
1.10 Explain Hydrograph.
1.11 Define hydraulic terms i) Head ii) Flow rate (discharge)
1.12 Write water power equation
1.13 Classify the Hydroelectric Plants based upon head, duty, location and hydraulic considerations.
1.14 Explain with layout diagram working of i) High Head ii) Medium Head iii) Low Head Power stations.
1.15 Explain the Function of (i) Surge Tank ii) Forebay iii) Spill gates.
1.16 State the advantages and disadvantages of hydroelectric power station.
1.17 State merits and risks involved in using nuclear energy
1.18 List out the nuclear fuels.
1.19 Explain fission and fusion reactions.
1.20 Explain sustained chain reaction.
1.21 Explain the working of a moderate type nuclear power station with a block diagram.
1.22 State the purpose of coolant, reflector and control rods. Mention the materials used for them.
1.23 List the types of Reactors used in Nuclear Power Station.
1.24 Explain the principle of working of gas power station with the help of schematic diagram.

2. Renewable energy sources of power generation

2.1 State necessity of developing Renewable energy methods of power generation.
2.2 Describe the method of power generation by (i) Solar Power plant (ii) Tidal Power plant (iii) Wind Power plant (iv) Biomass Power plant (v) Geothermal Power plant.
2.3 Differentiate between Renewable energy sources and Non-renewable energy sources.
2.4 State the need of energy conservation and its methods.

3. Power System Operation with Economic Aspects

3.1 State the need for integrated operation of power plants and list the merits of it.
3.2 Differentiate between isolated operation and integrated operation of power stations
3.3 State the concept of load dispatching and its process.
3.4 List the various charges and expenses in power station and classify them as fixed and running.
3.5 Define the terms load curve, connected load, Maximum demand, Demand factor, load factor, diversity factor, capacity factor and plant use factor.
3.6 State the cost of generation.
3.7 State the effects of load factor and diversity factor on cost of generation.

3.8 Solve problems on Load curve.
3.9 Explain various types of consumer tariffs and compare them.
3.10 List the causes of low power factor.
3.11 State the effects of power factor (p.f.) on electricity charges
3.12 List the methods to improve Power factor.
3.13 Explain the Following methods to improve the Power factor.
i) Static capacitor ii) Synchronous condensers iii) Phase Advancers

4. Switchgear in Power Systems

4.1 Define faults and list types of faults in power systems.
4.2 Define and classify switchgear.
4.3 Define isolators, air break switches and their uses.
4.4 Explain the phenomenon of arc.
4.5 List the methods of arc quenching.
4.6 Define relay and State the basic requirements of relays.
4.7 Classify the relays based upon (i) Principle of operation (ii) Time of operation(iii) Duty
4.8 Define current setting and time setting.
4.9 State the applications of (i) Induction type overcurrent relay (ii) Directional overcurrent induction type relay (iii) Distance relay (iv) Differential Relay
4.10 Define Circuit breakers.
4.11 Classify the circuit breakers based upon medium of arc quenching.
4.12 State the principle of M.O.C.B and explain its working.
4.13 State properties of SF_6 gas and explain the working of SF_6 circuit breaker.
4.14 Explain working principle of Vacuum circuit breaker (V.C.B).
4.15 Define current limiting reactors and state their importance.

5. Power System Protection

5.1 Define surge.
5.2 List the types of surges.
5.3 Give reasons for the cause of surges.
5.4 Explain the scheme of surge protection with diagram.
5.5 Define Lightning arresters.
5.6 Explain the types of lightning arresters or surge diverters.
5.7 Explain the construction and working of following types of lightning arresters.
i) Valve type ii) Thyrite type
5.8 List the probable faults in Stator and rotor of Alternator.
5.9 Explain the differential protection for alternator stator.
5.10 List the possible faults and their types in a transformer.
5.11 Explain the working of Buchholz relay in a transformer.

CO-PO/PSO MAPPING

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

CO5	3	3	2	2	2		1	3	2	3
Average	3	2.4	2.2	1.5	1.5	1.66	1.8	3	2.2	3

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note:
The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:
(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

COURSE CONTENT

1. **Non-Renewable Energy sources of Power generation**
   Different sources of energy, renewable and Non-renewable sources Thermal Power Station – Principle of working–Factors for selection of site Thermal Power Plant–Block diagram of condensing type thermal power station- Components and its working -Advantages of pulverization and Cooling towers -Causes of pollution and methods to control them. Principle of working of hydroelectric power station – limitations in location and operation. Hydraulic terms used – Water power equation – Classification of hydroelectric power stations based on head, duty, location and hydraulic considerations- Layout diagram of i)High Head ii) Medium Head iii) Low Head Power Stations- Function of surge tank, forebay, spill gates. Nuclear fuels - Fission and fusion reactions with mass energy balance, sustained chain reaction – Working of moderate type nuclear power station with a block diagram- Need and working of coolant, reflector, control rods – Materials used for them –reactors used in nuclear power plant- Principle and working of gas power plant.

2. **Renewable energy sources of Power generation**
   Methods of generation of energy from different renewable sources of power- Working principle of Solar, Tidal, Wind, Biomass and geothermal power plants- Differentiate between renewable and Non-renewable energy sources - Need for energy conservation and their methods.

3. **Power System Operation with Economic Aspects**
   Isolated operation and integrated operation of power stations — Load dispatching and its process –Charges/Expenses involved in power station – Their classification as fixed and running-Load curve, load factor, diversity factor, demand factor, capacity factor and plant use factor and maximum demand – Effects of load factor and diversity factor in power generation – Solve numerical problems on load curve. Consumer tariffs and their comparison – Effect of power factor on the electricity charges and methods to improve it.

4. **Switchgear in Power Systems**
   Faults in power systems - Switchgear and their classification – Isolators, air break switches and their uses. Explain the phenomenon of arc – methods of arc quenching. Requirements of relays – Classifications based on duty, principle of operation and time of operation – Construction and working of induction type over current relays – applications of induction type over current relay, directional over current relay, distance relay and differential relay Circuit breakers and their classification based on the medium of arc quenching – , M.O.C.B – Properties of SF_6 gas and working of SF_6 circuit breakers – Working of V.C.B, M.O.C.B, SF_6 C.B. Reactors – Current limiting reactors and their importance.

5. **Power System Protection**
   Surge Protection -Surge types and causes for production Need for Surge Protection and its

methods – Scheme of surge protection with diagram - Types of lightning arresters – Working and applications of valve type and Thyrite type - Faults in Alternator stator and rotor- its effects – differential protection for alternator stator- Possible faults and their types in the transformer – Buchholz relay in transformers.

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2. Generation, Transmission and Utilisation by A.T.Starr
3. Power System by C.L.Wadhwa
4. Electrical power plants by J B Guptha
5. Switch gear and protection by Sunil S. 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 3.5
Unit Test - II	From 3.6 to 5.11

DIGITAL ELECTRONICS AND MICRO CONTROLLERS

Course code	Course Title	No. Of periods/ week	Total No. of periods / Semester	FA Marks	SA Marks	Credits
26EE403T	DIGITAL ELECTRONICS AND MICRO CONTROLLERS	6	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
1.	Basics of Digital Electronics	18	17	3	1	CO1
2.	Combinational Logic circuits	15	14	2	1	CO2
3.	Sequential Logic Circuits	18	22	2	2	CO3
4	8051 Microcontroller	15	14	2	1	CO4
5.	8051 instruction set and programming	24	33	3	3	CO5
	Total	90	100	12	08	

COURSE OBJECTIVES

Upon completion of the course the student shall be able
i) To introduce students to the basic theory of digital electronics, their practical applications.
ii) To familiarize students to the principle of operation, design and synthesis of different digital electronic circuits.
iii) To provide strong foundation for further study of digital electronic circuits and systems

iv) To understand different applications of microcontrollers

COURSE OUTCOMES

CO1	EE403.1	Understand number systems, basic operation and compare performance of various digital electronic circuits.
CO2	EE403.2	Design and analyse digital electronic circuits and learn to select suitable circuits by assessing the requirements of application fields.
CO3	EE403.3	Identify the critical areas in application levels and derive typical alternative solutions, select suitable digital electronic circuits to control industry grade apparatus.
CO4	EE403.4	Select 8051 microcontroller for given application and develop assembly program for a given application
CO5	EE403.5	Describe 8051 microcontrollers as per requirement and develop a simple real time application.

LEARNING OUTCOMES

Basics of Digital Electronics

1.1 Explain Binary, Octal, Hexadecimal number systems and compare them with Decimal system.
1.2 Perform binary addition, subtraction, Multiplication and Division.
1.3 Explain about BCD.
1.4 Write 1‘s complement and 2‘s complement numbers for a given binary number
1.5 Perform subtraction of binary numbers in 2‘s complement method.
1.6 Explain the importance of parity Bit.
1.7 State different postulates and De-Morgan‘s theorems in Boolean algebra.
1.8 Explain AND, OR, NOT, NAND, NOR and EX-OR gates with truth table.
1.9 Realize AND, OR, NOT operations using NAND, NOR gates.
1.10 Explain K-map (up to 3-variable).
1.11 Minimize the Boolean expression using K-maps.
1.12 Minimize the Boolean expression using Boolean laws.
1.13 Classify digital logic families.
1.14 Give IC numbers for different digital Logic gates.
1.15 List the important characteristics of Digital ICs of different logic families.
1.16 Explain the working Principle of CMOS technology with diagram.
1.17 Explain the working Principle of CMOS NAND and CMOS NOR gates with diagram.

2. Combinational Logic Circuits

2.1 Give the concept of combinational logic circuits.
2.2 Draw the Half adder circuit and verify its functionality using truth table.
2.3 Realize a Half-adder using NAND gates and NOR gates.

2.4 Draw the full adder circuit and explain its operation with truth table.
2.5 Realize full-adder using two Half-adders and an OR – gate and write truth table.
2.6 Explain 4-bit parallel adder.
2.7 Explain 4-bit serial adder.
2.8 Draw and explain the operation of 4 X 1 Multiplexers.
2.9 Draw and explain the operation of 1 X 4 demultiplexer.
2.10 Draw and explain 3 X 8 decoder.
2.11 List any three applications of multiplexers and decoders.
2.12 Draw and explain One-bit digital comparator.

3. Sequential Logic Circuits
3.1 Give the idea of Sequential logic circuits.
3.2 Explain NAND and NOR latches with truth tables.
3.3 State the necessity of clock and give the concept of level clocking and edge triggering,
3.4 Draw and explain clocked SR flip flop with preset and clear inputs.
3.5 Construct level clocked JK flip flop using S-R flip-flop and explain with truth table
3.6 Write the truth tables of edge triggered D and T flip flops and draw their symbols.
3.7 List the applications of flip flops.
3.8 Define modulus of a counter.
3.9 Define Synchronous counter and Asynchronous counter
3.10 Explain 4-bit synchronous counter with diagram
3.11 Explain 4-bit Asynchronous counter with diagram
3.12 Differentiate between Synchronous counter and Asynchronous counter
3.13 State the need for a Register and list the types of registers.
3.14 Draw and explain the working of 4- bit shift left and shift right registers
3.15 State memory read operation, write operation, access time, memory capacity, address lines and word length.
3.16 Distinguish between (a) EEPROM and UVEPROM (b) static RAM and dynamic RAM

4. Microcontroller
4.1 State the need of Microcontrollers.
4.2 List the three commonly used Commercial Microcontroller Device families.
4.3 Draw the block diagram of a microcontroller and explain the function of each block.
4.4 Explain the register structure of 8051.
4.5 Explain the functions of various special function registers.
4.6 Draw the pin diagram of 8051 micro controller and specify the purpose of each pin.
4.7 Explain internal memory, external memory and ports of 8051.
4.8 List the interrupts in 8051.

5. Instruction set and Programming
5.1 State the need for an instruction set.
5.2 Explain the instruction format of 8051.
5.3 Explain fetch cycle, execution cycle and instruction cycle.
5.4 Define the terms machine language, assembly language, and mnemonics.
5.5 Differentiate between machine level and assembly level programming.
5.6 List the major groups in the instruction set along with examples.

5.7 Explain the terms operation code, operand and illustrate these terms by writing an instruction.
5.8 Explain the addressing modes of 8051.
5.9 Explain data transfer instructions of 8051.
5.10 Explain the arithmetic instructions.
5.11 Explain the logic instructions.
5.12 Explain unconditional and conditional jump instructions
5.13 Define subroutine and explain its use.
5.14 Write program to perform
(i) Single byte & Multi byte addition
(ii) Summing-up of given N numbers
(iii) Multiplication of two 8-bit numbers using MUL instruction
5.15 Explain interfacing of stepper motor with 8051 micro controller.
5.16 List various advanced microcontrollers used in Electrical engineering
5.17 List electrical engineering applications of microcontrollers.
5.18 Explain how microcontrollers help in power monitoring of electrical devices
5.19 Explain how microcontrollers help in monitoring of energy meters

CO-PO/PSO MAPPING

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

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note:
The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:
(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

COURSE CONTENT

1. Basics of Digital Electronics
Binary, Octal. Hexadecimal number systems, 1's complement,2's complement of binary number , subtraction of binary numbers in 2's complement method ,parity bit, Logic gates: AND, OR, NOT, NAND, NOR, Ex-OR, Realize AND, OR, NOT operations using NAND, NOR gates. Boolean algebra, Boolean expressions, De-Morgan 's Theorems, K-maps Up to 3 variable, Characteristics of digital circuits, Logic families, working Principle of CMOS NAND and CMOS NOR gates.

2. Combinational Logic Circuits
Implementation of arithmetic circuits - Half adder, full-adder using two Half-adders and an OR – gate ,Full adder, 4-bit parallel adder,4-bit serial adder, Multiplexer, demultiplexer, decoder,

Comparator.

3. Sequential Logic Circuits

Principle of flip-flops operation, Concept of edge triggering and level triggering, RS, D, JK, T- flip-flops, Applications of flip flops, Counter- Synchronous counter, Asynchronous Registers-Shift Registers and its applications- Memories-terminology related to memories, RAM, ROM, EEPROM, UVEPROM, static RAM, dynamic RAM

4. Microcontrollers

Microcontroller families, Block diagram of 8051- Pin out diagram of 8051, registers, interrupts, memory organisation in 8051 microcontroller.

5. Instruction Set and Programming

Instruction set of 8051, instruction format, fetch cycle, execution cycle, instruction cycle, machine cycle, machine level and assembly level language, classification of instructions, addressing modes, Groups of instructions, Op-code, operand, subroutines, Assembly level programming, Applications of microcontrollers, Interfacing.

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2. Modern Digital Electronics By RP Jain TMH
3. Digital Electronics Tokhem TMH
4. Digital Design by Morris Mano, PHI
5. Kenneth J.Ayala. - 8051 Micro controller

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

Unit Test	Syllabus to be covered
Unit Test - I	1.0 to 3.16
Unit Test - II	4.1 to 5.19

INDUSTRIAL AUTOMATION

Course code	Course Title	No. Of periods/week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE404E	INDUSTRIAL AUTOMATION	03	45	30	70	2

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
1.	Fundamentals of Industrial Automation	10	25	3	2	CO1
2.	Sensors and Actuators	14	25	3	2	CO2
3.	Programmable Logic Controller (PLC)	15	36	4	3	CO3
4.	SCADA Systems	6	14	2	1	CO4
	Total	45	100	12	8	

COURSE OBJECTIVES

Upon completion of the course the student shall be able to
(i) To understand the concept of automation and impart adequate knowledge on various components of automation system
(ii) To understand the concept of control system
(iii) To acquire the knowledge of PLC and SCADA basics and Instruction set of PLCs
(iv) To familiarize various applications used in different Industries

COURSE OUTCOMES

CO1	EE404.1	Understand the concept of industrial automation
CO2	EE404.2	Explain the functions of Sensors and Actuators
CO3	EE404.3	Explain the basics of PLC
CO4	EE404.4	Explain the basics of SCADA

LEARNING OUTCOMES

1.0 Fundamentals of Industrial Automation

1.1 Define Automation
1.2 Describe the Evolution of Automation
1.3 Explain the need for Automation
1.4 Explain different types of Automation (Fixed, Programmable and Flexible)
1.5 Explain the challenges in implementing Automation
1.6 Describe the social impacts of Industrial Automation on employment and skill requirements.
1.7 List the basic components of an Automation system and state their purpose.
1.8 List the application of Automation in Industry.
1.9 Explain the importance of control engineering in industrial automation.
1.10 Explain the concept of control systems used in speed control of AC and DC motor
1.11 Explain the concept of control systems used in Water level Controllers.

2.0 Sensors and Actuators

2.1 Define Sensor and Actuators.
2.2 List various types of sensors and actuators based on their working principles and applications.
2.3 Classify sensors and actuators.
2.4 Define the following characteristics of sensors. 1. Accuracy 2. Precision 3. Sensitivity 4. Resolution.
2.5 Explain the operating principles of i) temperature sensor and ii) light sensor.
2.6 State the functions and operations of the following actuators.
1. Electric motors 2. Solenoids 3. Hydraulic 4. Pneumatic 5. Transducers
2.7 State the applications of sensors and actuators in automation.
2.8 Differentiate between sensor and actuator.
2.9 Explain the working of AC and DC Solenoids.
2.10 Explain the working of Thermal relay and Electromagnetic relay.

3.0 Programmable Logic Controller (PLC)

3.1 Define Programmable Logic Controller (PLC) and state its advantages.
3.2 Explain the different parts of PLC with a block diagram.
3.3 Describe the concept and structure of Ladder diagram.
3.4 Explain the different types of contacts and coils used in Ladder Logic.
3.5 Draw ladder diagrams for the following logic gates.
(i) AND gate (ii) OR gate (iii) NOT gate
(iv) NAND gate (iv) NOR gate (iv) X-OR gate
3.6 Explain the working of following PLC Timers and counters.
(i) T ON (ii) T OFF (iii) Retentive timer (iv) CTU (v) CTD
3.7 Draw ladder diagrams using Timers and counters for the following simple automation tasks.
i) Motor ON–OFF delay control ii) Conveyor start/stop with delay
iii) Bottle filling with timer control iv) Sequential lamp ON/OFF control v) Automatic pump control with delay.
3.8 Explain the basic PLC Instruction set.
3.9 Explain the concept of Scan Cycle (Input scan – Program scan – Output scan) in PLC.

3.10 Explain the concept of memory bits, internal relays, flags and markers in PLC.

3.11 Draw and Explain ladder diagrams for i) DOL starter and Star–Delta starter ii) Staircase lighting iii) Water level control iv) Temperature controller

3.12 List various industrial applications of PLC.

4.0 SCADA Systems

4.1 Define SCADA and state its need in industrial automation.

4.2 Explain the concept of SCADA.

4.3 Explain the functions of various components of a SCADA system.

4.4 Explain the working of SCADA with a block diagram.

4.5 State the advantages and limitations of SCADA system.

4.6 List different software used for SCADA.

4.7 State various communication methods/protocols used in SCADA.

4.8 List the applications of SCADA.

CO-PO/PSO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	3	1	-
CO2	3	2	3	2	-	-	-	3	2	-
CO3	3	2	3	2	3	-	-	3	3	-
CO4	2	2	2	2	3	-	-	2	3	-
Average	2.75	2	2.25	2	3	-	-	2.75	2.25	-

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note:

The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:

(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

COURSE CONTENT

1. Fundamentals of Industrial Automation

Definition of automation – Evolution of automation – Need for automation – Types of automation: Fixed, Programmable and Flexible – Challenges in implementing automation – Social impacts of automation on employment and skill requirements – Basic components of automation systems – Applications of automation in industries – Importance of control engineering – Control systems in AC/DC motor speed control, water level control.

2. Sensors and Actuators

Definition of sensors and actuators – Types of sensors and actuators – Operating principles: temperature, light sensors – Characteristics of sensors: Accuracy, Precision,

Sensitivity, Resolution – Function and operation of actuators: Electric motors, Solenoids, Hydraulic, Pneumatic, Transducers – Applications of sensors and actuators in automation – Working of AC & DC solenoids – Working of Thermal, Electromagnetic.

3. Programmable Logic Controller (PLC)

Definition and advantages of PLC – Block diagram and parts of PLC – Industrial Applications of PLC – Ladder diagram – PLC contacts and coils – Ladder diagram implementation: AND, OR, NOT, NAND, NOR, XOR – Timers and Counters in PLC: TON, TOFF, Retentive, CTU, CTD – Ladder diagrams using Timers and Counters – PLC instruction set – Scan cycle – concept of memory bit, internal relays, flags and markers - Ladder diagrams for: DOL, Star-Delta starter, Staircase lighting, Water level control, Temperature control.

4. SCADA System

SCADA and its need – concept of SCADA – Functions of various components – working of SCADA with block diagram – Advantages and limitations of SCADA – SCADA software – Communication methods/protocols – Applications of SCADA.

REFERENCES

1. Gary Dunning –Introduction to Programmable Logic Controllers – Delmar Cengage Learning
2. John W. Webb & Ronald A. Reis – Programmable Logic Controllers – Prentice Hall
3. S.K. Singh – Industrial Instrumentation and Control – McGraw Hill Education
4. D. Patranabis – Sensors and Transducers – PHI Learning Pvt. Ltd.
5. R.K. Rajput – Control Systems Engineering – S. Chand Publishing

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 2.10
Unit Test - II	From 3.1 to 4.8

ELECTRIC VEHICLE TECHNOLOGY

Course code	Course Title	No. Of periods/ week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE405E	ELECTRIC VEHICLE TECHNOLOGY	3	45	30	70	2

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
1.	Fundamentals of Electric Vehicles	07	17	3	1	CO1
2.	Types of Electric Vehicles	10	25	3	2	CO2
3.	Energy Storage Technologies in EVs	10	25	3	2	CO3
4	Basics of Propulsion Systems in EVs	18	33	3	3	CO4
	Total	45	100	12	8	

COURSE OBJECTIVES

Upon completion of the course the student shall be able
(i) To provide foundational knowledge of Electric Vehicles (EVs) by comparing them with Internal Combustion Engine Vehicles (ICEVs), and by introducing different types of EVs including BEV, HEV, PHEV, and FCEV.
(ii) To develop understanding of key EV components and systems, including energy storage technologies (like Li-ion batteries), charging systems, electric motor technologies and battery management systems (BMS).
(iii) To enable students to analyze and apply electric vehicle technologies, particularly in propulsion, braking (including regenerative braking) and their impacts on the environment, economy and the power grid.

COURSE OUTCOMES

CO1	EE405.1	Explain the working of IC engines, compare them with electric vehicles, and identify the components and advantages of EVs.

CO2	EE405.2	Classify various types of electric vehicles (BEV, HEV, PHEV, and FCEV) and compare their construction and working principles.
CO3	EE405.3	Describe battery types, charging methods, BMS components, and analyze energy storage technologies used in EVs.
CO4	EE405.4	Classify the different motor configurations used in Electric Vehicles and explain various electric braking methods and their integration in Electric Vehicles.

LEARNING OUTCOMES

1. Fundamentals of Electric Vehicles

1.1 Classify and identify the main components of an I.C. Engine.
1.2 Explain the working principle of a four-stroke engine with a suitable illustration.
1.3 Identify different pollutants produced by IC engine vehicles (ICEVs) and state their effects on human health.
1.4 Define an Electric Vehicle (EV) and explain the current need for electric vehicles.
1.5 List the advantages and disadvantages of electric vehicles.
1.6 Compare Electric Vehicles (EVs) with IC Engine vehicles in different aspects.
1.7 Explain the major components of an electric vehicle with a block diagram.

2. Types of Electric Vehicles

2.1 Classify electric vehicles according to their source of power (BEV, HEV, PHEV, and FCEV).
2.2 Explain the working principle of a Battery Electric Vehicle (BEV) with a neat block diagram.
2.3 Explain the working principle of a Hybrid Electric Vehicle (HEV) with a neat block diagram.
2.4 Classify hybrid vehicles based on their power train configurations.
2.5 Explain the working principle of a Plug-in Hybrid Electric Vehicle (PHEV) with a neat block diagram.
2.6 Explain the working principle of a Fuel Cell Electric Vehicle (FCEV) with a neat block diagram.
2.7 Compare the different types of Electric Vehicles (BEV, HEV, PHEV, FCEV) based on key characteristics.
2.8 Describe the impacts of EVs/HEVs on the power grid, environment and economy.

3. Energy Storage Technologies in EVs

3.1 Classify electrochemical cells as primary and secondary cells.
3.2 Define key terms related to batteries, including Battery Capacity, Specific Energy Density, State of Charge, Cycle Life, A-h efficiency, W-h efficiency
3.3 Solve simple problems on A-h efficiency and W-h efficiency of a battery.
3.4 List the main requirements for Electric Vehicle (EV) batteries.
3.5 List the advantages and disadvantages of alternative energy storage devices such as Ultracapacitors and Fuel Cells.
3.6 List the basic requirements for EV charging systems, focusing on safety, reliability and standardization.
3.7 State the principles of Constant Voltage, Constant Current and Trickle Charging methods.
3.8 State the principles of Inductive (Wireless) charging in Electric Vehicles.
3.9 Describe the Concept of V2G (Vehicle to Grid) Technology.

3.10 State the need for a Battery Management System (BMS) in electric vehicles.
3.11 Explain the major components and functions of a Battery Management System (BMS) using a block diagram.

4. Basics of Propulsion Systems in EVs

4.1 State the function of Electric motors in EV propulsion.
4.2 State the key requirements of traction motors for EV applications, including high torque, speed control and efficiency.
4.3 List the types of motors used in Electric Vehicles.
4.4 List the advantages of electric braking over conventional friction braking systems in Electric Vehicles.
4.5 List the different methods of electric braking.
4.6 Explain the Plugging, Rheostatic and Regenerative braking methods for DC Shunt motors.
4.7 Describe how regenerative braking contributes to the efficiency and range of Electric Vehicles.
4.8 Explain the Rolling resistance force, aerodynamic drag force, Grading resistance acting on the vehicle.
4.9 Derive the Maximum Tractive effort required for movement of vehicle
4.10 Solve simple numerical problems on tractive-effort required for a vehicle
4.11 Define Drive cycle and discuss its characteristics
4.12 Estimate (only formula) the battery power required for movement of vehicle
4.13 Estimate (only formula) the electric motor power required for movement of vehicle.
4.14 Solve simple problems on battery power and motor power required for the vehicle movement.

CO–PO/PSO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2			2		1	3	2	2
CO2	3	2	2		2		1	3	2	2
CO3	3	2		2	2		1	3	2	2
CO4	3	2	2	2	2		1	3	2	2
Average	3	2	2	2	2		1	3	2	2

Note: The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following: (i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

COURSE CONTENT

1. Fundamentals of Electric Vehicles

IC Engine Classification, Components - Illustrate the working of Four Stroke Engine - ICEV Pollutants - Health Effects - EV Definition - Current Need of EV - Electric Vehicle Advantages & Disadvantages - EVs vs ICEVs Vehicle Comparison - Electric Vehicle Block Diagram & Components.

2. Types of Electric Vehicles

EV Classification by Power Source (BEV, HEV, PHEV, FCEV) - Battery Electric Vehicle (BEV)

Working, Block Diagram - Hybrid Electric Vehicle (HEV) Working & Block Diagram - Classification of Hybrid Vehicle Power train Configurations - Plug-in Hybrid Electric Vehicle (PHEV) Working & Block Diagram - Fuel Cell Electric Vehicle (FCEV) Working & Block Diagram - Different EV Types Comparison (BEV, HEV, PHEV, FCEV) - EV/HEV Impacts on Power Grid, Environment, Economy.

3. Energy Storage Technologies in EVs

Electrochemical Cells, Primary and Secondary Classification - Battery Terminology Definitions (Battery Capacity, Specific Energy Density, State of Charge, Cycle Life, A-h efficiency, W-h efficiency) – Problems on A-h & W-h efficiency - EV Battery Main Requirements (Safety, Energy Density) - Advantages and Disadvantages of Ultracapacitor and Fuel Cells - EV Charging System Basic Requirements (Safety, Reliability, Standardization) - Battery Charging Methods (Constant Voltage, Constant Current, Trickle Charging - Principle of Inductive (Wireless) Charging - Vehicle to Grid Technology - Need of Battery Management System (BMS) - Major Components and Functions of BMS using Block diagram.

4. Basics of Propulsion Systems in EVs

Electric Motors function in EV Propulsion - Traction Motor Requirements (High Torque, Speed Control, Efficiency)- Types of motors used in EV - Classification of motor configurations used in Electric Vehicles - Electric Motors Braking Systems Overview - Electric Braking Advantages over Conventional Braking Systems- Methods of Electric Braking Methods: Plugging, Rheostatic, Regenerative Braking Methods for DC Shunt Motor – Regenerative Braking Contribution to EV Efficiency and Range - Rolling resistance force, aerodynamic drag force, grading resistance – Maximum tractive effort – Simple problems on tractive effort – Drive cycle – Battery power – Electric motor power – Simple problems on battery power and motor power.

REFERENCE BOOKS

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
2. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.tbook/References.
4. Sandeep Dhameja, “Electric Vehicle Battery Systems”, Newnes, 2001
5. Prof. Ahok Jhunjhunwala, IITM – Fundamentals of Electrical Vehicles (NPTEL VIDEOS)

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 4.14

INTERNET OF THINGS IN EEE

Course code	Course Title	No. Of periods/week	Total No. of periods/ Semester	FA Marks	SA Marks
26EE406A	Internet of Things in EEE	2	30	-	-

TIME SCHEDULE

S. No.	Chapter / Unit Title	No of Periods	COs Mapped
1	Introduction to IoT	6	CO1
2	IoT Hardware Components	6	CO2
3	Communication Protocols in IoT	6	CO3
4	Applications of IoT in Electrical Systems	6	CO4
5	Practical Exposure and Case Studies	6	CO5
	TOTAL	30	

COURSE OBJECTIVES

Upon completion of the course the student shall be able
(i) To introduce students to the fundamentals of IoT and its significance in electrical engineering.
(ii)To expose learners to sensors, actuators micro-controllers, and communication protocols used in IoT.
(iii) To explore real-time applications of IoT in energy management, smart grids, and automation.
(iv)To encourage basic hands-on skills using Cloud platforms like BlynkIoT, Firebase, Things Speak and Node-Red.

COURSE OUTCOMES

CO1	EE406.1	Describe the evolution of industrial revolutions and explain the role and architecture of IoT in Industry 4.0.
CO2	EE406.2	Identify various IoT hardware components such as sensors, actuators, and microcontrollers and explain their working and interfacing in electrical systems.
CO3	EE406.3	Explain and compare different IoT communication protocols (Bluetooth, Wi-Fi, Zigbee, LoRa, MQTT,

		Modbus) used in electrical applications.
CO4	EE406.4	Describe real-world applications of IoT in smart metering, smart grids, energy management, fault detection, and automation in electrical systems.
CO5	EE406.5	Demonstrate the implementation of IoT systems through practical exposure using sensors, ESP32, cloud platforms.

LEARNING OUTCOMES

Unit 1: Introduction to IoT
1.1 State the importance and relevance of IoT in industry 4.0.
1.2 Explain the architecture of an IoT system.
1.3 List and describe components of an IoT system (sensors, microcontrollers, actuators).
1.4 State the advantages and challenges of using IoT in electrical systems.

Unit 2: IoT Hardware Components
2.1 Identify types of sensors & actuators used in electrical applications.
2.2 State the role of sensors & actuators in IoT systems.
2.3 Explain microcontrollers, Arduino, NodeMCU, ESP32.
2.4 Explain sensor–controller interfacing with a legible block diagram.
2.5 State the role of embedded systems in IoT devices.

Unit 3: Communication Protocols in IoT
3.1 Explain the need for communication in IoT systems.
3.2 Describe Bluetooth and Wi-Fi communication technologies.
3.3 State Zigbee and LoRa protocols with use cases.
3.4 Define MQTT protocol and state its applications in data transmission.
3.5 Compare MQTT, Zigbee, LoRa and Modbus protocols used in electrical IoT systems.

Unit 4: Applications of IoT in Electrical Systems
4.1 Explain IoT applications in smart metering.
4.2 Describe the role of IoT in smart grid development.
4.3 State energy management systems using IoT.
4.4 Explain the use of IoT in electrical fault detection and predictive maintenance.
4.5 Explain the home automation using IoT.
4.6 List advantages of IoT integration in electrical automation.

Unit 5: Practical Exposure and Case Studies
5.1 Fire and Gas Leak Detection System for Substations using sensors, ESP32 & Cloud.
5.2 Smart Home Energy Automation System using sensors, ESP32 & Cloud.
5.3 Collect and visualize Dustbin data (garbage monitoring) on a dashboard using sensors, ESP32 & Cloud.
5.4 Real-Time Monitoring of Substation Equipment like (Transformer, Circuit Breaker, Battery, Busbar) using sensors, ESP32 & Cloud.
5.5 Present a group seminar/project on an IoT-based electrical application.

CO-PO/PSO MAPPING

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	1	3	2	-
CO2	3	2	2	-	-	-	-	3	3	-
CO3	3	2	-	-	-	-	-	3	3	-
CO4	3	3	2	-	1	-	1	3	3	-
CO5	3	3	3	-	1	-	1	3	3	-
Average	3	2.4	2.3	-	1	-	1	3	2.8	-

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note:
The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:
(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

COURSE CONTENT

1. **Introduction to IoT**

Brief history of Industrial revolutions – Importance and relevance of IoT in Industry 4.0 – Architecture of an IoT system – Components of IoT: Sensors, Microcontrollers, Actuators – Advantages and challenges of using IoT in electrical systems.

2. **IoT Hardware Components**

Types of sensors and actuators used in electrical applications – Role and functioning of sensors and actuators in IoT systems – Comparison of microcontrollers: Arduino, NodeMCU, ESP32 – Sensor to microcontroller interfacing with block diagram – Role of embedded systems in IoT.

3. **Communication Protocols in IoT**

Need for communication in IoT – Bluetooth and Wi-Fi technologies: working and use – Zigbee and LoRa protocols: comparison and applications – MQTT protocol: structure and

applications in data transmission – Comparison of MQTT, Zigbee, LoRa, and Modbus protocols in electrical systems.

4. Applications of IoT in Electrical Systems

IoT in smart metering systems – IoT for smart grid development – Energy management using IoT – Home automation using IoT- Predictive maintenance and fault detection using IoT – Advantages of IoT integration in electrical automation.

5. Practical Exposure and Case Studies

Fire and gas leak detection in substations using sensors and ESP32 with Cloud – Smart home energy automation using sensors, ESP32 and cloud services – Garbage monitoring system using dashboard visualization – Real-time monitoring of substation equipment: Transformer, Circuit Breaker, Battery, Busbar – Group seminar/project on IoT-based electrical application.

REFERENCES

1. Baharul Islam - Internet of Things - Cengage Learning
2. Arshdeep Bahga, Vijay Madisetti-Internet of Things:A Hands-On Approach – Universities Press
3. Rajan Sundaralingam - Introduction to Internet of Things - Wiley India
4. Pethuru Raj, Anupama C. Raman - The Internet of Things: Enabling Technologies, Platforms, and Use Cases - CRC Press
5. K. Shibu - Introduction to Embedded Systems - Tata McGraw-Hill

ELECTRICAL MACHINES – II LABORATORY

Course code	Course Title	No. Of periods/week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE407L	ELECTRICAL MACHINES – II LABORATORY	6	90	40	60	1.5

TIME SCHEDULE

S.No	Chapter / Unit Title	No. of Periods	COS Mapped
1	Testing of 3-phase Induction Motors	42	**CO1**
2	Testing of 1-Phase induction Motors	30	**CO2**
3	Testing of Alternators and Synchronous Motors	18	**CO3**
Total Periods		90	

COURSE OBJECTIVES

Upon completion of the course the student shall be able
(i) To conduct tests and estimate the parameters of three phase induction motors and predict the performance (ii)To operate fractional horse power Motors and analyse their performance (iii)To conduct tests and interpret the performance of three phase Alternators and Synchronous motors

COURSE OUTCOMES

CO1	EE407.1	Demonstrate the skill of planning and organising experimental setup for three phase Induction Motors and observe various parameters, their variations, sketch them graphically.
CO2	EE407.2	Analyse the experimental results from the load test data of 1 phase induction motors and special motors to calculate the machine parameters
CO3	EE407.3	Conduct of various tests on Alternators and Synchronous Motors to know their performance

LEARNING OUTCOMES

1. **Testing of 3-phase Induction Motors**

1. Identify the terminals of 3-phase Squirrel cage, Slip ring Induction Motors and its starters.

2. Measure insulation resistance of the 3-phase induction motor.
3. Make DOL starter and run the Three phase Induction Motor.
4. Make Star-Delta starter and run the Three phase Induction Motor.
5. Conduct brake test on 3-phase squirrel cage induction motor (use star delta starter).
6. Conduct Brake test on 3-phase slip ring induction motor (Use Rotor resistance starter).
7. Identify and rectify faults in Induction Motors and A.C. Starters.
8. Analyse speed control of 3- Phase induction motor with Variable Voltage &Variable Frequency (VVVF) control technology and understand running and reversing of Motor.
9. Practice winding for a 3-phase Induction motor.

2. **Testing of 1-phase induction Motors**

1. Perform Load test on single phase capacitor start motor.
2. Obtain Speed-Torque characteristics of AC Servo motor by conducting suitable test.
3. Obtain operating characteristics of Stepper Motor and its control.
4. Perform Load test on a single-phase Universal motor.
5. Practice Winding of single-phase Induction motor and ceiling fan.

3. **Testing of Alternators and Synchronous Motors**

1. Conduct (direct) load test on Alternator and obtain voltage regulation.
2. Synchronisation of Alternator by using two bright one dark lamp method and Synchroscope method.
3. Conduct load test on synchronous motor and draw 'V' and inverted 'V' curves.

Competencies & Key competencies to be achieved by the student

S.No	Experiment Title	Competencies	Key competency
1	Identify the terminals of 3-phase Squirrel cage, Slip ring Induction Motors and its starters.	▪ Identify and distinguish between squirrel cage and slip ring induction motors. ▪ Recognize and label terminal markings (U1, V1, W1, U2, V2, W2) accurately. ▪ Understand the function and connection of rotor terminals in slip ring motors. ▪ Interpret terminal diagrams and motor nameplates correctly. ▪ Identify and explain the working of DOL, Star-Delta, and Rotor Resistance starters. ▪ Ensure correct terminal identification using a multi meter and follow safety protocols.	▪ Identify and label terminals of squirrel cage and slip ring induction motors using diagrams and testing tools. ▪ Recognize and connect appropriate starters (DOL, Star-Delta, Rotor Resistance) following safety procedures.
	Measure	▪ Read and observe the circuit diagram. ▪ Understand the purpose and principle of DOL starter in controlling 3-phase induction motors. ▪ Identify and explain the functions of	▪ Safely prepare and connect the motor for insulation resistance

2	insulation resistance of the 3-phase induction motor	components: MCB, contactor, overload relay, start/stop push buttons, wiring connections. ▪ Recognize the advantages, limitations, and applications of DOL starters in industry. ▪ Make the connections as per the circuit diagram. ▪ Measure the insulation resistance between the terminals. ▪ Note down the readings ▪ Measure the insulation resistance between earth and each terminal. ▪ Note down the readings.	testing. ▪ Accurately measure insulation resistance (Phase–Phase, Phase–Earth) using Megger. ▪ Record and interpret readings as per standards.
3	Make DOL starter and run the Three phase Induction Motor.	▪ Read and interpret the power and control diagram. ▪ Mount all the components of the starter on the work station board with the help of den drill. ▪ Make the connections as per the circuit diagram. ▪ Set the current rating in the over load relay according to motor rating. ▪ Switch on the supply. ▪ Start the motor by using the start push button of the starter. ▪ Test and verify correct functioning of contactor, relay, and motor operation. ▪ Take the voltage reading by using multi meter and current readings by using the clamp meter. ▪ Measure the speed of the motor by using the tachometer. ▪ Switch off the motor by using stop push button. ▪ Switch off the MCB and remove connections.	• Assemble and wire the DOL starter circuit correctly. • Operate the starter to run and stop the 3-phase induction motor. • Verify and troubleshoot the circuit for correct performance.
4	Make Star-Delta starter and run the Three phase Induction Motor	▪ Read and interpret the power and control diagram. ▪ Mount all the components of the starter on the work station board with the help of den drill. ▪ Make the connections as per the circuit diagram. ▪ Set the current rating in the over load relay according to motor rating. ▪ Switch on the supply. ▪ Start the motor by using the start push button of the starter. ▪ Test and verify correct functioning of contactor, relay, and motor operation. ▪ Take the voltage reading by using multi	▪ Assemble and wire the star delta starter circuit correctly. ▪ Operate the starter to run and stop the 3-phase induction motor. ▪ Verify and troubleshoot the circuit for correct performance

		meter and current readings by using the clamp meter. ▪ Measure the speed of the motor by using the tachometer. ▪ Switch off the motor by using stop push button. ▪ Switch off the MCB and remove connections	
5	Brake test on 3-phase squirrel cage induction motor.	▪ Draw the circuit diagram ▪ Identify the different terminals of 3-ph induction motor ▪ Select the suitable starter. ▪ Identify the terminals of the starter. ▪ Select the range and type of the meters ▪ Make the connections as per the circuit diagram ▪ Start the motor using a starter Apply the load up to full load insteps ▪ Pour water in the brake drum ▪ Note down the readings of ammeter and voltmeter for each load. ▪ Calculate the output, torque and efficiency etc ▪ Plot the performance characteristics ▪ Verify the performance of the machine.	▪ Apply the load up to full load in steps ▪ Pour water in the brake drum ▪ Before Switching off the motor remove the load
6	Brake test on 3-phase slip ring induction motor.	▪ Draw the circuit diagram ▪ Interpret the name plate details ▪ Identify the different terminals of the 3-ph induction motor ▪ Select the suitable starter. ▪ Identify the terminals of the starter. ▪ Select the range and type of the meters ▪ Make the connections as per the circuit diagram ▪ Start the motor using a starter	▪ Before giving supply, slip rings must be short circuited ▪ Speed should be measured accurately
7	Identify and rectify faults in Induction Motors and A.C. Starters	▪ Detect common faults in induction motors such as winding failures, bearing issues, or overheating. ▪ Identify starter-related faults like contactor failure, overload relay trips, or wiring issues. ▪ Use diagnostic tools like multi meters, meggers, and continuity testers effectively. ▪ Interpret motor and starter wiring diagrams for troubleshooting. ▪ Perform safe disassembly, inspection, and repair of motor components. ▪ Follow standard troubleshooting procedures and safety protocols throughout the process.	▪ Diagnose and identify faults in induction motors and A.C. starters using testing instruments and circuit diagrams. ▪ Apply troubleshooting techniques to rectify issues while ensuring safety and proper system functionality.

8	Analyse speed control of 3- Phase induction motor with Variable Voltage &Variable Frequency (VVVF) control technology and understand running and reversing of Motor.	▪ Understand the principle of VVVF control to adjust motor speed by varying supply voltage and frequency simultaneously. ▪ Analyse the relationship between motor speed, supply frequency, and slip for precise speed regulation. ▪ Explain how VVVF drives maintain the V/f ratio to ensure efficient motor torque and prevent overheating. ▪ Demonstrate knowledge of motor starting, running, and dynamic speed control using VVVF in different load conditions. ▪ Understand the electrical and mechanical methods to reverse the motor direction through phase sequence or VVVF control. ▪ Evaluate the benefits of VVVF control in energy efficiency, reduced mechanical stress, and smooth acceleration/deceleration.	▪ Understand the principles of Variable Voltage Variable Frequency (VVVF) control for adjusting motor speed and direction. ▪ Configure and operate VFDs to control motor start, stop, speed variation, and reverse rotation safely and accurately.
9	Practice winding of a three-phase induction motor	▪ Understand the construction and working principle of a three-phase induction motor. ▪ Interpret winding diagrams and calculate winding data (slots/pole/phase, coil span). ▪ Select appropriate wire gauge, insulation materials, and tools for winding. ▪ Wind coils uniformly and insert them correctly into stator slots ▪ Connect windings in star or delta configuration as per motor requirements. ▪ Perform insulation and continuity tests using a multi meter or megger ▪ Apply varnish and bake the stator to ensure insulation integrity. ▪ Follow standard electrical safety procedures and wear PPE. ▪ Maintain accurate documentation of winding data and test results. ▪ Troubleshoot and rectify common winding faults efficiently. ▪ Let me know if you need these aligned with	▪ Understand motor construction, interpret winding diagrams, and perform accurate coil winding with correct connections ▪ Apply safety practices, test insulation, document data, and troubleshoot faults to ensure reliable motor performance.

		a curriculum or train.	
10	Load test on Capacitor-start induction motor	▪ Draw the circuit diagram ▪ Identify the different terminals of the 1-ph split phase induction motor /1-ph capacitor type induction motor and the starter ▪ Select the ranges and type of the meters ▪ Make the connections as per circuit diagram ▪ Start the motor using a starter ▪ Apply the load in steps ▪ Record the meter readings ▪ Verify the performance of the machine.	▪ Start the motor using a starter without load ▪ Apply the load up to full load in steps
11	Obtain Speed-Torque characteristics of AC Servo motor by conducting suitable test	▪ Understand the setup and instrumentation required for conducting speed-torque tests on an AC servo motor. ▪ Perform controlled tests by varying load and speed to record torque and corresponding speed values accurately. ▪ Analyse test data to plot the speed-torque characteristic curve of the AC servo motor. ▪ Interpret the relationship between speed, torque, and motor performance parameters for different operating conditions. ▪ Apply test results to optimize motor control and ensure precise positioning and speed regulation in applications.	▪ Understand and conduct speed-torque tests on AC servo motors to accurately record and analyse performance data. ▪ Interpret the speed-torque characteristics to optimize motor control for precise operation.
12	Obtain operating characteristics of Stepper Motor and its control	▪ Understand the construction and working principle of stepper motors. ▪ Set up experiments to measure operating characteristics like step angle, torque, and speed. ▪ Analyse the effect of input pulse frequency on motor speed and position accuracy. ▪ Evaluate torque-speed characteristics under different load conditions. ▪ Demonstrate knowledge of common control methods, including open-loop and closed-loop control. ▪ Apply control techniques to achieve precise positioning and speed regulation in stepper motor applications.	▪ Understand and test stepper motor operating characteristics like step angle, torque, and speed under varying inputs. ▪ Analyse results and apply control methods for accurate positioning and speed regulation.

13	Load test on single-phase Universal motor.	▪ Draw the circuit diagram ▪ Identify the different terminals of the 1-ph universal motor ▪ Select the range and type of the meters ▪ Make the connections as per the circuit diagram ▪ Start the motor using a starter ▪ Apply the brake load lightly ▪ Verify the performance of the machine	▪ Apply the brake load lightly ▪ Take the readings properly
14	Practice Winding of single-phase Induction motor and ceiling fan	▪ Understand the basic construction and winding types of single-phase induction motors and ceiling fans. ▪ Identify the materials, tools, and safety precautions required for winding practice. ▪ Demonstrate the correct procedure for coil winding, including turns count and wire specification. ▪ Perform connections for main and auxiliary windings as per motor design. ▪ Test and verify winding continuity, insulation resistance, and polarity. ▪ Troubleshoot common winding faults and ensure proper assembly for reliable motor operation.	▪ Understand and perform coil winding, connections, and testing for single-phase induction motors and ceiling fans. ▪ Ensure proper techniques, safety, and troubleshooting for reliable motor operation.
15	Conduct (direct) load test on Alternator and Obtain the regulation	▪ Draw the circuit diagram ▪ Identify different terminals of the 3-ph alternator ▪ Select the range and type of the meters ▪ Make the connections as per the circuit ▪ Start the alternator as per the procedure ▪ Increase the load and take the readings ▪ Reduce the load to zero gradually. ▪ Switch off the alternator. ▪ Disconnect the circuit. ▪ Plot the performance characteristics.	▪ Switch on the excitation at correct time ▪ Apply the brake load lightly Take the readings properly

16	Synchronisation of Alternator by using two bright one dark lamp method and Synchro scope method	▪ Understand the principles of alternator synchronization and importance of matching voltage, frequency, and phase. ▪ Set up and connect the alternator with the bus bar and synchronization panel safely. ▪ Apply the two bright one dark lamp method to visually detect phase matching for synchronization. ▪ Use the synchroscope to accurately determine the phase difference and speed difference between alternator and supply. ▪ Demonstrate the procedure to close the alternator breaker at the correct moment for successful synchronization. ▪ Troubleshoot synchronization issues and ensure stable parallel operation of the alternator with the grid.	▪ Understand and apply the two bright one dark lamp and synchroscope methods to synchronize an alternator by matching voltage, frequency, and phase. ▪ Demonstrate safe connection, accurate phase detection, and proper breaker closing for stable parallel operation
17	Conduct load test on synchronous motor and draw V and inverted V curves	▪ Draw the circuit diagram ▪ Identify different terminals of the 3-phase synchronous motor ▪ Select the range and type of the meters ▪ Make the connections as per the circuit ▪ Start the motor as per the procedure ▪ Switch on the excitation at correct time ▪ Vary the excitation insteps ▪ Pour water in the brake drum for cooling. ▪ Reduce the load to zero gradually. ▪ Switch off the motor. ▪ Disconnect the circuit. ▪ Calculate the output, torque, efficiency etc. ▪ Plot the performance characteristics. ▪ First switch off the excitation and then only switch off the mains ▪ Draw the V and inverted V curves on a single graph sheet	▪ Switch on the excitation at correct time ▪ Vary the excitation insteps ▪ First switch off the excitation and then only switch ▪ off mains

CO-PO/PSO MAPPING

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

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note:
The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:
(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

COURSE CONTENT

1. Testing of 3-phase Induction Motors

Brake test on three phase squirrel cage induction motor and slip ring induction motor, calculate the efficiency and plot the torque slip characteristics**.** No-load test and blocked rotor test on squirrel cage and slip ring induction motor, calculate output power, Torque, Efficiency, calculate the machine parameters, Draw the circle diagram, estimate the performance and verify the performance.

2. Testing of 1-phase induction motors

Load test on –, single phase capacitor-start induction motor-servo motor -stepper motor-universal motor -calculate output power, Torque, Efficiency, calculate the machine parameters

3. Testing of Alternators and Synchronous Motors

Load test on Alternator – obtain the regulation of alternator -synchronization of alternators by two bright lamp and one dark and synchro scope method – Draw the v curves and inverted v curves

REFERENCES

1. Nagrath & Kothari. “Electric Machines”, McGraw Hill, 2022.
2. Bhimbra, P.S. “Electrical Machinery”, Khanna Publishers, 2021.
3. Fitzgerald, A.E. “Electric Machinery”, McGraw Hill, 7th Ed., 2014.
4. Online Resources
    i) NPTEL – Electrical Machines II (IIT Roorkee)

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 2.1
Unit Test – II	From 2.2 to 3.3

COMMUNICATION AND EMPLOYABILITY SKILLS
(PRACTICUM -PRACTICAL)

Course code	Course Title	No. Of periods /week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE408L	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

Upon completion of the course the student shall be able	
(i)	To impart verbal and non-verbal communication skills
(ii)	To foster employability skills among the students for career building

COURSE OUTCOMES

CO1	EE408.1	Practise appropriate body language and etiquette
CO2	EE408.2	Listen and comprehend the listening inputs related to different genres effectively
CO3	EE408.3	Interpret data and give oral and written presentations in academic and professional contexts
CO4	EE408.4	Communicate effectively in interpersonal interactions, interviews, and group discussions
CO5	EE408.5	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 MAPPING

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			

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in CO and PO mapping will be met by one or more appropriate activities from the following:

(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (iv) Library Visits etc.,

COURSE CONTENT

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

REFERENCES

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 TEST I & II

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

DIGITAL ELECTRONICS AND MICROCONTROLLERS LABORATORY

Course code	Course Title	No. Of periods /week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE409L	DIGITAL ELECTRONICS AND MICROCONTROLLERS LABORATORY	3	45	40	60	1

TIME SCHEDULE

S. No	Chapter/ Unit Title	No. of periods	COs Mapped
1.	Logic Gates	6	CO1
2.	Combinational Logic Circuits	9	CO2
3.	Sequential Logic Circuits	12	CO3
4	Basics of Microcontrollers	6	CO4
5	Programming on Microcontrollers	12	CO5
	TOTAL	**45**	

COURSE OBJECTIVES

Upon completion of the course the student shall be able
(i) To understand number representation and conversion between different representation in digital electronic circuits.
(ii)To analyse logic processes and implement logical operations using combinational logic circuits.
(iii) To know the importance of different peripheral devices and their interfacing to microcontrollers.
(iv) To know the design aspects of microcontrollers and to write assembly language programs of microcontrollers for various applications.

COURSE OUTCOMES

CO1	EE409.1	Understand theory of Boolean Algebra & the under lying features of various number systems.
CO2	EE409.2	Apply the concepts of Boolean Algebra for the analysis & design of various combinational & sequential logic circuits.
CO3	EE409.3	Analyse the sequential logic circuits design both in synchronous and asynchronous modes for various complex logic and switching devices.

CO4	EE409.4	Interpret various peripheral devices to the microcontrollers.
CO5	EE409.5	Write assembly language program for microcontroller and Design microcontroller-based system for various applications.

LEARNING OUTCOMES

1. Logic Gates

1.1 Verify the truth tables of basic gates and universal gates.
1.2 Show NAND gate and NOR gate as Universal gates.

2. Combinational Logic Circuits

2.1 Construct half adder and full adder and verify the truth tables.
2.2 Verify the function of 74138 decoder IC.
2.3 Verify the working of Multiplexer (Using IC 74153)
2.4 Verify the functional table of 4-bit magnitude comparator 7485 IC.

3. Sequential Logic Circuits

3.1 Construct and verify the truth tables of NAND & NOR latches.
3.2 Construct clocked RS FF using NAND gates and Verify its truth table.
3.3 Verify the truth table of JK FF using 7476 IC.
3.4 Construct D and T flip flops using 7476 and verify the truth tables.

4. Basics of Microcontrollers

4.1 Familiarization of 8051 Microcontroller Kit.
4.2 Familiarization of 8051 simulator EDSIM 51 (or similar).

5. Programming on Microcontrollers

5.1 Write a program to demonstrate different register addressing techniques on 8051.
5.2 Write a program to demonstrate Addition, subtraction, division and multiplication of 8 bit numbers using immediate data access on 8051.
5.3 Write a program to Add and Subtract 16- bit numbers on 8051.
5.4 Interfacing of 7-segment display with 8051 microcontroller.

CO-POS MAPPING

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

COURSE CONTENT

1. Logic Gate

Verify the truth tables of basic gates and universal gates - Show NAND gate and NOR gate as Universal gates.

2. Combinational Logic Circuits

Construct half adder and full adder and verify the truth tables - Verify the function of 74138 decoder IC - Verify the working of Multiplexer (Using IC 74153)

3. Sequential Logic Circuits

Construct and verify the truth tables of NAND & NOR latches - Construct clocked RS FF using NAND gates and Verify its truth table - Verify the truth table of JK FF using 7476 IC - Construct D and T flip flops using 7476 and verify the truth tables.

4. Basics of Microcontrollers

Familiarization of 8051 Microcontroller Kit - Familiarization of 8051 simulator EDSIM 51 (or) similar

5. Programming on Microcontrollers

Write small ALP to demonstrate different register addressing techniques - Write an ALP to demonstrate Addition, subtraction, division and multiplication of 8-bit numbers using immediate data access - Write an ALP to Add and Subtract 16-bit numbers – Interface Programming

Competencies & Key competencies to be achieved by the student

Sl.No.	Experiment Title	Competencies	Key Competencies
1	Logic Gates	• Understand the connection patterns in bread board • Identifying and constructing circuits using the basic logic gates (NOT, OR, AND, NOR, NAND) and their truth tables. • Identifying and constructing circuits using the compound logic gates (EXOR, EXNOR) and their truth tables.	• Connection of devices with exact ratings as per circuit diagram in bread board • Ability to verify truth table
2	Combinational Logic Circuits	• Applying fundamental theorems, associative laws, distributive laws, commutative laws, and De Morgan's theorems to solve problems. • Applying Boolean principles to perform logic circuit evaluation by using truth tables, simplification by fundamental theorems, and simplification by the Karnaugh map technique. • Minimizing logic circuits into sum of products (SOP) and product of sums (POS) form. • Identifying types of encoding, decoding, multiplexer and de-multiplexer devices and describing their functions and uses.	• Ability to verify truth table • Ability to build half adder and full adder and verify the truth tables
	Sequential Logic Circuits	• Ability to detect and respond to clock signals	• Ability to detect and respond to changes

3		• Connection of circuit diagram on kit with proper input sources • Using CRO to observe frequency response waveform patterns	in input signals • Ability to generate output signals based on input signals • Ability to detect and respond to enable signals
4	Basics of Microcontrollers	• Knowledge of microcontroller architecture and its components • Ability to write and debug assembly language programs • Knowledge of communication protocols	• Ability to write and debug assembly language programs
5	Programming on Microcontrollers	• Understanding of the microcontroller's instruction set • Knowledge of embedded system design principles • Ability to interface with external devices	• Ability to write and debug C and assembly language programs • Ability to interface with external devices

REFERENCES

1. R.P. Jain. "Modern Digital Electronics", McGraw Hill, 4th Ed., 2020.
2. Mazidi, Mazidi & McKinlay. "8051 Microcontroller and Embedded Systems", Pearson, 3rd Ed., 2021.
3. Mano, M. Morris. "Digital Logic Design", Pearson, 5th Ed., 2018.
4. Online Resources
    i) NPTEL – Digital Circuits (IIT Kharagpur)
    ii) NPTEL – Microcontrollers (IIT Madras)

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 5.4

CAD AND SIMULATION LABORATORY
(PRACTICUM -PRACTICAL)

Course code	Course Title	No. Of periods/week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE410L	CAD AND SIMULATION LABORATORY	03	45	40	60	1

TIME SCHEDULE

S. No	Chapter / Unit Title	No. of periods	CO's Mapped
1.	Exercise on various Commands	09	CO1
2.	Exercise on drawing isometric drawings in 2D and introduction to 3D	06	CO1
3.	Exercise on drawing of electrical equipment	09	CO2
4.	Exercise on PSpice Environment and simulation of circuits	09	CO3
5	Exercise with MATLAB software and simulation of basic circuits	12	CO4
	Total	**45**	

COURSE OBJECTIVES

Upon completion of the course the student shall be able
(i) This comprehensive course aims to equip diploma students with foundational practical skills in using CAD software for electrical drafting, PSpice for circuit simulation and analysis, and an introduction to MATLAB for electrical engineering applications. (ii) Students will learn to create, analyze, and visualize electrical designs and concepts using industry-relevant software tools.

COURSE OUTCOMES

CO1	EE4101	Apply fundamental CAD software tools for creating and modifying electrical engineering drawings and schematics.
CO2	EE410.2	Design and represent electrical wiring diagrams, infrastructure layouts, and isometric views using CAD software, adhering to basic electrical standards.
CO3	EE410.3	Simulate and analyse the behaviour of DC and AC electrical circuits using PSpice software.

CO4	EE410.4	Perform basic mathematical operations and simulate fundamental electrical circuits using MATLAB and Simulink.

LEARNING OUTCOMES

1. Exercise on various Commands

Theory:

1. Define AutoCAD and explain the different types of commands used for creating and editing drawings.
2. What is the User Coordinate System (UCS)? Explain how UCS is used in drawing and how layouts can be increased or decreased.
3. Explain the role of the command bar, cursor inputs, tool names, and the crosshair in locating and creating objects in AutoCAD.
4. Describe the basic file operations in AutoCAD such as creating a new file, opening, saving, closing a file, and invoking commands.
5. Explain the functions and steps of commonly used commands such as DELETE, COPY, PASTE, ZOOM, LINE, MLINE, and POLYLINE.

Practical:

1. Draw basic shapes such as a circle, polygon, helix, spline, and ellipse, and fill rectangular, triangular, and quadrilateral areas with solid colour.
2. Use editing commands like TRIM, STRETCH, BREAK, JOIN, FILLET, CHAMFER, MIRROR, ARRAY, HATCH, and EXPLODE to modify the objects in your drawing.
3. Insert blocks using the INSERT command, attach a raster image, use REDRAW, and manage layers by changing visibility, properties, locking, and unlocking.
4. Add text with different font sizes and styles, and apply dimensions such as linear, aligned, angular, radius/diameter, arc length, coordinate, baseline, and centremark using the QDIM tool.
5. Draw the orthographic (front, top, side) and isometric views of a simple object, and apply SHADE and HIDE commands for better visualization.

2. Exercise on drawing isometric drawings in 2D and introduction to 3D

Theory:

1. Explain how SW and NE isometric views are visualized in AutoCAD and how Isometric SNAP and GRID settings help in creating isometric drawings.

Practical:

1. Use set snap spacing, Change the default axis colours, size of the crosshair display by using Cross hair tab.
2. Create an isometric circle on the current isometric plane using Ellipse Iso circle

3. Exercise on drawing of Electrical equipment

Practical:

1. Drawing of electrical wiring circuit of one lamp controlled by one switch
2. Drawing of electrical wiring circuit of stair case wiring
3. Drawing of pipe earthing with dimensions
4. Drawing of Pole mounted substation.

4. Exercise on PSpice Environment and simulation of circuits

Theory:

1. Explain the PSpice environment and its main components such as OrCAD Capture CIS, Schematics, and PSpice A/D.
2. Describe the basic workflow in PSpice, including schematic capture, simulation setup, and viewing waveform results.
3. Write about the graphical interface of PSpice, including menus, toolbars, and the project manager window.
4. How are components placed and connected in a PSpice schematic? Explain using resistors, capacitors, inductors, and sources as examples.
5. Explain how to edit component properties, save/open PSpice projects, and use zoom and pan controls in the schematic editor.

Practical:

1. Simulate simple DC series and parallel circuits, voltage dividers, current dividers.
2. Simulate simple RC, RL, and RLC series circuits under AC excitation
3. Simulate and analyze half-wave and full-wave rectifiers with and without filters.

5. Exercise with MATLAB software and simulation of basic circuits

Theory:

1. Explain the purpose of the MATLAB command window and describe how simple mathematical calculations are performed in it.
2. What is Simscape/SIM Power Systems in MATLAB–Simulink? Describe its use in modeling and simulating electrical and physical systems.

Practical:

1. Use different blocks from the Simscape/SIM Power Systems library and build a basic electrical circuit to observe the behavior of its components.
2. Construct a simple DC circuit in Simulink and verify Thevenin's Theorem by finding the Thevenin equivalent voltage and resistance through simulation.
3. Simulate a single-phase full-wave converter circuit using R and RL loads in Simulink and observe the output voltage and current waveforms.

CO-PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3

CO.1	2	2	3	3	1	1	2	3	1	1
CO.2	2	2	3	3	2	1	2	3	1	2
CO.3	3	3	2	3	1	1	2	1	3	2
CO.4	3	2	2	3	1	1	2	1	3	2
Average	2.5	2.25	2.5	3	1.25	1	2	2	2	1.75

COURSE CONTENT

1. Exercise on various Commands

Study components in menu bar-Customise and arrange tool bar-Display the drawing created in the working area-user coordinate system (UCS)-Increase or decrease layouts-Give the inputs in the command bar-Display name and purpose of the tools-Study cross hair to locate the cursor-Invoke the commands-Getting started with AutoCAD-Create a new file-Open a file-Save a file-Close a file- Delete the object or text -Copy the object or text-Paste entities-Zoom an object.

Use LINE command-MLINE command-POLYLINE command-Draw a circle using CIRCLE command-with centre point and radius-POLYGON command-HELIX command-Draw a rectangular-Triangular and quadrilateral areas filled with a solid-colour with the help of plane tool-Understand SPLINE command-ELLIPSE command- DIV command-Understand INSERT command-HATCH command- MIRROR command-ARRAY command-Understand STRETCH command-TRIM command-BREAK command-JOINT command-Understand FILLET command-CHAMFER command-EXPLODE command- GROUP command.

QDIM command-Practice LINEAR-ALIGNED and COORDINATE dimensions-RADIUS or DIAMETER commands-ANGULUR dimension command-ARC LENGTH command-BASELINE command- CENTREMARK command-LAYER command-Control the visibility of objects and assigned properties to objects-Practice the locking, unlocking of layers-Write a text to drawing-change font size and style- Create a standard naming convention to a text styles-table styles-layer styles-dimension styles etc.

Insert blocks into current drawing file using INSERT command-Understand ATTACH RASTER IMAGE command-REDRAW command-Draw the orthographic views (side view-top view-front view) of any object-Draw the isometric views of any object-SHADE command-HIDE command.

2. Exercise on drawing isometric drawings in 2D and introduction to 3D

Visualise the isometric view SW-NE isometric views-Isometric SNAP and GRID-Use set snap spacing- Change the default axis colours-size of the crosshair display by using crosshair tab-Create an isometric circle on the current isometric plane using Ellipse Isocircle.

3. Exercise on drawing of Electrical equipment.

Drawing of electrical wiring circuit of one lamp controlled by one switch – stair case wring - Drawing of pipe earthing - Drawing of Pole mounted substation.

4. Exercise on PSpice Environment and simulation of circuits

Navigating the PSpice graphical interface (menus, toolbars, project manager)-Placing components from libraries (resistors, capacitors, inductors, independent voltage/current sources)-Wiring components, creating connections-Editing component properties (values, tolerance)-Saving and opening PSpice projects-Zooming, panning, and navigating in the schematic editor-Simulate simple DC series and parallel circuits, voltage dividers, current dividers- Simulate simple RC, RL, and RLC series/parallel circuits under AC excitation - Simulate and analyze half-wave and full-wave rectifiers with and without filter capacitors.

5. Exercise MATLAB software and simulation of basic circuits

Introduction to command window - perform simple math calculations (addition, multiplication, matrix formation) – Procedure to save MATLAB files - Simscape/SIM Power systems – Introduction – Familiarization with different blocks available in Simscape/SIM Power systems-Simulation of DC Circuits-Verification of Thevenin's and Norton's Theorem in a simple DC Circuit using SIMULINK- Single phase full wave converter circuit with R and RL Load using SIMULINK.

REFERENCES

1. Get started with AutoCAD Electrical (Vol.1 and 2)– James Richardson-Musselburgh Press Publishers.
2. AutoCAD Electrical 2022 Black Book 7th edition–Gaurav Verma, Matt Weber – Cadcamcae Works Publishers.
3. PSspice for Basic Circuit Simulation – Muhammad H. Rashid.
4. MATLAB & Simulink for Engineers – Holly Moore.

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 4.1 to 5.3

V SEMESTER

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
FIFTH SEMESTER

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										
26EE501T	Electrical Utilization & Traction	6	--	N	90	4	3	30	70	100
26EE502T	Power Systems - II	6	--	N	90	4	3	30	70	100
26EE503T	Power Electronics	6	--	N	90	4	3	30	70	100
ELECTIVE COURSES										
26EE504E	Basics of Artificial Intelligence	3	--	N	45	2	3	30	70	100
26EE505E	Industrial Management & Smart Technologies	3	--	N	45	2	3	30	70	100
AUDIT COURSE										
26EE506A	Smart Grid Technology	2	--	N	30	--	--	--	--	--
PRACTICAL COURSE										
26EE507L	Power Electronics Laboratory	--	3	N	45	1.5	3	40	60	100
26EE508L	PLC & SCADA Laboratory	--	3	Y	45	1	3	40	60	100
26EE509L	IOT Laboratory	--	6	N	90	1.5	3	40	60	100
26EE510P	Project Work	--	4	N	60	1.5	3	40	60	100
26EE511C	Student Centric Activities	--	3	N	45	0.5	--	--	--	--
TOTAL		**23**	**19**		**630**	**20**	--	**280**	**520**	**800**

Note: 0.5 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

ELECTRICAL UTILIZATION AND TRACTION

Course code	Course Title	No. Of periods/week	Total No. of periods/Semester	FA Marks	SA Marks	Credits
26EE501T	ELECTRICAL UTILIZATION AND TRACTION	6	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
1	Electric Lighting	17	25	3	2	CO1
2	Electric Heating	14	14	2	1	CO2
3	Electrical Energy saving devices	12	11	1	1	CO3
4	Electric Drives	15	14	2	1	CO4
5	Electric Traction	32	36	4	3	CO5
	Total	90	100	12	8	

COURSE OBJECTIVES

Upon completion of the course the student shall be able
(i) Understand about terminology regarding illumination, understand about various lamps, designing of simple lighting schemes.
(ii) Understand about different Electric Heating Methods, identifying a heating scheme for a given application.
(iii) Understand different schemes of traction, its main equipment

COURSE OUTCOMES

CO1	EE501.1	Design lighting schemes for a given application
CO2	EE501.2	Ability to identify the type of Electric heating suitable for any specific application
CO3	EE501.3	Ability to draw Automatic Temperature and Illumination control circuits.
CO4	EE501.4	Understand the different electrical drives used for different applications and methods of electric braking
CO5	EE501.5	Understand the basic principle of electric traction including speed – time curves of different traction services and traction equipment - Analyze the operation of traction supply systems and train lighting systems

LEARNING OBJECTIVES

1. Electric Lighting

1.1. Define the following terms related to electric lighting.
a) Plane and solid angles b) luminous flux c) Luminous intensity
d) Lumen Illumination e) Candle power f) MHCP
g) MSCP h) MHSCP i) Glare

1.2. Explain the production of light by
a) Excitation b) Ionisation c) Fluorescence and d) Phosphorescence

1.3. List the types of lamps used for illumination at different situations such as
a) Domestic b) Industrial c) Decoration d) Advertisements e) Street lighting schemes

1.4. State the requirements of good lighting

1.5. List the lamp fittings (based on distribution of light) used in domestic and industrial applications

1.6. State and explain the laws of Illumination

1.7. Solve problems on Illumination

1.8. Define the following terms a) Utilisation factor b) Depreciation factor c) Luminous efficiency D) Space height ratio

1.9. Design a simple lighting scheme for drawing hall

2. Electric Heating

2.1. State the advantages of electric heating

2.2. List the requirements of good heating material and state the materials employed for heating

2.3. Explain the following with legible sketch and state its industrial applications
a) Direct resistance heating b) Indirect resistance heating

2.4. Explain the following with legible sketch and state its industrial applications
a) Direct arc furnace b) Indirect arc furnace

2.5. Explain the following with legible sketch and state its industrial applications
a) Core type Induction furnace b) Coreless type Induction furnace

2.6. State the principle of dielectric heating and list the industrial applications of the dielectric heating

3. Electrical Energy saving Devices

3.1 State the need of power saving devices

3.2 Draw Automatic temperature control circuits for coolers, geysers, air conditioners and iron boxes

3.3 Draw Automatic illumination control circuits using LDR's

3.4 List the advantages of Compact Fluorescent Lamps (CFL)

3.5 Explain the operating principle of Light Emitting Diode (LED)

3.6 Explain about the necessity of driver circuit in LED light

3.7 List the advantages of LED lamps over other types of lamps

4. Electric Drives

4.1. Define Electric Drive and explain the concept of electric drive.

4.2. List the advantages of Electric Drives.

4.3. Draw the block diagram of an Electric drive and state the function of each block.

4.4. List the factors governing the selection of electric drive.

4.5. State the different types of loads for which drives are needed.

4.6. Classify the drives based on (i) Duty Cycle (ii) Industrial Application

4.7. List the different systems of braking with respect to electric motors
a) Mechanical b)Compressed air c) Vacuum d) Magnetic e) Electric

4.8. State the advantages of electric braking over other methods of braking.

4.9. Explain the methods of plugging, Rheostatic and Regenerative braking.
4.10. List the advantages of Regenerative Braking System over other electric braking.

5. Electric Traction

5.1. List different methods of track electrification.
5.2. Explain the suitability of different motors.
5.3. State the important requirements of traction motors.
5.2. List the types of traction services.
5.3. State each stage of the speed-time curve with appropriate speeds.
5.4. Define Maximum speed, average speed and scheduled speed.
5.5. Sketch the simplified speed-time curves and state their practical importance.
5.7. Derive the expression for maximum speed, acceleration and retardation for the following speed time curves and solve simple problems on it.
a) Trapezoidal speed time curve b) Quadrilateral speed time curve
5.8. Define tractive effort and write the expression (No derivation) for tractive effort for acceleration to overcome gravity pull and train resistance and solve problems.
5.9. State the equation showing the relationship between power, torque and transitive force (No derivation).
5.10. Define `Coefficient of adhesion' and list the factors affecting the coefficient of adhesion& list the methods to improve it.
5.11. Solve problems on calculation of number of axles required.
5.12. Define specific energy consumption and list the factors affecting it (No problems on specific energy consumption).
5.13. List the important Overhead Equipment (OHE) used in Traction.
5.14. State the need for Booster Transformer in Traction.
5.15. Explain a) End on Generation b) Mid on Generation c) Head on Generation
5.16. State the requirements of Train lighting.
5.17. Mention the requirements of railway coach air conditioning.

CO-PO/PSO MAPPING

CO.No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PS02	PS03
CO1	3	1	1			1		3		
CO2	3				1		1	3		1
CO3	3				1	1		3		
CO4	3		1	2			1	3	1	1
CO5	3	1		1	1	1		3	1	
Average	3	1	1	1.5	1	1	1	3	1	1

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note:

The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:

(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

COURSE CONTENT

1. Electric Lighting

Important terms and definitions of lighting - Plane and solid angles, luminous flux, Luminous intensity, Lumen Illumination, Candle power, Polar curve, Brightness, MHCP, MSCP, MHSCP, Wave length and Glare – Principle of production of light by Excitation, Ionisation, Fluorescence and Phosphorescence – Types of lamps – Requirements of good lighting – Different types of lamp fittings – Laws of Illumination – important terms used in designing of simple lighting scheme – Problems.

2. Electric Heating

Advantages of electric heating - requirements of good heating material - materials generally employed for Electric Heating, resistance heating - direct and indirect types - applications - Electric arc furnaces - direct and indirect types - applications - Induction furnace heating - core and coreless type - applications - Dielectric heating - principle – applications

3. Electrical Energy saving Devices

Need of power saving devices - Automatic temperature control circuits- Automatic illumination control circuits using LDR's- Advantages of CF Lamps –Operating Principle of LED lamp - Advantages of LED lamps over other types of lamps- Compare LED lamps with tungsten filament lamps.

4. Electric Drives

Concept of Electric Drive- Advantage over other drives – Block diagram of electric drive factors governing the selection of drive – classification of loads – Drives based on duty cycle and application – Braking systems of electric motors – methods of electric braking – advantages of regenerative braking among other electrical braking systems

5. Electric traction

Methods of track electrification – suitability of traction motors – requirements of traction motors - Types of services (main line, suburban , Metro and urban) - Maximum speed, average speed and scheduled speed - Simplified speed-time curves & its practical importance - Expression for maximum speed, acceleration and retardation for Trapezoidal & Quadrilateral speed time curves - numerical examples - Tractive effort equation – Relation between power, torque and tractive force - Coefficient of adhesion - factors affecting the coefficient of adhesion - problems on calculation of number of axles required - methods of improving the coefficient of adhesion - specific energy consumption - factors affecting specific energy consumption - Overhead Equipments (OHE) - Need of Booster Transformer - End on Generation - Mid on Generation - Head on Generation - Requirements of Train lighting - requirements of railway coach air conditioning.

REFERENCES

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3. H. Partab - Art and Science of electric power – Dhanpat Rai & Co

4. K.B. Bhatia – Study of electrical Appliances and devices – Khanna Publications
5. R.K. Rajput - Utilisation of Electric Power – Parag Enterprises
6. G.K. Dubey – Fundamentals of Electric Drives

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 3.7
Unit Test - II	From 4.1 to 5.17

POWER SYSTEMS – II

Course code	Course Title	No. Of periods/week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE502T	POWER SYSTEMS–II	6	90	30	70	04

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
1	Transmission lines	2	28	4	2	CO1
2	Transmission Line Components	30	25	3	2	CO2
3	Electric Power Distribution System	20	22	2	2	CO3
4	Protection of Transmission lines	7	11	1	1	CO4
5	Modern Trends in power systems	8	14	2	1	CO5
TOTAL		90	100	12	8	

COURSE OBJECTIVES

Upon completion of the course the student shall be able

(i) To understand the role of transmission and distribution in power systems
(ii) To analyze the electrical and mechanical characteristics of transmission lines
(iii) To identify and evaluate components of overhead and underground systems
(iv) To explain the structure and operation of substations and distribution networks
(v) To Explore protection techniques and modern trends in power systems

COURSE OUTCOMES

CO1	EE502.1	Describe the concepts of power transmission, distribution systems and HVDC transmission systems
CO2	EE502.2	Explain different structures, insulators, laying of lines including calculation of Sag and evaluation of underground cables
CO3	EE502.3	Explain various substations and basic concepts of distribution
CO4	EE502.4	Understand basic concepts of transmission line protection

CO5	EE502.5	Enhance the knowledge of the students with the recent trends in emerging power system operation

LEARNING OUTCOMES

1. Transmission Lines

1.1. Explain the necessity of transmission and distribution lines in electric power systems.
1.2. Compare A.C and D.C transmission systems with their respective merits and limitations.
1.3. Describe various power supply systems and their configurations.
1.4. Explain the effects of supply frequency on the performance of transmission lines.
1.5. State the effects of higher transmission voltage on efficiency, voltage drop, power loss, conductor size and overall system cost.
1.6. State empirical formula to determine suitable system voltages for transmission.
1.7. Compare different conductor types such as solid, stranded, hollow, and bundled conductors.
1.8. Explain current distortion phenomena including skin effect, proximity effect and spirality effect.
1.9. State expressions for inductance and capacitance of single-phase and three-phase systems.
1.10. Explain the need for transposition in overhead lines and its effect on system parameters.
1.11. Classify transmission lines into short, medium and long based on their characteristics.
1.12. Define voltage regulation and calculate it using appropriate formulas.
1.13. Solve problems related to short transmission lines, including efficiency and regulation.
1.14. Explain Nominal-T and Nominal-π methods to analyze medium transmission lines.
1.15. Explain the Ferranti effect and its implications on lightly loaded lines.
1.16. Define corona and state factors affecting it.
1.17. List the methods to reduce corona.
1.18. Explain the concept of HVDC transmission and list its types.
1.19. State the advantages and disadvantages of HVDC.

2. Transmission line components

2.1. Identify components of overhead transmission lines.
2.2. List the requirements and types of line supports used in practice.
2.3. State standard conductor spacing and ground clearances for various voltage levels.
2.4. Define 'sag' and state the factors affecting it.
2.5. Derive sag equations for supports at equal and solve related problems.
2.6. State the disadvantages of excessive sag in transmission lines.
2.7. State the function of insulator and list different types.
2.8. State the requirements of insulators used in overhead lines.
2.9. List the applications of different types of insulators (pin, strain, suspension, shackle).
2.10. Compare pin type and suspension type insulators based on mechanical and electrical characteristics.
2.11. Define flashover, puncture and string efficiency
2.12. Solve problems on distribution of voltage across string and string efficiency.
2.13. List the methods to improve string efficiency.
2.14. State the need for arcing horns and guard rings.
2.15. State the causes of insulator failure in power systems.

2.16. Describe the construction of underground cables and classify them based on configuration, voltage, insulation and stress control.
2.17. Compare overhead lines with underground cables in different aspects.
2.18. Derive the insulation resistance of a cable and solve numerical problems.

3. Electric Power Distribution System

3.1. Define substation and explain the purpose of substations in electrical power systems.
3.2. Compare indoor and outdoor substations.
3.3. State the functions of major substation equipment, including transformers, switchgear, relays, meters, bus-bars, lightning arresters, cables, Insulators and firefighting equipment.
3.4. State the need for auxiliary power supply in substations.
3.5. Draw and label schematic diagrams of 33kV/11kV and 220kV/132kV substations.
3.6. Define feeders, distributors and service mains and their role in power distribution.
3.7. Explain radial and ring main systems with advantages and disadvantages.
3.8. Solve numerical problems related to voltage drop in DC distribution systems.

4. Protection of Transmission Lines

4.1. State the need for protection of transmission lines.
4.2. Explain the importance of bus-bar protection and causes of bus-bar faults.
4.3. Describe different methods of transmission line protection.
4.4. Explain the working of distance relays in protecting transmission lines.
4.5. Describe the use of pilot wire systems for protection schemes.
4.6. Explain differential protection techniques applied to transmission lines.

5. Modern Trends in Power Systems

5.1. Explain the concept of hot line techniques.
5.2. State the applications of hot line techniques
5.3. Define Micro-grids and describe their operation and benefits.
5.4. Define FACTS devices and explain their importance in modern transmission networks.
5.5. Explain the concept of wireless power transmission (WiTricity) and its basic working.
5.6. Define distributed generation and its role in future power systems.

CO-PO/PSO MAPPINMG

CO \ PO / PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	1				3	1	
CO2	3		1					3	1	
CO3	3	2	1	1				3	1	
CO4	3	2	1	1	2			3	1	
CO5	3			1	1			3		3
Average	3	2	1	1	1.5			3	1	3

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note:

The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:

(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes(vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

COURSE CONTENT

1. Transmission Lines

Need for transmission lines-Transmission supply systems, Relative advantages and disadvantages of AC & DC Transmission, Choice of frequency, Choice of voltage, Effect of voltage, Empirical formula for determining the system voltage -Types of conductor-Solid-Stranded-Hollow- Bundled conductors - Relative merits of different types of conductors-Transmission parameters: Resistance, Inductance capacitance- skin effect, proximity effect, spirality effect- inductance of Round and Parallel Conductors ,Transposition of O.H. lines-Effect of transposition on Inductance calculations in transposed lines, capacitance in round and parallel conductors - Regulation and efficiency-Approximate formula for Regulation-Short line calculation of-Efficiency-Regulation-Sending end voltage-sending end p.f. for the given receiving end conditions -Regulation-Sending end voltage-sending end p.f. for the given receiving end conditions in medium transmission lines using Nominal pie method- Nominal T method-Vector diagrams in the above methods- -Ferranti's effect- Corona in transmission lines -Effects of corona –methods of reducing corona- Basic Concepts and Types of HVDC transmission- Advantages and disadvantages of HVDC transmission.

2. Transmission Line Components:

Requirements of line supports-Types of lines support- Conductors spacing and ground clearance -lines spaces-Approximate ground clearance- Sag, Factors affecting sag, calculating sag. Disadvantages of loose span, Insulators, Requirements of insulators, Materials used , Types of Insulators, Voltage distribution across string of suspension Insulators, Flashover, Puncture, string efficiency, improving string efficiency, Arcing horns and guard rings, Causes for failure of insulators-Cables, Comparison between O.H. Lines and underground cables, Classification of cables, General construction of cables, Insulation resistance of cables and problems.

3. Electric Power Distribution System

Definition and classification of sub-stations, Relative merits of indoor and outdoor sub-stations equipment in sub-stations Bus-bars, Insulators, Switch gear, Transformer, Protective relays, Meters, Lightning arresters, Cables, Firefighting equipment - Schematic diagrams- Feeders, distributors and service mains, Classification of Distribution systems- Radial and Ring system of Distribution.

4. Protection of Transmission Lines and Feeders,

Transmission line protection –Bus-bar protection-transmission line protection using distance relays. -Pilot wires-differential protection

5. Modern trends in power systems

Hot line technique– Micro Grid –FACTS (Flexible AC transmission systems) – Witricity (Wireless power Transmission)-Distributed Generation.

REFERENCES

1. V.K.Mehta-Principle of Power systems
2. S.L. Uppal – Electrical power
3. Soni, P.V Gupta & Bhatnagar –Textbook of Electrical Power
4. CL Wadhwa –Electrical power Systems- New Age International (P) limited.
5. J B Guptha -A course in power systems-KATSON BOOKS

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

Unit Test	Learning Outcomes to be Covered
Unit Test - I	From1.1 to 2.13
Unit Test - II	From 2.14 to 5.6

POWER ELECTRONICS

Course code	Course Title	No. Of periods/ week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE503T	POWER ELECTRONICS	6	90	30	70	4

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
1.	Power Electronic devices	20	25	3	2	CO1
2.	Converters	12	22	2	2	CO2
3.	Power Electronic Controllers	15	14	2	1	CO3
4.	Inverters	20	14	2	1	CO4
5.	Applications of Power Electronic circuits	23	25	3	2	CO5
Total		90	100	12	8	

COURSE OBJECTIVES

Upon completion of the course the student shall be able
(i)To introduce the fundamentals of power semiconductor devices and their operation. (ii)Understand the principles, design, and implementation of various power conversion circuits. (iii)Build a solid foundation for studying power electronic circuits and their applications.

COURSE OUTCOMES

CO1	EE503.1	Explain the construction, working, and characteristics of power electronic devices such as SCR, TRIAC, DIAC, MOSFET and IGBT.
CO2	EE503.2	Analyze the operation of single-phase and three-phase converters with various types of loads.
CO3	EE503.3	Apply the principles of AC voltage controllers and choppers in controlling power to electrical loads.
CO4	EE503.4	Describe the working of inverters and compare various Pulse Width Modulation (PWM) techniques used in inverter control.
CO5	EE503.5	Apply power electronic circuits for motor control, UPS, and other practical systems, and evaluate their performance in real-world applications.

LEARNING OUTCOMES

1. Power Electronic Devices

1.1 List different Thyristor family devices.
1.2 Draw the ISI circuit symbols for each device.
1.3 Describe constructional details of SCR
1.4 Explain the Operation of SCR.
1.5 Explain the Volt–Ampere characteristics of SCR with the help of a diagram.
1.6 Mention the ratings of SCR.
1.7 Describe how SCR can be protected against overvoltage, overcurrent, di/dt & dv/dt
1.8 Give the advantages of SCR as a switch.
1.9 List ten applications of SCR.
1.10 Explain the construction of MOSFET
1.11 Explain the input and output characteristics of MOSFET.
1.12 Explain the construction of IGBT
1.13 Explain the input and output characteristics of IGBT.
1.14 Explain the Volt-ampere characteristics of DIAC under forward/ reverse bias.
1.15 Explain the Volt-ampere characteristics of TRIAC under forward/ reverse bias.
1.16 State the necessity of Commutation in SCR's
1.17 List various commutation methods of SCR.
1.18 Introduction about wide band gap semiconductors
1.19 List various wide band gap semiconductors
1.20 List applications of wide band gap semiconductors.

2. Converters

2.1 Classify converters.
2.2 Explain the working of single-phase half wave-controlled converter with R load
2.3 Explain the working of single-phase half wave-controlled converter with R-L load.
2.4 Explain the working of single-phase full wave-controlled bridge converter with R load.
2.5 Explain the working of single-phase full wave-controlled bridge converter with R- L load.
2.6 Understand need for freewheeling diode.
2.7 Explain the operation of a single-phase full-wave controlled converter feeding an R-L load with a freewheeling diode
2.8 Explain the working of three-phase half wave-controlled converter with resistive load
2.9 Explain the working of three phase full wave-controlled converter with resistive load.

3. Power Electronic Controllers

3.1. Define AC voltage controller
3.2 Explain the working of single-phase AC voltage controller with resistive load.
3.3 Explain the working of three phase AC voltage controller with resistive load.
3.4 Compare AC voltage controller with transformer.
3.5 List the applications of AC voltage controller.
3.6 Define chopper.
3.7 Explain the working principle of chopper.
3.8 Explain the different control modes of chopper.
3.9 Explain the operation of buck converter
3.10 Explain the operation of boost converter
3.11 Explain the operation of buck-boost converter.

4. Inverters

4.1 Define inverter

4.2 Classify inverters.
4.3 Define Pulse Width Modulation
4.4 List various Pulse Width Modulation Techniques.
4.5 Explain about single, multiple and sinusoidal PWM Techniques.
4.6 Explain the working of series inverter.
4.7 Explain the working of parallel inverter.
4.8 Explain the working of single-phase bridge inverter.
4.9 Explain the working of three-phase bridge inverter in 120^0 conduction mode.
4.10 Explain the working of three-phase bridge inverter in 180^0 conduction mode.
4.11 State the advantages of MOSFET based inverters over SCR based inverters.
4.12 List applications of Inverters.

5 Applications of Power Electronic Circuits

5.1 List applications of power electronic circuits.
5.2 Mention the factors affecting the speed of DC Motors.
5.3 Explain the speed control of separately excited DC motor using converter.
5.4 Explain the speed control of separately excited DC motor using chopper.
5.5 Explain the speed control of PMDC motor using converter.
5.6 List the factors affecting speed of the AC Motors.
5.7 Explain the speed control of induction motor by using AC voltage controller.
5.8 Explain the speed control of induction motor by using converter and inverter (V/F control).
5.9 List the various power disturbances in power supplies.
5.10 Describe about the devices used to suppress the spikes in supply system.
5.11 Explain the working of UPS with block diagram.
5.12 Describe an Electric Vehicle (EV) Charging Station with a neat block diagram.
5.13 Explain a Power Factor Improvement Circuit using SCR with the help of a diagram.
5.14 Explain a Solar-Based Battery Charger Circuit using DC-DC Converters with a suitable block diagram
5.15 Describe the Role of Power Electronics in Automation Systems with relevant examples
5.16 Explain the Role of Power Electronic Converters in Renewable Energy Systems.

CO-PO/PSO MAPPING

CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1						3		
CO2	3	2	2					3		
CO3	3	2	2					3	2	
CO4	3	2	2					3	2	
CO5	3	2	3		1			3	2	
Average	3	1.8	2.25		1			3	2	

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note:
The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:
(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

COURSE CONTENT

1. Power Electronic Devices

Types of power semiconductor devices – SCR, DIAC, TRIAC - Construction, Working principle of all devices, symbols - V-I & Gate characteristics of SCR- Forward break over voltage, latching current, holding current, turn on triggering time, turn off time – Construction of MOSFET-operation of MOSFET-Construction of IGBT- operation of IGBT-V-I characteristics of DIAC & TRIAC-Necessity of Commutation- various methods of Commutation-wide band gap semiconductors-list - applications.

2. Converters

Classification of converters - single phase half wave controlled converter - freewheeling diode- single phase full wave controlled converter- three phase halfwave controlled converter- full wave controlled converter

3. Power Electronic Controllers

Single phase AC voltage controller- three phase ac voltage controller –Choppers-Control modes of chopper-buck converter-boost converter- buck boost converter.

4. Inverters

Classification of Inverters –PWM Techniques- Series inverter-Parallel inverter-Single Phase bridge Inverter – Three phase bridge Inverter – applications of inverter.

5. Application of Power Electronic Circuits

DC Motor control - Speed control of DC shunt Motor by using converters - AC Motor Controls - speed control of induction Motor by using AC voltage controllers - V/F control (Converters and inverters control) - Devices used to suppress spikes in supply system.- Working of UPS with block diagram – Charging station- Solar Battery charger Circuit using SCR - power factor improvement circuit –Power electronics in automation- power electronic converters in renewable energy systems.

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2. Jamil Asghar -Power Electronics– PHI, NewDelhi.
3. P.C.Sen.-Advanced Power Electronics
4. Power Electronics: Converters, Applications, and Design – Ned Mohan
5. Modern Power Electronics and AC Drives – Bimal K. Bose
6. Advanced Power Electronics – P.C. Sen

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 5.16

BASICS OF ARTIFICIAL INTELLIGENCE

Course code	Course Title	No. Of periods/week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE504E	BASICS OF ARTIFICIAL INTELLIGENCE	03	45	30	70	2

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
1.	Introduction to Artificial Intelligence	12	28	4	2	CO1
2	Machine Learning Essentials	12	25	3	2	CO2
3	AI in Electrical Engineering	12	22	2	2	C03
4	Future Scope of AI	9	25	3	2	CO4
Total		45	100	12	8	

COURSE OBJECTIVES

Upon completion of the course the student shall be able
(i) To understand the basics of Artificial Intelligence and Machine Learning. (ii) To acquire knowledge on Sensors, data, and collection of data. (iii) To acquire knowledge on applications of AI in Electronics and Communication engineering. (iv) To know the drawbacks of using AI, its future scope, and careers in AI.

COURSE OUTCOMES

CO1	EE504.1	Understand the fundamentals and evolution of Artificial Intelligence (AI) and various AI models
CO2	EE504.2	Demonstrate the basics of Machine Learning (ML) and the importance of data in AI
CO3	EE504.3	Analyse applications of AI and ML in Electrical, Electronics and allied engineering fields
CO4	EE504.4	Evaluate the ethical concerns, future scope, and career opportunities in AI

LEARNING OUTCOMES

1.0 Introduction to Artificial Intelligence

1.1 Definition of Artificial Intelligence (AI)
1.2 Explain the Evolution of AI
1.3 List Features & Goals of AI
1.4 List Differences between AI, Machine Learning (ML) and Deep Learning (DL)
1.5 List Different types of AI models

1.6 Differentiate AI and Human intelligence
1.7 Explain the Impact of AI on various industries i.e. Healthcare, BFSI, Entertainment and Administration
1.8 List Different AI tools in the market and their use
1.9 Define Sensor and Explain the Role of Sensors in AI
1.10 List Types of Sensors and their applications
1.11 Explain the process of data collection using sensors interfaced with Arduino or Raspberry Pi.

2.0 Machine Learning Essentials
2.1 Definition of Data
2.2 List types of Data
2.3 List the Importance of Data in AI
2.4 List different types of Data Collection method
2.5 Definition of ML (Basic ideas using simple examples)
2.6 Importance of ML in AI
2.7 Application of ML
2.8 List Learning methods
2.9 Explain different Learning methods
2.10 List Simple ML Algorithms and their significance use in ML

3.0 AI applications in Electrical Engineering
3.1 List the AI applications in Electrical and Electronics Engineering
3.2 Explain the Role of AI & ML in Smart systems and Automation
3.3 Explain the Role of AI & ML in Smart Grids and Power System Optimization
3.4 State any two benefits of predictive maintenance for electrical equipment using AI and ML
3.5 Explain the Role of AI & ML in Predictive Maintenance for Electrical Equipment
3.6 Explain the Role of AI & ML in Embedded systems and IoT
3.7 Explain the Role of AI & ML in Renewable energy forecasting
3.8 Explain the Role of AI & ML in Fault Detection and Diagnosis in power systems
3.9 List any three uses of AI in automated electronic design automation (EDA) for electronics engineering.
3.10 Explain the Role of AI &ML in Automated Electronic Design Automation (EDA)
3.11 Explain the Role of AI &ML in Battery Management Systems

4.0 Future scope of AI
4.1 Explain Bias and Fairness in AI
4.2 Specify the Privacy concerns of AI
4.3 Essential Government regulations on use of AI
4.4 Mention the drawbacks of AI
4.5 Explain the social implications of AI
4.6 Elucidate the Importance of development in responsible AI
4.7 List the Future applications and advancements in AI
4.8 List the various Career opportunities in AI.

COURSE CONTENT

1. Introduction to Artificial Intelligence

Definition and evolution of AI - Features and goals of AI - Differences between AI, ML, and Deep Learning (DL) - Types of AI models - Comparison: AI vs Human Intelligence - Impact of AI on industries: Healthcare, BFSI, Entertainment, Administration - AI tools in the market and their applications - Role and types of sensors in AI - Practical: Data collection using

Arduino/Raspberry Pi and sensors.

2. Machine Learning Essentials

Definition and types of data - Importance of data in AI - Data collection methods - Definition and significance of sensors - Basic ideas of ML and its importance in AI - Applications of ML - Types and explanation of learning methods - Simple ML algorithms and their usage.

3. AI Applications in Electrical Engineering-

Smart systems and automation - Smart grids and power system optimization - Predictive maintenance for electrical equipment - Embedded systems and IoT applications - Renewable energy forecasting - Fault Detection and Diagnosis in power systems - Automated Electronic Design Automation (EDA)- Battery Management Systems.

4. Future scope of AI

Bias and fairness in AI - Privacy concerns - Government regulations for AI–Social Implications of AI - Drawbacks and responsible use of AI - Future applications and advancements - Career opportunities in AI

REFERENCES

1. Artificial Intelligence: A Modern Approach by Stuart Russell & Peter Norvig
2. Machine Learning by Tom M. Mitchell
3. Introduction to Artificial Intelligence by Wolfgang Ertel
4. Fundamentals of Artificial Intelligence by S. Rajasekaran, G.A. Vijayalakshmi Pai

CO-PO/PSO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	2	2		1	1	3	2	
CO2	3	2	1	2	2	1		3	1	
CO3	3	2	2	2	1	2	1	3	2	
CO4	3	1	1	2	2	2	2	3	2	
Average	3	1.5	1.5	2	1.66	1.5	1.33	3	1.75	

3: Strongly Mapped, 2: Moderately Mapped, 1: Slightly Mapped

Gaps in CO-PO mapping will be addressed using: Assignments, Tutorials, Seminars, Guest Lectures, Group Discussions, Quizzes, Industrial Visits, Tech Fests, Mini Projects, Library Visits.

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 2.10
Unit Test - II	From 3.1 to 4.8

INDUSTRIAL MANAGEMENT & SMART TECHNOLOGIES

Course code	Course Title	No. Of periods/ week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE505E	INDUSTRIAL MANAGEMENT & SMART TECHNOLOGIES	3	45	30	70	02

TIME SCHEDULE

S. No.	Chapter/ Unit Title	No. of Periods	Weightage of marks	No. of Short Questions	No. of Essay Questions	COs Mapped
1	Industrial Management	15	28	4	2	CO1
2	Material Management	12	25	3	2	CO2
3	Quality Management	8	25	3	2	CO3
4	Smart Technologies	10	22	2	2	CO4
TOTAL		45	100	12	8	

COURSE OBJECTIVES

Upon completion of the course the student shall be able to	
(i)	To familiarise the concepts of management, organisation structures and ownership styles,materials management and importance of safety at the workplace.
(ii)	To familiarize students with the process of business idea generation, feasibility analysis, business planning and principles of Total Quality Management.
(iii)	To explore integration of smart systems in Industry and prepare students for modern technological challenges in industrial ecosystems

COURSE OUTCOMES

CO1	EE505.1	Understand the fundamentals of industrial management and organizational structure

C02	EE505.2	Describe the different aspects of production, materials management and ensure industrial safety
C03	EE505.3	Describe the role of entrepreneur in economic development and business planning Analyzing and maintaining the quality standards of the product and Implement principles of Total Quality Management in industrial scenarios
CO4	EE505.4	Understand and evaluate the role of smart technologies in industry

LEARNING OBJECTIVES

1. Industrial Management

1.1. Define industry, commerce (Trade) and business.
1.2. Know the need for management.
1.3. Explain the principles of scientific management.
1.4. State the different levels of Management.
1.5. State the importance of managerial skills (Technical, Human, Conceptual)
1.6. State the need of organization structure of an industry.
1.7. Explain the types of organization line, staff and Line & staff (Functional) organizations.
1.8. State the factors of effective organization.
1.9. State motivation theories.
1.10. State Maslow's Hierarchy of needs.
1.11. Explain the process of selection, recruitment, training and development.
1.12. Explain types of business ownerships.
1.13. Explain the meaning and definition of social responsibilities.
1.14. Need for corporate social responsibility.

2. Material Management

2.1. Define production.
2.2. Explain the stages of Production, planning and control.
2.3. Know the basic methods of demand forecasting.
2.4. Explain Break Even Analysis
2.5. Draw PERT/CPM networks.
2.6. Solve the critical path in simple project.
2.7. Know the functions of Materials Management.
2.8. Explain ABC analysis.
2.9. Define safety stock and reorder level.
2.10. Explain the importance of safety at Workplace.
2.11. Explain hazard and accident.
2.12. List out different hazards in the Industry.
2.13. State the causes of accidents.

3. Quality Management

3.1. Define the word entrepreneur.
3.2. Determine the role of entrepreneurs in promoting Small Scale Industries.

3.3. State various self-employment schemes.
3.4. List out the organizations that help an entrepreneur.
3.5. Understand the concept of make in India, Zero defect and zero effect.
3.6. Understand the importance of startups.
3.7. Explain the conduct of demand and market surveys.
3.8. Prepare feasibility report of any start-up plant/processing industry.
3.9. Explain the concept of quality.
3.10 List the quality systems and elements of quality systems.
3.11 Explain ISO standards and the concepts of ISO 14000.
3.12 Understand the basic concepts of TQM.

4 Smart Technologies

4.1 Define Smart technologies
4.2 State the importance of Smart technologies
4.3 State the core components of Smart technologies
4.4 List the benefits and security challenges of Smart technologies
4.5 Explain the applications of Smart technologies in Electrical engineering
4.5.1. Smart Energy
4.5.2. Smart metering
4.5.3. Smart Home
4.5.4. Smart Factory and Smart Manufacturing
4.5.5. Smart fault detection in transmission lines

CO-PO MAPPING

CO. NO.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2	-	-	2	-	2	1	-
CO2	2	3	2	2	3	3	2	3	2	-
CO3	2	2	3	2	2	1	-	2	2	3
CO4	2	2	3	3	3	2	2	3	3	
AVERAGE	2.25	2.25	2.5	2.3	2.6	2	2	2.5	2	3

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:
(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes(vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

COURSE CONTENT

1. Industrial Management

Introduction- Industry, Commerce and Business-Definition of management-Principles of scientific management – F.W. Taylor, - levels of management - managerial skills - Line, Staff and functional Organizations, Motivational Theories; types of leadership styles Forms of Business ownerships: Types – Sole proprietorship, Partnership, Joint Stock Companies, Cooperative types of Organizations; Corporate Social responsibility

2. Material Management

Definition of production - Production Planning and Control: Demand forecasting, Break

even analysis; CPM and PERT techniques; simple numerical problems- ABC Analysis, Safety stock, re-order level - Importance of Safety at workplaces; Causes of accidents- different hazards

3. Quality Management:

Definition of Entrepreneur – Role of Entrepreneur-Concept of Make in India, ZERO Defect, Zero Effect- Concept of Start-up Company-Entrepreneurial Development-Role of SSI, MSME, DICs, Entrepreneurial development schemes-Institutional support, Market survey and Demand survey - Preparation of Feasibility study reports.
Introduction to Total Quality Management (TQM)- Quality systems – Definitions of the terms used in quality systems like, quality policy, quality management, quality systems. IS:14000

4. Smart Technologies:

Define Smart technologies –State Core components of Smart technologies –Benefits and challenges of Smart technologies –Applications of Smart technologies - Smart Energy, Smart metering, Smart Factory and Smart Manufacturing, and Smart fault detection and monitoring.

REFERENCES

1. Industrial Engineering and Management-by O.P. Khanna
2. Production Management-by Buffa.
3. Engineering Economics and Management Science-by Banga &Sharma.
4. Production and Operations Management–S.N.Chary

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

Unit Test	Learning Out comes to be Covered
Unit Test – I	From 1.1 to 2.13
Unit Test – II	From 3.1 to 4.5

SMART GRID TECHNOLOGY

Course code	Course Title	No. Of periods/week	Total No. of periods/ Semester	FA Marks
26EE506A	SMART GRID TECHNOLOGY	2	30	0

TIME SCHEDULE

Chapter No.	Chapter / Unit Title	No. of periods	COS Mapped
1	Basics of Smart Grid	06	CO1, CO2
2	Smart Grid Components	12	CO2, CO3
3	Applications of Smart Grids	12	CO4, CO5
TOTAL		30	

COURSE OBJECTIVE

Upon completion of course student may able

(i) To understand the evolution, concept, and necessity of smart grids in modern electrical systems compared to conventional grids.
(ii) To explain the architecture, key components, and communication technologies involved in the operation of smart grids.
(iii) To explore the integration of renewable energy sources and electric vehicles into smart grid systems for sustainable and efficient power management.
(iv) To create awareness of cyber security challenges, government initiatives, and emerging technologies like IoT, AI, and Blockchain in smart grid development.

COURSE OUTCOMES

CO1	EE506.1	Explain the concept, evolution, and need for smart grids and differentiate them from conventional power grids.
CO2	EE506.2	Describe the architecture and key components of smart grids such as smart meters, PMUs, RTUs, and automation systems.
CO3	EE506.3	Identify and explain the communication technologies and control tools (e.g., SCADA, AMI) used in smart grid operation.
CO4	EE506.4	alyze the integration of renewable energy sources and electric vehicles within smart grid systems for efficient energy management.

CO5	EE506.5	cuss cyber security measures, real-world case studies, and emerging technologies such as IoT, AI, and Blockchain in smart grid applications.

LEARNING OUTCOMES

1. Basics of smart grid

1.1. Define the concept and evolution of electrical grids and explain the need for smart grids.
1.2. Differentiate between conventional grid and smart grid systems.
1.3. Describe the basic architecture and layers of a smart grid.
1.4. Identify the benefits and challenges of implementing smart grid technology.
1.5. Explain the role of automation, sensors, and control systems in smart grids.

2. **Smart Grid Components**

2.1. Identify key smart grid components: smart meters, digital relays, sensors, RTUs, and PMUs.
2.2. Describe the working of Advanced Metering Infrastructure (AMI) and its technology options.
2.3. Explain the communication technologies used in smart grids (PLC, RF, Zigbee, Wi-Fi, cellular, fiber).
2.4. Explain the role of SCADA and real-time monitoring systems in grid automation.
2.5. Describe Demand Side Management (DSM) and Demand Response (DR) techniques in power systems.
2.6. Explain the importance of energy storage systems in smart grid operations.

3. Applications of Smart Grids

3.1. Explain the integration of renewable energy sources (solar, wind) into smart grids.
3.2. Describe the role of electric vehicles (EVs) and smart charging stations in grid systems.
3.3. Discuss cybersecurity concerns and protection methods in smart grids.
3.4. Describe key features of smart cities, microgrids, and pilot smart grid projects in India.
3.5. Explain the role of IoT, AI, machine learning, and Blockchain in the evolution of smart grids.
3.6. Explain the role of Indian government initiatives, policies, and standards related to smart grid implementation.

CO-PO/PSO MAPPING

CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1		2	2		3	2	1
CO2	3	3	2	2		1		3	2	1
CO3	3	3	3	3	2	2		3	3	2
CO4	3	3	2	2	2	3	1	3	3	2
CO5	3	3	2	2	3	2	2	2	3	3
AVERAGE	3	2.8	2	2.25	2.25	2	1.5	2.8	2.6	1.8

COURSE CONTENT

1.0 Basics of Smart Grid

Concept of electrical grid-Evolution of grid - Need of Smart grid -Conventional vs. smart grid-Smart grid architecture and layers of it-Benefits-Challenges-Role of Automation, Sensors, Control systems

2.0 Smart Grid Components

Key components of Smart grid -Smart meters, Digital relays, Sensors, RTUs and PMUs-Working of AMI-communication technologies used in smart grids-PLC, RF, Zigbee, Wi-Fi, Cellular and Optical fiber-Role of SCADA and Real-time monitoring- Demand Side Management (DSM) and Demand Response (DR) techniques in power system-Importance of Energy storage in smart grids.

3.0 Applications of Smart Grid

Solar integration and Wind integration to smart grids- Role of Electric vehicles and Smart charging - Cybersecurity-concerns and protection methods-Real world case studies of Microgrids, Smart cities and Pilot projects (in India)-Explore future trends like-IoT, AI, Machine learning, Blockchain in smart grid development-Implementation Government initiatives, policies and Standards on smart grids.

REFERENCES

1. N.K. Sharma -Smart Grid: Concepts and Case Studies- McGraw Hill Education
2. Janaka Ekanayake, Kithsiri Liyanage, Nick Jenkins et al. - Smart Grid: Technology and Applications-Wiley India publications.
3. James Momoh- Smart Grid: Fundamentals of Design and Analysis- Wiley –IEEE press publications
4. Stuart Borlase -Smart Grids: Infrastructure, Technology and Solutions- CRC Press
5. Mini S. Thomas, John D. McDonald -Power System SCADA and Smart Grids- CRC Press (Indian edition)

POWER ELECTRONICS LABORATORY

Course code	Course Title	No. Of periods/ week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE507L	POWER ELECTRONICS LABORATORY	3	45	40	60	1.5

TIME SCHEDULE

S. No.	Chapter / Unit Title	No. of Periods	COS Mapped
1.	Characteristics of Power Electronic Devices	9	CO1
2.	Characteristics of Power Transistors	6	CO2
3.	Performance of different converter circuits	12	CO3
4.	Speed control of the electrical motors using the Power Electronic Devices	9	CO4
5.	Power Electronic circuits	9	CO5
Total		45	

COURSE OBJECTIVES

Upon completion of the course the student shall be able
(i) To understand the operation and characteristics of SCR, DIAC, TRIAC, IGBT and Power MOSFET. (ii)To provide a practical exposure to operating principles, design and synthesis of different power electronic converters. (iii) To perform the speed control of electric motors by using power electronic circuits.

COURSE OUTCOMES

CO1	EE507.1	Understand the operation of SCR, DIAC and TRIAC, Plot their characteristics.
CO2	EE507.2	Understand the operation of IGBT and Power MOSFET, Plot their characteristics.
CO3	EE507.3	Analyse the performance of different converter circuits.
CO4	EE507.4	Controlling the speed of electrical motors by using Power electronic circuits.
CO5	EE507.5	Designing of power electronic circuits for practical applications.

LEARNING OUTCOMES

1. Characteristics of Power Electronic Devices

1. Plot the Characteristics of SCR.
2. Plot the Characteristics of DIAC
3. Plot the Characteristics of TRIAC.

2. Characteristics of Power Transistors

1. Plot the Characteristics of IGBT.
2. Plot the Characteristics of Power MOSFET.

3. Performance of different converter circuits

1. Perform the experiment on single phase half wave-controlled converter and draw its waveforms at different firing angles.
2. Perform the experiment on single phase full wave fully controlled centre tapped converter and draw its waveforms at different firing angles.
3. Perform the experiment on single phase full wave fully controlled bridge converter and draw its waveforms at different firing angles.
4. Perform the experiment on single phase PWM inverter.

4. Speed control of the electrical motors using the Power Electronic Devices

1. Perform speed Control of DC motor by using single phase bridge converter.
2. Perform speed Control of 1-phase AC induction motor using AC voltage controller.
3. Perform speed Control of DC motor by using chopper.

5. Power Electronic circuits

1. Perform the experiment for illumination control using TRIAC and DIAC.
2. Perform the experiment for ceiling fan regulator using TRIAC.
3. Perform the experiment for battery charging circuit using Buck Converter.

Note: All experiments shall be conducted either through simulation or using hardware kits, depending on availability.

CO-PO/PSO MAPPING

CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1						3		
CO2	3	1						3		
CO3	3	1	1					3	1	

CO4	3	1						3		
CO5	3	1		1	1			3	1	1
Average	3	1	1	1	1			3	1	1

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:

(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

COURSE CONTENT

1. **Characteristics of Power Electronic Devices**

   Plot the Characteristics of SCR, DIAC and TRIAC.

2. **Characteristics of Power Transistors**

   Plot the Characteristics of IGBT and Power MOSFET.

3. **Performance of different converter circuits**

   Single phase half wave-controlled converter, single phase full wave fully controlled converter and single-phase full wave fully controlled bridge converter – Single phase PWM inverter.

4. **Speed control of the electrical motors using the Power Electronic Devices**

   Speed Control of DC motor by using single phase bridge converter and speed Control of 1-phase AC induction motor using AC voltage controller - Speed control of DC motor using chopper.

5. **Power Electronic circuits**

   Illumination control circuit using TRIAC and DIAC, Ceiling fan regulator circuit using TRIAC – Battery charging circuit using Buck Converter.

Competencies & Key competencies to be achieved by the student

S. NO.	Experiment Title	Competencies	Key competencies
1	i) Characteristics of SCR, DIAC and TRIAC ii)Characteristics of IGBT and Power MOSFET	Identify the different Power Devices available in the laboratory SCR, DIAC, TRIAC, IGBT and MOSFET.	Identify the Different terminals; Make the connections of the circuit as per the circuit diagram.
		Draw the symbols of the above	
		Identify the different terminals.	
		Draw the necessary circuit diagram and identify the	
		Make the connections of the circuit as per the circuit diagram	
		Record the different values of And current	

		Plot the characteristics on a graph sheet	
2	i) single phase half wave converter ii) single phase full wave fully controlled converter iii) single Phase full wave Controlled bridge Converter	Draw the circuit diagram for the Phase half wave-controlled converter	Verify the waveforms in the CRO at different firing angles
		Identify the different components Apparatus required for the circuit	
		Make the necessary connections as per the circuit diagram with resistive load.	
		Verify the waveforms in the CRO at different firing angles	
		Change the R-load with R-L load Observe the waveforms at different Angles	
		Implement the same for single phase full Wave fully controlled Load and R-L load	
		Implement the same for single Wave fully controlled bridge With R load and R-L load	
		Draw the circuit diagram for the Single Phase PWM inverter and Verify the waveforms in CRO at different duty cycles.	
3	i) speed Control of DC motor by using single phase bridge ii)speedControlof1 - phase AC induction motor using AC voltage	Draw the circuit diagram for the Control of the DC motor using the Phase bridge convertor	Change the triggering Draw the graph between Speed Vs Triggering Angles
		Identify the different apparatus required from the circuit diagram	
		Make the necessary connections according to the circuit	
		Change the triggering angles and Note Down the readings of the DC motor	
		Plot the graph Speed Vs Triggering angles	
		Implement the same procedure for speed control of single-phase AC induction motor using AC voltage controller	
		Implement the same procedure for speed control of DC motor using chopper.	
		Draw the circuit diagram for	

4	i) illuminatio n control circuit using TRIAC and DIAC ii) Ceiling fan regulator circuit using TRIAC.	Illumination control circuit using TRIAC And DIAC	i) change the firing angles and observe the illumination of the lamp ii) observe the speed of the ceiling fan
		Identify the different apparatus required From the circuit diagram	
		Make the necessary connections according to the circuit	
		Change the triggering angles and Note down the readings of voltage across the load. Note down the firing angles	
		Implement the same procedure for Ceiling fan regulator circuit using TRIAC	
		Implement the same procedure for battery charging circuit using Buck converter.	

REFERENCES

1. Mohan, Undeland & Robbins. "Power Electronics: Converters, Applications and Design", Wiley, 4th Ed., 2022.
2. Rashid, M.H. "Power Electronics: Devices, Circuits and Applications", Pearson, 4th Ed., 2021.
3. Bimbra, P.S. "Power Electronics", Khanna Publishers, 2019.
4. Online Resources
   i) NPTEL – Power Electronics (IIT Madras)

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 5.2

PLC AND SCADA LABORATORY
(PRACTICUM -PRACTICAL)

Course code	Course Title	No. Of periods/ week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE508L	PLC AND SCADA LABORATORY	3	45	40	60	1.0

TIME SCHEDULE

S. No.	Chapter / Unit Title	No. of Periods	COS Mapped
1.	Basics of PLC	6	CO1
2.	Ladder Diagrams for logic gates, timers and counters	6	CO2
3.	Ladder Diagrams for domestic applications	12	CO3
4.	Ladder Diagrams for industrial applications	12	CO4
5.	Supervisory Control and Data Acquisition (SCADA)	9	CO5
Total		45	

COURSE OBJECTIVES

Upon completion of the course the student shall be able

(i) To acquire the knowledge for PLC programming and operating.
(ii) To develop ladder diagrams for domestic and industrial applications.
(iii) Apply PLC Timers and Counters for the control of industrial processes and to develop a coil and contact control to operate analog PLC operations.
(iv) To understand the fundamentals of SCADA and to design Programs of automated applications.

COURSE OUTCOMES

CO1	EE508.1	Familiarise automation, its importance, expectations from automation and applications in industry. Analyze the working of PLC, I/O modules of PLC, Programming languages and Instructions of PLC.
CO2	EE508.2	Design and writing ladder diagrams for logic gates, timers and counters.
CO3	EE508.3	Designing a small automated ladder diagrams For domestic applications.
CO4	EE508.4	Designing a small automated ladder diagrams For industrial applications.

CO5	EE508.5	Understand the fundamental of SCADA systems, design of ON and OFF switch in SCADA, design programs of automated applications in SCADA.

LEARNINGOUTCOMES

1. **Basics of PLC**

Theory:

1. Define PLC and state the advantages of PLC.
2. Explain the different parts of PLC with block diagram.
3. State the applications of PLC.

Practical:

4. Working with various tools available in PLC software
5. Preparation of ladder diagram, uploading of code to PLC and running the code on PLC
6. Ladder diagram for ON/OFF inputs to produce ON/OFF outputs.

2. **Ladder Diagrams for logic gates, timers and counters**

Theory:

1. Explain the ladder diagram.
2. Explain contacts and coils used in PLC.
3. Explain the following timers and counters.
   I) TON ii) TOFF iii) Retentive timer iv) CTU v) CTD

Practical:

1. Execute ladder diagram for Logical Gates–AND gate, OR gate, NOT gate, NAND gate, NOR gate, EX-OR gate and EX-NOR gate.
2. Execute the following Boolean expressions
   - $\bar{A}BC+\overline{AB}$
   - $A\overline{BC} + \bar{C}B + \bar{A}CB$
3. Execute ladder diagram to run the motor for a specified time using timers.
4. Execute the ladder diagram for blinking the LED until a key is pressed using timer.
5. Execute the ladder diagram for starting the motor after pressing the push button for three times using counters.

3. **Ladder Diagrams for domestic applications**

Practical:

1 Execute ladder diagram for interfacing of lamp and single push button for ON /OFF operation.
2 Execute ladder diagram for delayed operation of lamp by using PUSH button.
3 Execute ladder diagram by multiple push button operation with delayed lamp for ON/OFF operation.
4 Execute ladder diagram for Stair Case Lighting
5 Execute ladder diagram for sensing of temperature of the given liquid.

4. **Ladder Diagrams for industrial applications**

Practical:

1 Execute ladder diagram for DOL starter
2 Execute ladder diagram for Star-Delta starter

3 Execute ladder diagram for PMDC Motor Speed Controller
4 Execute ladder diagram for Traffic Light Controller
5 Execute ladder diagram for rotating stepper motor in forward and reverse direction at constant speed.

5. Supervisory Control and Data Acquisition (SCADA)

Theory:

1. Define SCADA and state its importance in the industry.
2. List the software used for SCADA.
3. State various communications methods used in SCADA.
4. Explain the working of PLC with SCADA.
5. State the applications of SCADA.

Practical:

1. Interface SCADA with PLC and perform read/command transfer operation.
2. Design of ON and OFF switch in SCADA
3. Execute Parameter reading of PLC in SCADA.
4. Operate the PLC inputs through the switch symbol from the computer screen and view the status of the outputs using lamp and motor graphics symbols in the screen.
5. Perform Alarm annunciation using SCADA.
6. Perform Reporting and Trending in SCADA System.

CO-PO/PSO MAPPING

CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	1	2	2	-	-	3	1	-
CO2	3	2	2	2	2	-	-	3	2	-
CO3	3	2	2	2	2	-	-	3	2	1
CO4	3	2	3	2	3	-	-	3	2	2
CO5	3	2	2	3	3	-	-	3	3	2
Average	3	2	2	2.2	2.4	-	-	3	2	1.25

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note: The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:
(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

COURSE CONTENT

1. Basics of PLC

Demonstrate PLC architecture - Working with various tools available in PLC software Preparation of ladder diagram uploading of code to PLC and running the code on PLC

2. Ladder Diagrams for logic gates, timers and counters

Execute ladder diagram for different Logical Gates –ladder diagram using timers & counters

3. Ladder Diagrams for domestic applications

Execute ladder diagram for interfacing of lamp and button for ON / OFF operation - ladder diagram for delayed operation of lamp by using Push button - ladder diagram by multiple push button operation with delayed lamp for ON/OFF operation - ladder diagram with combination of counter and timer for lamp ON/OFF operation - ladder diagram for Stair Case Lighting - ladder diagram for Temperature Controller.

4. Ladder Diagrams for industrial applications

Execute ladder diagram for DOL starter - ladder diagram for Star-Delta starter - ladder diagram for PMDC Motor Speed Controller-ladder diagram for Traffic Light Controller-ladder diagram for rotating stepper motor in forward and reverse direction at constant speed.

5. Supervisory Control and Data Acquisition (SCADA)

Interface SCADA with PLC and perform read/command transfer operation-Design of ON and OFF switch in SCADA - Execute Parameter reading of PLC in SCADA – Operate the PLC inputs through the switch symbol from the computer screen and view the status of the outputs using lamp and motor graphics symbols in the screen - Perform Alarm annunciation using SCADA - Perform Reporting and Trending in SCADA System.

Competencies & Key competencies to be achieved by the student

S. NO.	Experiment Title	Competencies	Key competencies
	(i) Demonstrate PLC	Identify the PLC trainer kit, the Personal Computer and Load PLC software	i) Test the ladder logic
		Observe the input and output ports of the PLC	
		Make the interfacing between the PC and the PLC.	
		Prepare the appropriate ladder diagrams for different logic gates (AND, OR, NOT,NOR, NAND)	

1	architecture and Ladder diagram (ii) Execute Ladder diagrams for different Logical Gates (iii) Execute Ladder diagrams using timers &counters	Save the ladder diagram with relevant file names	with logic gate examples ii) Test the ladder logic with Timer/Counter instructions in ladder diagrams
		Execute each ladder diagram program and check for errors	
		Rectify errors if any then save and again execute the program	
		Download the Ladder Diagram Program in to the PLC	
		Run each program and check its output logic with relevant inputs.	
		Prepare simple ladder diagrams using timers and counters instructions	
		Execute, Run and check the output logic for each program	
2	Execute Ladder diagrams with model applications (i) ladder diagram for interfacing of lamp and button for ON/ OFF operation (ii) ladder diagram for delayed operation of lamp by using Push button (iii) ladder diagram by multiple push button operation with delayed lamp for ON/OFF operation (iv) ladder diagram with combination of counter and timer for lamp ON/OFF operation (v) Ladder diagram for Stair case lighting (vi) Ladder diagram for sensing of temperature of the given liquid	Identify the PLC trainer kit, the Personal Computer and Load PLC software	Execute the Ladder Diagram programs and observe the performance
		Observe the input and output ports of the PLC	
		Make the interfacing between the PC and the PLC.	
		Prepare the appropriate ladder diagrams for lamp ON/OFF operation	
		Save the ladder diagram with relevant file names	
		Execute each ladder diagram program and check for errors	
		Rectify errors if any then save and again execute the program	
		Download the Ladder Diagram program into the PLC	
		Run each program and check its output logic with relevant inputs.	
	Execute Ladder diagrams with model	Identify the different available model application kits in the lab	

3	applications (i) ladder diagram for DOL starter (ii) ladder diagram for Star-Delta starter (iii) ladder diagram for PMDC Motor Speed Controller (iv) ladder diagram for Traffic Light Controller (v) ladder diagram for rotating stepper motor in forward and reverse direction at constant speed.	Draw the ladder diagrams for the given program	Execute the ladder diagram programs and observe the performance
		Prepare the ladder diagrams in the Computer, save and execute the program	
		Make proper connections of the model application at the output port of PLC and download its relevant ladder Diagram program in PLC	
		Run the ladder diagram program and observe the outputs with the model applications	
4	(i) Execute Parameter reading of PLC in SCADA (ii) the PLC inputs through the switch symbol from the computer screen and view the status of the outputs using lamp and motor graphics symbols in the screen (iii) Alarm annunciation using SCADA (iv) Reporting and Trending in SCADA System.	Make the Interfacing between SCADA and PLC, perform read/ command transfer operation	Operate the buttons in SCADA and observe the outputs on the computer screen
		Develop switch symbols from the computer screen in SCADA to operate the PLC inputs	
		Observe the output in the computer screen	

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3. Hughes, T. “Programmable Logic Controllers”, Newnes Publications, 6th Ed., 2021.
4. Boyle, Patrick. “SCADA Systems: Fundamentals and Applications”, ISA Publications, 2017.
5. Online Resources
   i) NPTEL – Industrial Automation & PLC (IIT Kharagpur)

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 5.7

IOT LABORATORY

Course code	Course Title	No. Of periods/week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE509L	IoT laboratory	6	90	40	60	1.5

TIME SCHEDULE

S. No	Chapter/ unit Title	No. of Periods	COS Mapped
1	Introduction to IoT	12	CO1
2	Domestic applications of IoT	42	CO2
3	Industrial applications of IoT	36	CO3
TOTAL		**90**	

COURSE OBJECTIVES

Upon completion of the course the student shall be able
(i) Introduce the fundamental concepts and architecture of the Internet of Things (IoT), including commonly used hardware components and software tools.
(ii) Develop the ability to create smart domestic solutions using IoT
(iii) Equip students with the knowledge to build IoT applications for industrial use.

COURSE OUTCOMES

CO1	EE509.1	Identify and explain the basic components of IoT systems, including hardware, software (Arduino IDE), and platforms such as Blynk. Integrate various sensors, actuators, and cloud platforms to build complete IoT systems that offer automation, safety, and efficiency.
CO2	EE509.2	Demonstrate the use of IoT technology in controlling and monitoring domestic appliances
CO3	EE509.3	Design and implement energy-efficient IoT-based home automation systems for smart lighting and appliance management.

LEARNING OUTCOMES

1. Introduction to IoT

1.1. Getting started with IoT hardware-common components

1.2. Familiarize with Arduino IDE software (or related software)
1.3. Familiarize with Blynk app

2. Domestic applications of IoT

2.1. Control the switching of an LED using IoT Technology
2.2. Develop remote monitoring and power off system for home appliances using an IoT platform.
2.3. Develop an IoT technology for automatically turn off the fan when the ambient temperature exceeds a defined threshold.
2.4. Use IoT Technology to monitor and control the water level in an overhead water tank.
2.5. Design and Implementation of an IoT System to Turn off Unused electrical Appliances Automatically for energy saving.
2.6. Design and develop an IoT-Based Smart Lighting System Using Human Presence Detection for power saving.

3. Industrial applications of IoT

3.1. Implement an IoT-based system for temperature tracking of an electric motor.
3.2. Implement an IoT-based gas leakage detection system.
3.3. Regulate the angular position of a servo motor between 0° and 180° using IoT Technology.
3.4. Develop an IoT-powered street lighting system that activates lights upon detecting vehicles.

CO-PO/PSO MATRIX

CO.No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PS02
CO1	3	2	1	-	2	-	-	3	2
CO2	2	2	3	2	3	1		3	3
CO3	2	3	3	3	3	-	-	3	3
Average	2.3	2.3	2.3	2.5	2.6	1	-	3	2.6

3-Strongly Mapped 2- Moderately Mapped 1- Slightly Mapped

Note:
The gaps in CO and PO mapping will be achieved by one or more appropriate activities from the following:
i)Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quizzes (vii) Industrial Visits (viii) Tech Fests (ix) Mini Projects (x) Library Visits

COURSE CONTENT

1. Introduction to IoT
IoT hardware – common components - Arduino IDE software (or related platforms) - Blynk mobile app for IoT control.

2. Domestic Applications of IoT

IoT-based LED control system - Remote monitoring and power-off system for home appliances - Automatic fan control system based on temperature threshold - Water level monitoring and control in an overhead tank using IoT - Smart energy-saving system to turn off unused electrical appliances - Smart lighting system using human presence detection for power saving

3. Industrial Applications of IoT

IoT-based temperature tracking of an electric motor - IoT-based gas leakage detection system - Servo motor angular position control (0° to 180°) using IoT - IoT-powered street lighting system triggered by vehicle detection

Competencies & Key competencies to be achieved by the student

Sl.No.	Experiment Title	Competencies	Key Competencies
1	Introduction to IoT	Identify and describe the function of common IoT hardware components (sensors, actuators, microcontrollers, communication modules). Demonstrate basic wiring and connection of IoT hardware components on a breadboard. Install and configure Arduino IDE for programming microcontrollers. Write, upload, and test simple programs to control hardware using the Arduino platform. Use mobile-based IoT platforms (e.g., Blynk) to remotely monitor and control devices. Understand the structure of a typical IoT system including device, network, and application layers.	• Identify and explain common IoT hardware components (sensors, actuators, MCUs, communication modules). • Understand the role of microcontrollers (e.g., Arduino, ESP32) in IoT. • Set up and use the Arduino IDE and Blynk app for basic IoT projects. • Describe the structure of an IoT ecosystem (hardware, software, connectivity, cloud, UI).
2	Domestic Applications of IoT	Design and implement IoT-based home automation circuits using sensors (temperature, motion, water level, etc.). Control output devices (LEDs, fans, relays) using mobile applications connected via Wi-Fi (ESP8266/ESP32).	• Interface sensors and actuators for home automation (LEDs, fans, relays, pumps). • Develop mobile-controlled applications

		□ Create real-time monitoring systems using Blynk or similar platforms. □ Program microcontrollers to respond to environmental conditions (e.g., temperature-based fan control). □ Implement condition-based logic for automation (e.g., turning off lights/appliances when not in use). □ Apply power-saving techniques in home IoT systems to reduce energy consumption.	using IoT platforms like Blynk. • Implement threshold-based automation (e.g., temperature, motion, water level). • Optimize home systems for energy efficiency
3	Industrial Applications of IoT	□ Integrate industrial sensors (e.g., gas sensors, temperature sensors) into an IoT system for monitoring. □ Develop safety alert systems (e.g., for gas leakage) with real-time notification using mobile apps. □ Control actuators such as servo motors using IoT-based interfaces. □ Build IoT solutions for public or industrial use (e.g., street lights based on vehicle detection). □ Analyze sensor data from industrial systems for predictive maintenance or optimization. □ Ensure reliability and robustness in industrial IoT applications, considering environmental factors.	• Monitor environmental and equipment parameters remotely (e.g., motor temperature, gas leakage). • Implement safety-based systems using gas sensors and alert mechanisms. • Control servo motor position remotely via IoT interfaces. • Design responsive IoT systems for industrial/public use (e.g., street lighting).

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1. Arshdeep Bahga & Vijay Madisetti. “Internet of Things: Hands-On Approach”,

Universities Press, 3rd Ed., 2022.
2. Samuel Greengard. “The Internet of Things”, MIT Press, 2015.
3. Raj Kamal. “Internet of Things: Architecture & Design”, McGraw Hill, 2nd Ed., 2022.
4. Online Resources
    i) NPTEL – Introduction to IoT (IIT Kharagpur)

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 2.5 to 3.4

PROJECT WORK

Course code	Course Title	No. Of periods/ week	Total No. of periods/ Semester	FA Marks	SA Marks	Credits
26EE510P	Project Work	4	60	40	60	1.5

COURSE OBJECTIVES

Upon completion of the course the student shall be able to	
i	Enhance the knowledge by innovative learning and get the skills through the teamwork
ii	Provide with the opportunity to synthesize knowledge from various areas of learning
iii	Critically and creatively apply it to real life situations

COURSE OUTCOMES

CO1	EE510.1	Organising teamwork.
CO2	EE510.2	Innovative learning.
CO3	EE510.3	Apply theoretical knowledge to practical work situations.
CO4	EE510.4	Practice technical project reports preparation and presentation.

LEARNING OUTCOMES

Upon completion of the course the student shall be able to exhibit the following skill sets:

1. Problem solving and Critical Thinking

1.1 Identify different works to be carried out in the Project
1.2 Collect data relevant to the project work
1.3 Carryout need survey
1.4 Select the most efficient method from the available choices based on preliminary investigation
1.5 Design the required elements of the project work as per standard practices
1.6 Prepare the working modules / equipment required for the project work
1.7 Estimate the cost of project, technological need, computer skills, materials and other equipment
1.8 Prepare the plan and schedule of starting time and sequence of operations to be carried out at various stages of the project work in detail
1.9 Prepare critical activities at various stages of the project work
1.10 Test various conditions with different electrical input parameter if required

1.11 Implement project work and record the results.
1.12 Draw Appropriate Conclusions
1.13 Preparation of project report.

2. Communication

2.1 Communicate effectively.
2.2 Present Ideas Clearly.
2.3 Present Ideas Coherently.
2.4 Report writing.

3. Collaboration

3.1. Discuss the ideas.
3.2. Coordinate with team members
3.3. Team work in accomplishing the task.

4. Independent Learning

4.1. Involves in the group task.
4.2. Analyse the appropriate actions.
4.3. Compares merits and demerits
4.4. Analyse the activities for sustainability
4.5. Analyse the activities to ensure ethics

5. 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 MAPPING

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

3=strongly mapped, 2=moderately mapped and 1=slightly mapped

Note:

The gaps in CO and PO mapping will be met by one or more appropriate activities from the following:
(i) Assignments (ii) Tutorials (iii) Seminars (iv) Guest Lectures (v) Group Discussions (vi) Quiz (vii) Industry Visits (viii) Tech Fest (ix) Mini Projects (x) Library Visits.

COURSE CONTENT

1.0 Design/Assembling/Analysis/Case Study Projects in the areas of Electronics & Communication Engineering

Weightage of marks for Assessment of Learning Outcomes of Project work

S.No	Item	Marks
1	**Internal Marks** Completion of Assigned task in the group/individual to complete the project	**40**
2	**End Exam Marks:** i) Demonstration of skill relevant to the project (30) ii) Project Report (20) iii) Viva Voce (10)	**60**
Total marks		**100**

- Each group should have a project guide assigned by the HOS/Principal.
- End Examination assessment shall be done by HOS, external examiner and faculty supervisor who guided the students during project work.
- The external examiner shall be from an industry/organisation/Head of Section of other polytechnic/Senior faculty of other polytechnic.

Internal Assessment Guidelines:

- First Review: To be conducted after the completion of 4 weeks.
- Second Review: To be conducted after the completion of 10 weeks.
- Third Review: To be conducted after the completion of 14 weeks.

SCHEME OF EVALUATION
Internal marks

Review 1 (10 Marks)	Review 2 (15 Marks)	Review 3 (15 Marks)
COMMITTEE : 5 Marks PROJECT GUIDE : 5 Marks	COMMITTEE : 7.5 Marks PROJECT GUIDE : 7.5 Marks	COMMITTEE : 7.5 Marks PROJECT GUIDE : 7.5 Marks

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VI SEMESTER

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING
SCHEME OF INSTRUCTIONS AND EXAMINATIONS
SIXTH SEMESTER (INDUSTRIAL TRAINING)

Course Code	Name of the Course	Duration	Scheme of Valuation			Remarks / credits
			Item	Nature	Max Marks	
26EE601I	Industrial Training	One Semester	First assessment	Assessment of Learning Outcomes by both the faculty and training mentor of the industry.	120	20
			Second assessment	Assessment of Learning Outcomes by both the faculty and training mentor of the industry.	120	
			Final Assessment	Training Report	20	
				Demonstration	30	
				Viva -Voce	10	
TOTAL					**300**	**20**

INDUSTRIAL TRAINING

Course Code	Course Title	Duration	Credits
26EE601I	Industrial Training	One Semester	20

TIME SCHEDULE

Sl.No.	Code	TOPICS	Duration
1	26EE601I	● Practical training in Industry ● Training Report Preparation **Report Preparation:** Title Page, Certificate, Acknowledgements, Abstract, Contents Introduction of Industry, Organization Chart, List of Major Equipment **List of Processes:** Skills Acquired; Conclusions; Bibliography	One Semester

COURSE OBJECTIVES

Upon completion of the course the student shall be able
(i) Expose to real time working environment (ii)Enhance knowledge and skill already learnt in the institution. (iii) Acquire the required skills of assembling, dismantling, testing, trouble shooting, observing and supervising in electrical engineering fields.

COURSE OUTCOMES

CO1	Apply theory to practical work situations
CO2	Cultivate sense of responsibility and good work habits
CO3	Exhibit the strength, teamwork spirit and self-confidence
CO4	Gaining knowledge in installations, manufacturing, operations and maintaining various electrical goods and appliances.
CO5	Writing reports and auditing in electrical projects.

CO – PO / PSO Mapping

CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	1	1		2		1	3		2
CO2	3			1		3		3	1	2
CO3	3				2	3	1	3		2
CO4	3	1	1	1		3		3	1	2
CO5	3	1					1	3		2
Average	3	1	1	1	2	3	1	3	1	2

3: High, 2: Moderate, 1: Low

LEARNING OUTCOMES

1) Demonstration Skills
2) Reading drawings and analysing Specifications
3) Handling Tools/Instruments/Materials/Machines

4) Assembling, dismantling, testing, trouble shooting and maintenance skills.
5) Assess and Control of quality parameters
6) Planning, Organizing, recording and report submission Skills

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.HoD 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.

WEIGHTAGE OF MARKS FOR ASSESSMENT OF LEARNING OUTCOMES DURING FIRST AND SECOND ASSESSMENT

Sl. No	Learning Outcome	Max Marks Allotted For each parameter	Marks secured for each parameter
1	Demonstration Skills	20	
2	Reading drawings and analysing Specifications	20	
3	Handling Tools / Instruments / Materials / machines	20	
4	Assembling, dismantling, testing, trouble shooting and maintenance skills.	20	
5	Assess and Control of quality parameters	15	
6	Planning, Organizing, recording and report submission Skills	25	
	Total	**120**	

During assessment the performance of the students shall be assessed in those skills in which the student has been trained and be awarded the marks as per the weightage assigned as above. In case the student has undergone training in a few skill sets then the total marks obtained shall be raised to 120 marks for the given assessment i.e. either assessment 1 or 2. However the performance of the student shall be assessed at the most skill sets listed above but not less than three skill sets.

ILLUSTRATION

If the student has undergone training in only 4 skill sets (namely serial number 1, 3, 4, 5 of above skill sets) and marks awarded during assessment is 50 out of 80 marks, then the marks of 50 shall be enhanced to 120 proportionately as (50/80)*120 =75.

GUIDELINES FOR INDUSTRIAL TRAINING OF DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING PROGRAMME:

1. Duration of the training: One Semester.
2. Eligibility: As per SBTET norms
3. Training Area: Students can be trained in APGENCO/APTRANSCO/APDISCOM/Captive Power plants/Wind power plants/Solar power plants/Milk factories/Railways/Roadways/Communication sectors/Television sectors/Public and private Organizations or industries or companies etc., related to electrical & electronics fields.
4. The Industrial Training shall carry 300 marks and pass marks is 50% in assessment at industry (first and second assessment put together) and also 50% in final summative assessment at institution level.
5. Formative assessment at industry level shall be carried out by the representative of the industry, where the student is undergoing training and the faculty from the concerned section in the institution.
6. If the student fails to secure 50% marks in industrial assessments put together, the student should reappear for industrial training at his/her own expenses.
7. If the student fails to secure 50% marks in final summative assessment at institution level, the student should reappear for final summative assessment in the subsequent board examination.
8. Final Summative assessment at institution level is done by a committee including

1. Head of the section (of concerned discipline ONLY), 2. External examiner from an industry and 3. Faculty member who assessed he student during industrial training as member.

9. During Industrial Training the candidate shall put a minimum of 90% attendance.
10. If the student fails to secure 90% attendance during industrial training, the student should reappear for industrial training at his/her own expenses.

GUIDELINES AND RESPONSIBILITIES OF THE FACULTY MEMBERS WHO ARE ASSESSING THE STUDENTS PERFORMANCE DURING INDUSTRIAL TRAINING:

- Shall guide the students in all aspects regarding training.
- Shall create awareness regarding safety measures to be followed in the industry during the training period, and shall check it scrupulously.
- Shall check the logbook of the students during the time of their visit for the assessment.
- Shall monitor progress at regular intervals and make appropriate suggestions for improvement.
- Shall visit the industry and make first and second assessments as per stipulated schedules.
- Shall assess the skill sets acquired by the students during their assessment.
- Shall award the marks for each skill set as per the marks allotted for that skill set during 1st and 2nd assessments
- Shall voluntarily supplement students learning through appropriate materials like photographs, articles, videos etc.
- Shall act as co-examiner along with other examiners in the final assessment at institution.
- Shall act as liaison between the student and mentor.
- Shall maintain a diary indicating his observation with respect to the progress of students learning in all three domains (Cognitive, Psychomotor and Affective).

GUIDELINES TO THE TRAINING MENTOR IN THE INDUSTRY:

- Shall train the students in all the skill sets as far as possible.
- Shall assess and award the marks in both the assessments along with the faculty member.
- Shall check and approve the log books of the students.
- Shall approve the attendance of each student at the end of the training period.
- Shall report to the guide about student's progress, personality development or any misbehavior as the case may be.

✓ **Every Teacher (including HoD if not holding any FAC) shall be assigned a batch of students of 10 to 15 for industrial training irrespective of student's placements for training.**