DRAFT CURRICULUM-2026

(C-26)

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING

STATE BOARD OF TECHNICAL EDUCATION AND TRAINING, ANDHRA PRADESH

HIGHLIGHTS OF CURRICULUM C-26

1. The duration of the Diploma course is three years.
2. The curriculum follows a semester pattern, while the First Year is maintained as year-wise pattern.
3. Industrial training continues in this curriculum during the VI semester, with a duration of six months.
4. Updated subjects and topics relevant to industry are introduced in all courses at appropriate stages.
5. Policy decisions taken at the State and Central levels regarding Environmental Science are implemented by including relevant topics in Chemistry, in accordance with the Supreme Court guidelines issued in the Sri Mehta case.
6. In the C-26 scheme, elective subjects are introduced in all semesters except the First Year. Students are given the choice to select one subject from two elective options.
7. In every semester, one audit subject is introduced which carries no credits and no weightage. The main aim is to provide stress-free education and a student-friendly learning environment. Audit subjects such as Electrical Safety Practices, Renewable Energy Sources, Internet of Things in EEE, and Smart Grid Technology are introduced in the I Year, III semester, IV semester, and V semester respectively.
8. A new concept called the "Practicum Subject" is introduced in every semester. It requires faculty to teach theory along with demonstrations of relevant parts, devices, or equipment. The objective is to help students understand concepts more clearly through direct visualization and to ensure industry readiness by linking classroom teaching with real-world applications.
9. Considering the increasing importance of communication skills for Diploma students in industry, emphasis is given to listening, speaking, reading, and writing skills in English. Accordingly, English Essentials and the Communication & Employability Skills Laboratory are introduced for all branches.
10. CAD specific to the branch is given emphasis in the curriculum. Preparing drawings using CAD software is given higher importance.
11. Upon reviewing the existing C-23 curriculum, the ratio of theory to practical content was found to be 50:50. In the C-26 curriculum, the same ratio is maintained, with greater focus on strengthening practical skills in laboratories and workshops.
12. With increased emphasis on practical skills, the course content of all subjects has been thoroughly reviewed and restructured as outcome-based rather than conventional procedure-based.
13. Laboratory and Workshop curricula have been revised based on industry and faculty suggestions to ensure better utilization of available equipment. Experiments and exercises are aligned with the field requirements of industry.
14. Theory and practical subjects are restructured to create space for new subjects that meet current industrial needs.
15. Considering the growing importance of Artificial Intelligence, a new theory subject titled "Basics of Artificial Intelligence" is introduced in the V semester.
16. Since Electric Vehicles are a key technology for decarbonizing road transport, the subject "Electric Vehicle Technology" is continued in the IV semester.
17. A new laboratory titled "IoT Laboratory" is introduced in the V semester with IoT-based practicals to enhance the innovative thinking of students.
18. To ensure overall student development, three periods per week are allotted in every year/semester for Student Centric Activities (SCA). These include training for placements,

library usage, participation in sports and games, clean and green initiatives, and other activities. This helps students to become physically fit, socially responsible, and better prepared for employment.

SPECIFIC CHANGES INCORPORATED IN PRESENT CURRICULUM C-26

Electrical & Electronics Engineering Branch:

a) The number of theory subjects in each semester is limited to four (including electives) by restructuring related topics and removing repeated or higher-level content. Relevant laboratories are also reorganized to create space for new laboratories.
b) To strengthen technical knowledge and enhance practical understanding, the ratio of theory to practical content is maintained at 50:50 in the C-26 curriculum.
c) A new laboratory titled "26EE110l, Computer and Digital Skills" is introduced in the First Year to equip students with computer and digital skills essential for present industrial needs.
d) A new audit subject titled "26EE307A, Renewable Energy Sources" is introduced in the III semester which covers various renewable energy sources and a compulsory field visit to a nearby renewable energy plant is included to provide hands-on exposure.
e) A new theory subject titled "26EE405E, Electric Vehicle Technology" is introduced in the IV semester. It covers EV technology and battery technology to meet present industrial needs.
f) A new audit subject titled "26EE406A, Internet of Things in EEE" is introduced in the IV semester. It covers the basics of IoT and its applications in Electrical Engineering, preparing students for IoT practicals in the V semester laboratory.
g) A new laboratory titled "26EE410L, AutoCAD & Simulation Tools Laboratory" is introduced in the IV semester. It covers CAD and simulation tools that are essential for Diploma EEE students.
h) Considering the growing importance of Artificial Intelligence, a new theory subject 26EE504E titled "Basic of Artificial Intelligence" is introduced in the V semester.
i) A new audit subject titled "26EE506A, Smart Grid Technology" is introduced in the V semester. It covers the fundamentals, application and emerging trends such as PLC, AMI, and SCADA in smart grids.
j) A new laboratory titled "26EE508L, IoT Laboratory" is introduced in the V semester, where students perform IoT-based practicals related to electrical engineering applications.
k) Industrial visits are made compulsory in the subject 26EE307A, Renewable Energy Sources which is an audit subject, to bridge classroom learning with real-world industry practices.

NOTE ON PRACTICUM SUBJECT

Practicum mode of teaching is introduced in the C-26 curriculum to bridge theory and practice. Faculty should explain the theory content by showing the relevant part, device or equipment available in the department/market, so that students can clearly connect concepts with real-life applications.

1. Concept of Practicum:

1. Practicum is designed to bridge the gap between theory and practice in diploma education.
2. It requires the faculty to teach theory along with demonstration of relevant parts, devices or equipment.

3. The equipment may be taken from the department laboratories or shown as available in the market/industry.
4. Students are expected to see, observe and relate the theoretical concept with the actual device.
5. This approach gives practical exposure within the classroom itself.

2. Objectives of Practicum:

1. To make students understand concepts more clearly through direct visualization.
2. To develop practical insight, confidence and application-oriented thinking.
3. To create an interactive and engaging classroom environment.
4. To provide hands-on learning opportunities without the need for separate lab hours.
5. To ensure that students are industry-ready by linking classroom teaching with real-world applications.

Examples:

1. While teaching Circuit Breakers, the faculty can show the actual breaker available in the lab, point out its parts, demonstrate its operation and then explain the theoretical concepts such as types, ratings and applications etc which are mentioned in the curriculum.
2. While teaching Energy Meters, the faculty can demonstrate a single-phase or three-phase meter, explain the meaning of each terminal, show the rotating disc or digital display and then connect with the theoretical discussion.

PRACTICUM MODE SUBJECTS

In the C-26 curriculum, certain subjects are identified to be taught in Practicum Mode. The intention is to link theoretical concepts with direct demonstrations, hands-on activities and visualization of components. This method enhance the learning experience and ensure industry readiness of diploma students.

The following subjects are to be taught in Practicum Mode to bridge theory and practical:

SL.NO	SUBJECT CODE	SUBJECT TITLE	MODE OF TEACHING
1	26EE107D	Engineering Drawing	Practicum Mode
2	26EE108L	Basic Electrical & Electronics Workshop	Practicum Mode
3	26EE110L	Computer and Digital Skills	Practicum Mode
4	26EE306E	Electrical Installation & Estimation	Practicum Mode
5	26EE309L	Programming in "C" Laboratory	Practicum Mode
6	26EE410L	Auto CAD & Simulation Tools Laboratory	Practicum Mode
7	26EE508L	IOT Laboratory	Practicum Mode

Faculty handling the above courses shall integrate theory with practical demonstration of devices, tools, equipment, software or drawings, as applicable. This approach ensures that students gain both conceptual clarity and practical exposure within the classroom itself.

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING

SCHEME OF INSTRUCTIONS AND EXAMINATIONS

FIRST YEAR

	Subject Code	Name of the Subject	Periods per week	Total Periods	Credits	Scheme of Examination			
						Duration (Hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY SUBJECTS	26EE101T	English Essentials	3	90	4	3	30	70	100
	26EE102T	Engineering Mathematics - I	6	180	6	3	30	70	100
	26EE103T	Engineering Physics	3	90	5	3	30	70	100
	26EE104T	Engineering Chemistry & Environmental Studies	3	90	5	3	30	70	100
	26EE105T	Basic Electrical & Electronics Engineering	6	180	6	3	30	70	100
	AUDIT SUBJECT								
	26EE106A	Electrical Safety Practices	2	60	--	--	--	--	--
	TOTAL THEORY		**23**	**690**	**26**	--	**150**	**350**	**500**
PRACTICAL SUBJECTS	26EE107D	Engineering Drawing	4	120	3	3	40	60	100
	26EE108L	Basic Electrical & Electronics workshop	6	180	4	3	40	60	100
	26EE109L	Physics & Chemistry Laboratory	(1.5+1.5) 3	(45+45) 90	3	3	40	60	100
	26EE110L	Computer and Digital skills Laboratory	3	90	3	3	40	60	100
	--	Student Centric Activity	3	90	1	--	--	--	--
	TOTAL PRACTICAL		**19**	**570**	**14**	--	**160**	**240**	**400**
GRAND TOTAL			**42**	**1260**	**40**	--	**310**	**590**	**900**

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

	Subject Code	Subject	Periods per week	Total Periods	Credits	Scheme of Examination			
						Duration (Hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY SUBJECTS	26EE301T	Electrical Machines - I	6	90	4	3	30	70	100
	26EE302T	Electronics Engineerig	6	90	4	3	30	70	100
	26EE303T	Electrical Circuits & Measuring Instruments	6	90	4	3	30	70	100
	ELECTIVE SUBJECT								
	26EE304E	Engineering Mathematics - II	3	45	2	3	30	70	100
	26EE305E	Electrical Engineering Drawing	3	45	2	3	30	70	100
	26EE306E	Electrical Installation & Estimation	3	45	2	3	30	70	100
	AUDIT SUBJECT								
	26EE307A	Renewable Energy Sources	2	30	--	--	--	--	--
	TOTAL THEORY		**23**	**345**	**14**	--	**120**	**280**	**400**
PRACTICAL SUBJECTS	26EE308L	Electrical Machines - I Laboratory	6	90	2	3	40	60	100
	26EE309L	Programming in "C" Laboratory	6	90	2	3	40	60	100
	26EE310L	Electronics Engineering Laboratory	4	60	1.5	3	40	60	100
	--	Student Centric Activity	3	45	0.5	--	--	--	--
	TOTAL PRACTICAL		**19**	**285**	**6**	--	**120**	**180**	**300**
GRAND TOTAL			**42**	**630**	**20**	--	**240**	**460**	**700**

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING

SCHEME OF INSTRUCTIONS AND EXAMINATIONS

FOURTH SEMESTER

	Subject Code	Subject	Periods per week	Total Periods	Credits	Scheme of Examination			
						Duration (Hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY SUBJECTS	26EE401T	Electrical Machines - II	6	90	4	3	30	70	100
	26EE402T	Power Systems - I	6	90	4	3	30	70	100
	26EE403T	Digital Electronics & Micro Controllers	6	90	4	3	30	70	100
	ELECTIVE SUBJECT								
	26EE404E	Industrial Automation	3	45	2	3	30	70	100
	26EE405E	Electrical Vehicle Technology	3	45	2	3	30	70	100
	AUDIT SUBJECT								
	26EE406A	Internet of Things in EEE	2	30	--	--	--	--	--
	TOTAL THEORY		**23**	**345**	**14**	--	**120**	**280**	**400**
PRACTICAL SUBJECTS	26EE407L	Electrical Machines -II Laboratory	6	90	2	3	40	60	100
	26EE408L	Communication & Employability skills Laboratory	4	60	2	3	40	60	100
	26EE409L	Digital Electronics & Micro Controllers Laboratory	3	45	1	3	40	60	100
	26EE410L	Auto CAD & Simulation Tools Laboratory	6	90	1	3	40	60	100
	TOTAL PRACTICAL		**19**	**285**	**6**	--	**160**	**240**	**400**
GRAND TOTAL			**42**	**630**	**20**	--	**280**	**520**	**800**

ADD ON COURSE	**Extra credits are awarded to the students who completes ADD ON course as per course duration.**

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

	Subject Code	Subject	Periods per week	Total Periods	Credits	Scheme of Examination			
						Duration (Hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY SUBJECTS	26EE501T	Electrical Utilisation & Traction	6	90	4	3	30	70	100
	26EE502T	Power Systems - II	6	90	4	3	30	70	100
	26EE503T	Power Electronics	6	90	4	3	30	70	100
	ELECTIVE SUBJECT								
	26EE504E	Basics of Artificial Intelligence	3	45	2	3	30	70	100
	26EE505E	Industrial Management & Smart Technologies	3	45	2	3	30	70	100
	AUDIT SUBJECT								
	26EE506A	Smart Grid Technology	2	30	--	--	--	--	--
	TOTAL THEORY		**23**	**345**	**14**	--	**120**	**280**	**400**
PRACTICAL SUBJECTS	26EE507L	Power Electronics & PLC Laboratory	6	90	2	3	40	60	100
	26EE508L	IOT Laboratory	6	90	2	3	40	60	100
	26EE509P	Project Work	4	60	1.5	3	40	60	100
	--	Student Centric Activity	3	45	0.5	--	--	--	--
	TOTAL PRACTICAL		**19**	**285**	**6**	--	**120**	**180**	**300**
GRAND TOTAL			**42**	**630**	**20**	--	**240**	**460**	**700**

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

Subject Code	course Title	Duration	Scheme of Valuation			Remarks / credits
			Item	Nature	Max Marks	
26EE601I	Industrial Training	Six Months	First assessment	Assessment of Learning Outcomes by both the faculty and training mentor of the Industry.	120	6
			Second assessment	Assessment of Learning Outcomes by both the faculty and training mentor of the Industry.	120	6
			Final Assessment	Training Report	20	3
				Demonstration	30	3
				Viva -Voce	10	2
TOTAL					**300**	**20**

FIRST YEAR

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING

SCHEME OF INSTRUCTIONS AND EXAMINATIONS

FIRST YEAR

	Subject Code	Name of the Subject	Periods per week	Total Periods	Credits	Scheme of Examination			
						Duration (Hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY SUBJECTS	26EE101T	English Essentials	3	90	4	3	30	70	100
	26EE102T	Engineering Mathematics - I	6	180	6	3	30	70	100
	26EE103T	Engineering Physics	3	90	5	3	30	70	100
	26EE104T	Engineering Chemistry & Environmental Studies	3	90	5	3	30	70	100
	26EE105T	Basic Electrical & Electronics Engineering	6	180	6	3	30	70	100
	AUDIT SUBJECT								
	26EE106A	Electrical Safety Practices	2	60	--	--	--	--	--
	TOTAL THEORY		**23**	**690**	**26**	--	**150**	**350**	**500**
PRACTICAL SUBJECTS	26EE107 D	Engineering Drawing	4	120	3	3	40	60	100
	26EE108L	Basic Electrical & Electronics workshop	6	180	4	3	40	60	100
	26EE109L	Physics & Chemistry Laboratory	(1.5+1.5) 3	(45+45) 90	3	3	40	60	100
	26EE110L	Computer and Digital skills Laboratory	3	90	3	3	40	60	100
	--	Student Centric Activity	3	90	1	--	--	--	--
	TOTAL PRACTICAL		**19**	**570**	**14**	--	**160**	**240**	**400**
GRAND TOTAL			**42**	**1260**	**40**	--	**310**	**590**	**900**

ENGLISH ESSENTIALS
C26-Common-101

Course code	Course Title	No. Of periods/ week	Total No. of periods	Marks for FA	Marks for SA	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 Answer Questions	No. of Essay Questions	CO's Mapped
1.	Exploring English	10	11	1	1	CO1, CO2, CO3, CO4, CO5
2.	The Better You!	10	11	3	1	CO1, CO2, CO3, CO4, CO5
3.	Drive to Destiny!	10	14		1	CO1, CO2, CO3, CO4, CO5
4.	Renew, Rewire & Resolve!	10	14	1	1	CO1, CO2, CO3, CO4, CO5
5.	Brains & Bots	10		1		CO1, CO2, CO3, CO4, CO5
6	The Blue Planet: Mend or End	10	11	1	1	CO1, CO2, CO3, CO4, CO5
7	One World One Dream	10	11	1	1	CO1, CO2, CO3, CO4, CO5
8	The Net Norms	10	11	1	1	CO1, CO2, CO3, CO4, CO5
9	Managing Moods & Moments	10	11	1	1	CO1, CO2, CO3, CO4, CO5
	Total	**90**	**94**	**10**	**8**	

COURSE OBJECTIVES

(i)	To inculcate knowledge of functional English and enrich vocabulary.
(ii)	To impart effective listening, speaking, reading, and writing skills.
(iii)	To sensitise the students on themes related to personality, technological advancements, sustainability, and human values.

COURSE OUTCOMES:

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

CO1	COMMON101.1	Learn and apply various English grammatical concepts to communicate in academic, professional, personal, and social contexts.
CO2	COMMON101.2	Use appropriate vocabulary in academic, professional, and in business correspondence and on social media platforms.
CO3	COMMON101.3	Listen and understand, read and comprehend different forms of academic, professional, and general listening and reading materials.
CO4	COMMON101.4	Communicate effectively and fluently in oral and written forms in various life situations.
CO5	COMMON101.5	Display scientific temper and universal human values technology for holistic development and harmonious living through 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 certain rules of spelling, correct the misspelt words and use dictionary to enrich vocabulary

1.3 To identify various parts of speech suitable to 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 positive attitude in personal and academic spheres.

3.0 DRIVE TO DESTINY

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

3.2 To distinguish word pairs and use them contextually.

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

3.4 To describe actions using appropriate tense.

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 recognize 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 the skills of critical thinking and creativity in solving problems.

5.0 Brains & Bots

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

5.2 To communicate using phrasal verbs intelligibly.

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 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 to a third person with necessary grammatical changes.

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

7.5 To appraise the importance of inclusivity in the 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 summarize 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 organized and comprehensive reports on experiments, events, visits and incidents.

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

CO-PO/PSO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PS02	PS03

CO1	PO's 1 to 4 are not directly applicable for English course. However, activities that use content from science and technology relevant to the Programme taken up by the student shall be exploited for communication in the Course.					3	2	Programme Specific Outcomes are Branch specific with technical aspects which are not directly applicable to English Language course.		
CO2						3	2			
CO3						3	2			
CO4						3	2			
CO5					1		2			
Average					1	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

The text book "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, Grammar. The activities will be designed as Individual, Pair and Group activities to facilitate self and peer learning.

REFERENCE BOOKS

Martin Hewings : *Advanced Grammar in Use,* Cambridge University Press

Murphy, Raymond : *English Grammar in Use,* Cambridge University Press
Sidney Greenbaum : *Oxford English Grammar*, Oxford University Press
Wren and Martin (Revised by N.D.V. Prasad Rao): *English Grammar and Composition*, Blackie ELT Books, S. Chand and Co.
Sarah Freeman : *Strengthen Your Writing*, Macmillan

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TESTS I, II & III

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

C-26 Common-102
ENGINEERING MATHEMATICS-I
(Common to all Branches)

Course Code	Course Title	No. of Periods/ week	Total No. of periods	Marks for FA	Marks for SA	Credits
26EE102T	Engineering Mathematics-I	6	180	30	70	6

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

TIME SCHEDULE

S.No.	Chapter	No. of Periods	Marks Allotted	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	15	1	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	8	0	1	CO5

	Total	180	94	10	8	
			Marks	30	64	

COURSE OBJECTIVES

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

COURSE OUTCOMES

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

LEARNING OUTCOMES

UNIT - I

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.

UNIT - II

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±B), cos(A±B),tan(A±B) and cot(A±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 $\sin^2 A = (1 - \cos 2A)/2$ 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 into a 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.

Syllabus for Unit test-I completed

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 $a\sin x + b\cos x = c$.

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.

UNIT - III

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, intersection of 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 $y^2 = 4ax$.

Syllabus for Unit test-II completed

UNIT - IV

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

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

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

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

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

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

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

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

4.8 Find the derivatives of hyperbolic and inverse hyperbolic functions.

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

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

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

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

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

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

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

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

UNIT - V

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) $\int f(ax+b)\,dx$, *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

Syllabus for Unit test-III completed

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PSO 1**	**PSO 2**	**PSO 3**
CO 1	3	2	2	3				3	2	2
CO 2	3	3	2	2				3	2	2
CO 3	3	3	2	2				3	2	2
CO 4	3	3	3	3				3	3	3
CO 5	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±B), cos(A±B), tan(A±B), cot(A±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, tan x = k, where k is a constant. Solutions of simple quadratic equations and equations of type a sin x + b cos x=c.
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.

REFERENCE BOOKS

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

SUGGESTED E-LEARNING REFERENCES

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

UNIT TEST SYLLABUS

Unit Test	Learning Outcomes to be Covered
Unit Test – 1	From 1.1 to 2.11
Unit Test – 2	From 2.12 to 3.8
Unit Test – 3	From 4.1 to 5.14

COMMON-103- ENGINEERING PHYSICS

Course Code	Course Title	No. of Periods/ week	Total No. of periods	Marks for FA	Marks for SA	Credits
26EE103T	Engineering Physics	3	90	30	70	05

TIME SCHEDULE

S. No	Major Topics	No. of Periods	Marks Allotted	No. of Short Questions	No. of Essay Questions	COs
1.	Units and Measurements	09	06	2	0	CO1
2.	Elements of Vectors	11	11	1	1	
3.	Mechanics	10	11	1	1	CO2
4.	Fundamentals of Astrodynamics	13	19	1	2	
5.	Energy and Thermal Physics	12	11	1	1	CO3
6.	Concepts of Acoustics	12	14	2	1	
7.	Electricity and Magnetism	13	11	1	1	CO4
8.	Modern Physics	10	11	1	1	
	Total	**90**	**94**	**10**	**08**	

COURSE OBJECTIVES

Upon completion of the course the student shall be able to

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

COURSE OUTCOMES

CO1	103.1	Familiarize with various physical quantities, their SI units and errors in measurements; Understand the concepts of vectors for solving engineering problems.
CO2	103.2	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	103.3	Familiarize with the knowledge of various forms of energy, thermal physics and concepts of acoustics in relevance to the societal requirements.
CO4	103.4	Familiarize with the basic knowledge of electricity, magnetism and advances in Modern Physics such as photoelectric cell, optical fibers, superconductors and nanotechnology.

LEARNING OUTCOMES

Upon completion of the course the student shall be able to

1 Units and Measurements

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

2 ELEMENTS OF VECTORS

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

(i) Bow and arrow (ii) working of a sling (iii) Flying of a bird.
2.11 Define dot product (scalar product) of two vectors.
2.12 Explain (i) work done (ii) power as examples of dot product.
2.13 Define cross product (vector product) of two vectors.
2.14 Explain (i) linear velocity (ii) torque as examples of cross product.
2.15 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 Explain the concept of echo.
6.12 Mention the applications of echo.
6.13 Define reverberation and reverberation time.
6.14 Write Sabine's formula and name the parameters in it.
6.15 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 Explain the concept of magnetic field.
7.8 Define uniform and non-uniform magnetic fields.
7.9 Define magnetic pole strength; Mention its SI unit.
7.10 Define magnetic moment; Mention its SI unit.
7.11 Define magnetic lines of force.
7.12 Write the properties of magnetic lines of force.
7.13 State Coulomb's inverse square law of magnetism. Write its equation.
7.14 Derive the expression for the moment of couple acting on a bar magnet placed in a uniform magnetic field.
7.15 Solve numerical problems on (i) Ohm's law (ii) Kirchhoff's first law (iii) Wheatstone 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

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

CO-PO MAPPNG STRENGTH

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

Common-103	**Engineering Physics**				**No of periods: 90**
POs	Mapped with CO No	CO periods addressing PO in Column-1		Level 1,2,3	Remarks
		No	%		
PO1	CO1,CO2,CO3,CO4	39	43.3%	3	>40% level 3 (highly addressed)
PO2	CO1,CO2,CO3,CO4	15	16.6%	1	
PO3	CO1,CO2,CO3,CO4	8	8.8%	1	25% to 40% level 2 (moderately addressed)
PO4	CO1,CO2,CO3,CO4	8	8.8%	1	
PO5	CO1,CO2,CO3,CO4	9	10.0%	1	
PO6	-	-	-	-	5%to25% level 1 (Low addressed)
PO7	CO1,CO2,CO3,CO4	11	12.2%	1	<5%(not addressed)

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- Echo- Reverberation - Reverberation time-Sabine 's formula - Problems.

7. **Electricity and Magnetism**

   Ohm's law- Resistance - Specific resistance - Kirchoff's laws - Wheatstone's 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
4. Dr. S.L Guptha and Sanjeev Guptha
5. Concepts of Physics, Vol 1 & 2 H.C. Verma

6. Text book of physics Volume I — Resnick & Holiday
7. Fundamentals of physics — Brijlal & Subramanyam
8. Text book of applied physics — Dhanpath Roy
9. NCERT Text Books of physics — Class XI & XII Standard
10. e-books/e-tools/websites/Learning Physics software

Table showing 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 6.15
Unit test - 3	From 7.1 to 8.12

ENGINEERING CHEMISTRY AND ENVIRONMENTAL STUDIES

Course Code	Course Title	No. of Periods per Week	Total No. of Periods	Marks for FA	Marks for SA	Credits
26EE104T	Engineering Chemistry and Environmental Studies	3	90	30	70	5

TIME SCHEDULE

Chapter No.	Unit Title/ Chapter	No. of Periods	Weightage	No. of Short Questions (3 marks)	No. of Essay Questions (8 marks)	COs Mapped
1	Basic Concepts of Chemistry	14	18	2	1.5	CO1
2	Solutions, Acids and Bases	14	15	1	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	6	2	0	CO4
7	uels and lternative nergy Sources	6	3	1	0	CO4
8	Environmenta lStudies	18	19	1	2	CO5
TOTAL		**90**	**94**	**10**	**8**	**CO1,CO2, CO3,CO4, CO5**

COURSE OBJECTIVES

Upon completion of course the student shall be able to	
(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

CO1	104.1&104.2	Explain the basics of atomic structure, chemical bonding, oxidation-reduction, mole concept, concentration expressing methods of solutions, acids-bases, pH and buffer solutions.
CO2	104.3 & 104.4	Explain electrolysis, Galvanic cell, batteries and corrosion.
CO3	104.5	Explain the chemistry involved in the treatment of hardness in water.
CO4	104.6 & 104.7	Explain the preparation and applications of polymers, and understand the composition and uses of alloys, nanomaterials and green fuels.
CO5	104.8	Explain environmental concepts, pollution types, global issues, green chemistry principles and sustainable development goals.

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.

CO-PO/PSO Mapping

CO/PO	**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**	**0**	**0**	**0**

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 Visits etc.

COURSE CONTENT

1.Basic Concepts of Chemistry

Atomic Structure:

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

Chemical Bonding:

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

2.Solutions, Acids and Bases

Solutions:

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

Acids and Bases:

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

3.Electrochemistry

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

4.Corrosion

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

5.Water Treatment

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

6.Polymers and Engineering Materials

Polymers:

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

Engineering Materials:

Alloys - Definition - Composition and applications of (i). Stainless Steel and (ii). Nitinol

Nano Materials – Definition - Applications of (i) Graphene and (ii). Nanotubes.

7.Fuels and Alternative Energy Sources

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

8.Environmental Studies

Introduction - Importance of environmental studies – Important terms related to environment – Pollution, Pollutant, Sink, Receptor, Particulate Matter, Dissolved Oxygen (DO), Threshold Limit Value (TLV) - Uses of forest resources – Deforestation - Definition – causes, effects, controlling methods –Air pollution – Definition, causes, effects, controlling methods - Global impacts of Air pollution – Global warming, Ozone layer depletion, Acid rain – Water pollution – Definition, causes, effects, controlling methods – e - pollution, Definition, sources, effects, management - Green Chemistry – Definition – Principles of Green Chemistry – Sustainable Development – Definition – Goals.

REFERENCE BOOKS

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

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TEST-I, UNIT TEST-II & UNIT TEST-III

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

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

Course code	Course title	No. of periods / week	Total no. of Periods	Marks for FA	Marks for SA	Credits
26EE105T	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	06	180	30	70	06

TIME SCHEDULE

S. No	Unit Title	No. of periods	Weightage of marks	No. of short Ans Questions	No. of Essay Questions	CO's Mapped
1	Fundamentals of Electricity	35	14	2	1	**CO1**
2	Circuit Analysis and Energy Concepts	40	22	2	2	**CO2**
3	Magnetism and Electromagnetism	45	22	2	2	**CO3**
4	Electrostatics, Capacitance, and Dielectrics	30	14	2	1	**CO4**
5	Introduction to Electronics and PCB Design	30	22	2	2	**CO5**
TOTAL		**180**	**94**	**10**	**8**	

COURSE OBJECTIVES

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 and PCBs

COURSE OUTCOMES

CO1	26EE105T.1	Understand basic principles of electricity, including conductors, insulators, and semiconductors, and solve problems related to Ohm's Law and resistance.
CO2	26EE105T.2	Familiarize with various laws and analysis of resistive circuits, including series, parallel, and star-delta transformations.
CO3	26EE105T.3	Understand magnetic effects of electric current and electromagnetic induction, including magnetic circuits, Faraday's laws, and magnetic materials.
CO4	26EE105T.4	Understand electrostatics, capacitance, and insulating materials, including Coulomb's laws, capacitance calculations, and dielectric properties.
CO5	26EE105T.5	Understand basic electronics, including semiconductor materials, diodes, and the principles of PCBs.

LEARNING OUTCOMES

1. Fundamentals of Electricity

1.1 Distinguish between conductors, insulators and semi-conductors based on valency electrons.
1.2 Define Electric Current, Potential difference, Voltage and 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 State the main properties of low resistive materials and high resistive materials
1.13 List some examples of low resistive materials and high resistive materials
1.14 Mention the properties and list the applications of copper and aluminium conductors.
1.15 List the application of ACSR conductors and AAAC
1.16 List the applications of Nichrome, Tungsten and Carbon
1.17 List the various protective materials like Lead, Paints, steel tapes etc.,
1.18 Explain the thermocouple materials
1.19 List the Bi-metals
1.20 Explain the process of galvanization and impregnation

2. Circuit Analysis and Energy Concepts

2.1 Develop the expressions for equivalent Resistance with simple SERIES and PARALLEL connections
2.2 Solve problems on equivalent resistance in case of Series - Parallel networks
2.3 State the concept of division of current when two/three Resistors are connected in parallel and solve the problems
2.4 Explain the concept of star and delta circuits
2.5 Give 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 State and explain electric Power and electrical Energy with Units
2.12 Solve simple problems on Electrical Power and Electrical Energy.
2.13 Calculate Electricity bill of domestic consumers as per the Electricity Tariff.
2.14 Define Joule's law and state its expression.
2.15 Define Thermal efficiency.
2.16 Solve problems on Electric heating.
2.17 List the applications of heat produced due to Electric current

3. Magnetism and Electromagnetism

3.1 State Coulombs laws of Magnetism
3.2 Define the terms Absolute and Relative Permeability of medium and give relation between them.
3.3 Explain the concept of lines of force & magnetic field
3.4 State Right hand Thumb rule
3.5 Draw the field patterns due to
(i) Straight current carrying conductor (ii) Solenoid
3.6 Explain and derive the expression for Mechanical force on a current carrying Conductor placed inside a Magnetic field.
3.7 State Fleming's Left-Hand rule
3.8 Define the terms MMF, Flux and Reluctance

3.9 Understand the concept of the Magnetic circuit
3.10 Compare Magnetic circuit with Electric circuit in different aspects
3.11 Explain the effect of air gap in a magnetic circuit
3.12 Explain the terms leakage flux and leakage co-efficient
3.13 State Faraday's laws of Electro-Magnetic Induction
3.14 Explain Dynamically and Statically induced E.M.Fs
3.15 State Lenz's law
3.16 Explain Fleming's Right-Hand rule
3.17 State the concept of Self and Mutual inductance and write their expressions
3.18 State Co-efficient of coupling
3.19 State the expression for the energy stored in a magnetic field
3.20 Draw (i) B-H Curve (ii) Hysteresis loop
3.21 Explain Hysteresis loop
3.22 Explain Hysteresis loss and State Steinmetz equation (No-Problems)
3.23 Explain Eddy Current Losses
3.24 State Curie point
3.25 Define Magnetostriction
3.26 Classify the Magnetic Materials
(i)Ferro (ii) Para (iii) Dia-Magnetic materials with examples
3.27 Explain (i) Soft Magnetic materials (ii) Hard Magnetic materials

4. Electrostatics, Capacitance, and Dielectrics

4.1 State Coulomb's laws of Electrostatics and solve the problems
4.2 Define the following terms
(i) Unit Charge (ii) Absolute permittivity (iii) Relative permittivity
(iv) Electric Flux (v) Flux Density (vi) Field intensity
4.3 Draw the field patterns due to
i) Isolated positive charge
ii) Isolated negative charge
iii) Unlike charges placed side by side
iv) Like charges placed side by side
4.4 Compare Electrostatic and Magnetic lines of force in different aspects.
4.5 Define Capacitance and state factors affecting the capacitance of a capacitor
4.6 Derive the formula for capacitance of a parallel plate capacitor
4.7 Derive an expression for equivalent capacitance
i) When two Capacitors are connected in series
ii) When two Capacitors are connected in parallel
4.8 Derive an expression for the Energy stored in a capacitor
4.9 Define Di-electric strength and Di-electric constant
4.10 Explain Di-electric Loss
4.11 Know the Permittivity of commonly used di – electric materials
(i) Air (ii)Bakelite (iii)Glass (iv)Mica
(v)Paper (vi) Porcelain (vii) Transformer oil
4.12 List any four applications of Di-electrics
4.13 Define Insulating Materials.
4.14 Define Insulation resistance and explain factors affecting insulation resistance
4.15 Classify insulating materials
4.16 State the properties and applications of
(i) Impregnated paper (ii) Wood (iii)Asbestos (iv)Mica
(v) Ceramics (vi) Glass

5 Introduction to Electronics and PCB Design

5.1 Define Semi-conductor Materials
5.2 Define 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 List the manufacturer specifications of PN & Zener Diode
5.9 Explain Light emitting Diode (LED)
5.10 List the materials used in construction of LED's
5.11 Give applications of various diodes.
5.12 State the need of Filters in Power Supply
5.13 List different types of filters used in Power Supply
5.14 Explain the working of voltage regulated Power Supply using Zener Diode
5.15 Explain the need of PCB in electronic equipment
5.16 Classify the PCB's and list the types of laminates used in PCB's
5.17 List the methods of transferring layout on to the copper clad sheet
5.18 List the materials used in screen-printing
5.19 List the steps involved in screen-printing for making PCB's
5.20 Explain the methods of etching, cleaning and drilling of PCB's
5.21 Explain the steps involved in making double-sided PCB
5.22 Explain surface mount technology and its uses
5.23 List the materials used in soldering
5.24 List the soldering methods of PCB's

HYPHENATED COURSE CONTENTS:

- **Fundamentals of Electricity:** 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 and applications (Copper, Aluminum, ACSR, AAAC, Nichrome, Tungsten, Carbon) - Protective materials - Thermocouple materials - Bi-metals - Galvanization and Impregnation.
- **Circuit Analysis and Energy Concepts:** 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.
- **Magnetism and Electromagnetism:** Coulombs laws of Magnetism - Absolute and Relative Permeability - lines of force & magnetic field - Right hand Thumb rule - Field patterns (straight conductor, solenoid) - Mechanical force on a current carrying Conductor - Fleming's Left-Hand rule - MMF, Flux and Reluctance - Magnetic circuit concept and comparison with Electric circuit - effect of air gap, leakage flux and leakage co-efficient - 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, Hysteresis loss, Steinmetz equation - Eddy Current Losses - Curie point - Magnetostriction - Classification of Magnetic Materials (Ferro, Para, Dia-Magnetic) - Soft and Hard Magnetic materials.
- **Electrostatics, Capacitance, and Dielectrics:** Coulomb's laws of Electrostatics - Unit Charge, Absolute permittivity, Relative permittivity, Electric Flux, Flux Density, Field intensity - Field patterns (isolated charges, unlike/like charges) - Comparison of Electrostatic and Magnetic lines of force - 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 - Di-electric Loss - Permittivity of commonly used di-electric materials - Applications of Di-electrics - Insulating Materials - Insulation resistance and factors affecting it - Classification of insulating materials - Properties and applications of Impregnated paper, Wood, Asbestos, Mica, Ceramics, Glass.

- **Introduction to Electronics and PCB Design:** Semi-conductor Materials - Intrinsic and Extrinsic semiconductors - P-type and N-type Semi-conductors - Junction Diode (working, V-I Characteristics) - Zener Diode (working, specifications) - Light emitting Diode (LED) (working, materials, applications) - Filters in Power Supply - Voltage regulated Power Supply using Zener Diode - Need for PCB - Classification of PCBs - Types of laminates - Methods of transferring layout - Materials and steps in screen-printing - Etching, cleaning and drilling of PCBs - Double-sided PCB making - Surface mount technology and uses - Soldering materials and methods.

REFERENCE BOOKS:

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

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 2.11 to 4.8
Unit Test – III	From 4.9 to 5.24

ELECTRICAL SAFETY PRACTICES

Course code	Course title	No. of periods/ week	Total no.of periods	Marks for FA	Marks for SA	Credits
26EE106A	ELECTRICAL SAFETY PRACTICES	02	60	-	-	_

COURSE OUTCOMES MAPPING:

S.No	Unit Title	No. of Periods	CO'S Mapped
1	Fundamentals of Electricity and Hazards	12	CO1
2	Electrical Safety Regulations and Standards	12	CO2
3	Safe Work Practices and Procedures	12	CO3
4	Electrical System Protection and Maintenance	12	CO4
5	Emergency Preparedness and Case Studies	12	CO5

Upon completion of the course the student shall be able to	
Course Objectives	i)To familiarize with the fundamental concepts of electricity and associated hazards.
	ii)To comprehend the electrical safety regulations, standards, and safe work practices.
	iii)To know the concept of electrical system protection, maintenance, and emergency response.

COURSE OUTCOMES:

Course Outcomes	CO1	26EE106A-1	Explain the basic electrical concepts and identify common electrical hazards and their effects.
	CO2	26EE106A-2	Analyse relevant electrical safety codes, regulations, and the importance of Personal Protective Equipment (PPE).
	CO3	26EE106A-3	Describe safe work procedures, including Lockout/Tagout (LOTO), and first aid for electrical incidents.
	CO4	26EE106A-4	Comprehend various electrical protection devices, grounding systems, and the significance of preventive maintenance.
	CO5	26EE106A-5	Understand emergency preparedness for electrical incidents, fire safety, and lessons from past accidents.

LEARNING OUTCOMES:

1. Fundamentals of Electricity and Hazards

1.1 Define basic electrical terms such as Voltage, Current, Resistance, Power and Energy.
1.2 State Ohm's Law and the Power Law.
1.3 Distinguish between Alternating Current (AC) and Direct Current (DC) electricity.
1.4 Explain the concept of electric shock, arc flash and arc blast hazards.
1.5 Describe the physiological effects of electric current on the human body, including burns and fibrillation.
1.6 List common causes of electrical accidents, including unsafe equipment and human error.
1.7 Understand the dangers of electrical fires and explosions.

2. Electrical Safety Regulations and Standards

2.1 State the purpose and importance of national and international electrical safety standards (e.g., NEC, OSHA, IS, IEC).
2.2 Explain the role of regulatory bodies and the legal implications of non-compliance in electrical safety.
2.3 Recognize and interpret electrical safety signs (danger, warning, caution), labels and tagging.
2.4 List different types of Personal Protective Equipment (PPE) specifically designed for electrical work.
2.5 Explain the proper selection, inspection, care, and use of electrical PPE.
2.6 Understand the concept of arc flash ratings and categories for protective clothing.
2.7 Identify colour codes for electrical wiring and components.

3. Safe Work Practices and Procedures

3.1 Explain the purpose and critical importance of Lockout/Tagout (LOTO) procedures.
3.2 Describe the six-step LOTO procedure for effective energy control.
3.3 Distinguish between working on de-energized and energized (live) circuits and when energized work is permissible.
3.4 State the minimum approach distances (MAD) for energized conductors and equipment.
3.5 Explain the safe use, inspection, and maintenance of insulated electrical hand tools and portable equipment.
3.6 Describe immediate first aid actions and Cardiopulmonary Resuscitation (CPR) for electrical shock victims.
3.7 Understand the proper handling and testing of electrical instruments like mustimeters and insulation testers.

4. Electrical System Protection and Maintenance

4.1 Classify different types of overcurrent protection devices, including fuses and various types of circuit breakers (MCB, MCCB, ACB).
4.2 Explain the working principle and applications of Residual Current Devices (RCDs) / Ground Fault Circuit Interrupters (GFCIs).
4.3 State the purpose and fundamental importance of earthing/grounding systems for safety and fault current paths.
4.4 List the key components of an earthing system and methods for testing earth resistance.
4.5 Explain the importance and benefits of preventive maintenance for electrical systems.
4.6 Describe common electrical maintenance activities such as cleaning, tightening connections, and lubrication.
4.7 Understand diagnostic techniques like thermography for identifying potential electrical issues.

5. Emergency Preparedness and Case Studies

5.1 Develop and implement effective emergency response plans for electrical incidents.
5.2 Classify different types of fire and identify appropriate fire extinguishers (especially Class C/E) for electrical fires.
5.3 Explain essential fire prevention strategies in electrical rooms and installations.
5.4 Describe the systematic steps involved in investigating electrical accidents.
5.5 Analyse real-world electrical accident scenarios to understand contributing factors.
5.6 Discuss key lessons learned from past electrical accidents to prevent recurrence.
5.7 Understand the importance of continuous learning and improvement in electrical safety practices.

CO-PO/PSO MATRIX

CO.No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PS01	PS02	PS03
26EE106A-1	3	-	-	-				2		
26EE106A-2	3	1	-		1			2	2	1
26EE106A-3	3	3	-	3	1	1	1	2	2	1
26EE106A-4	1		2	3			1	2	2	
26EE106A-5	-	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

HYPONATED COURSE CONTENTS

Fundamentals of Electricity and Hazards:

Basic electrical terms – Voltage, Current, Resistance, Power, Energy – Ohm's Law – Power Law – AC vs. DC electricity – Electric shock – Arc flash – Arc blast – Electrical fire – Explosions – Effects of electricity on human body – Physiological effects – Burns – Fibrillation – Common causes of electrical accidents – Unsafe equipment – Unsafe work practices – Environmental factors – Human error.

Electrical Safety Regulations and Standards:

Electrical safety codes and standards – NEC, OSHA, IS, IEC – Purpose and importance – Regulatory bodies – Compliance – Legal implications – Safety signs – Labels – Tagging – Color codes – Personal Protective Equipment (PPE) – Types of electrical PPE – Insulating gloves – Arc-rated clothing – Safety glasses – Face shields – Selection – Inspection – Care – Arc flash ratings.

Safe Work Practices and Procedures:

Lockout/Tagout (LOTO) procedures – Purpose – Six-step LOTO – Types of energy sources – LOTO devices – Group LOTO – Working on de-energized circuits – Energized work (Live work) – Justifications – Qualified personnel – Minimum approach distances (MAD) – Insulated tools – Safe

use of electrical tools – Portable equipment safety – Testing instruments – First aid for electrical shock – Burns – CPR – Artificial Respiration – Seeking medical attention.

Electrical System Protection and Maintenance:

Overcurrent protection devices – Fuses – Circuit Breakers (MCB, MCCB, ACB) – Working principles – Ratings – Coordination – Residual Current Devices (RCDs) – Ground Fault Circuit Interrupters (GFCIs) – Working principle – Purpose – Applications – Earthing / Grounding systems – Purpose – Importance – Types of earthing systems (TT, TN, IT) – Components of earthing system – Earth resistance testing – Preventive maintenance – Importance – Common activities – Cleaning – Tightening connections – Thermography – Record keeping.

Emergency Preparedness and Case Studies:

Emergency response plans – Electrical incidents – Developing plans – Roles and responsibilities – Evacuation procedures – Communication protocols – Fire safety in electrical installations – Causes of electrical fires – Classes of fire – Fire extinguishers (Class C/E) – Fire detection systems – Fire prevention strategies – Investigation of electrical accidents – Steps in investigation – Root causes – Reporting – Documentation – Case studies of electrical accidents – Lessons learned – Prevention strategies.

ENGINEERING DRAWING

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

TIME SCHEDULE

S. No	Unit Title	No. of periods	Weightage of marks	No. of short Ans Questions	No. of Essay Questions	CO's Mapped
1	Use of Drawing Instruments, Free Hand Lettering and 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 AND COURSE OUTCOMES

Course Objectives	1. **To develop fundamental skills in engineering drawing** through the proper use of drawing instruments, freehand lettering, dimensioning, and principles of geometric constructions.
	2. **To enhance visualization and interpretation abilities** by learning projections of points, lines, planes, and solids, along with sectional views.
	3. **To enable accurate representation of engineering objects** using orthographic projection techniques for effective communication in technical fields.

Course Outcomes	CO1	26EE109D.1	Practice the use of engineering drawing instruments and Familiarise with the conventions to be followed in engineering drawing as per BIS.
	CO2	26EE109D.2	Construct the i) basic geometrical constructions ii) engineering curves.
	CO3	26EE109D.3	Visualise and draw the projections of i) Points ii) Lines iii) Regular Planes iv) Regular Solids .
	CO4	26EE109D.4	Visualise and draw the sectional views of components.
	CO5	26EE109D.5	Visualise and draw the orthographic projections of components.

LEARNING OUTCOMES

Upon completion of the course the student shall able to

1.0 Use of Drawing Instruments, Free Hand Lettering and 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 slopping (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

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

3.1 Explain the basic principles of the orthographic projections
3.2 Visualise and draw the projection of a point with respect to reference planes (HP & VP)
3.3 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)
3.4 Visualise and draw the projections of planes (up to planes perpendicular to one plane and inclined to other plane)
3.5 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.	Use of Drawing Instruments, Free Hand Lettering and Dimensioning Practice	• Explain the linkages between Engineering drawing and other subjects 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 CONTENTS:

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 Use of Drawing Instruments, Free Hand Lettering and Dimensioning Practice

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

REFERENCE BOOKS

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

26EE107D	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
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: High, 2: Moderate,1: Low

Table specifying syllabus to be covered for UNIT TEST I, II and III.

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

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

TIME SCHEDULE

S.no	Chapter Title	No. of Periods	CO'S 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

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	26EE108L.1	Understanding various tools and know their usage
CO2	26EE108L.2	Perform different joints and perform various lamp control methods
CO3	26EE108L.3	Understand the test procedure and able to repair domestic appliances

CO4	26EE108L.4	Illustrating the characteristics of various electronic devices and perform soldering of electronic components.

LEARNING OUTCOMES

1. Wiring Tools and Accessories

1.1. 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 & DrillingBits.
d) Rawl plug jumper, andpoker
e) Voltage/linetester
f) Splicers (insulationremover)
g) Standard Wiregauge

1.2. Identify different types of Electrical Wiring accessories with respect to
i) Size ii) Shape iii) Purpose iv) Use.

a) Switches
b) Ceilingroses
c) Lamp Holders andAdopters
d) Sockets
e) Plug
f) Fuses

1.3. 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

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-pinsocket.
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'sandtwo1-wayswitches.
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

3.1. Testing and repair of electric heater
3.2. Testing and repair of iron box.
3.3. Testing and repair of electric kettle.
3.4. Testing and repair of electric cooker.
3.5. Testing and repair of electric geyser

4. Electronic devices and soldering practice

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 Zenor diode.
4.12. Plot the V-I characteristics of photo diode.
4.13. Plot the V-I characteristics of LDR.
4.14. Familiarisation to use soldering tools and components.
4.15. Soldering simple electronic circuits on PCB.

HYPONATED COURSE CONTENTS:

1. **Electrical-Wiring-Tools:** Identification and purpose 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-pinsocket - 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'sandtwo1-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:** Testing and repair of electric heater, iron box, electric kettle, electric cooker, electric geyser

4. **Electronic devices and soldering practice: T**ypes 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 MATRIX

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
26EE108L.1	3	1						3		
26EE108L.2	3		1	1	1.5			3	1.5	
26EE108L.3	3	1						3	1.5	
26EE108L.4	3							3	1.5	
Average	**3**	**0.5**	**1**	**1**	**1.5**			**3**	**1.5**	

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

COMPETENCIES TO BE ACHIEVED BY THE STUDENT:

S.No	Competencies	Key Competencies
1	Handle the differentwiringtools andaccessories a) Selectswitches,andMCB's b) Identify wiresandcablesas per the requirements of theload.	● Identify the size and specifications of various tools used for electricalwiring. ● Understand the usage of the standard wiregauge. ● 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 thecable ● Perform splicing of Insulationproperly. ● Perform Straight joint/Marriedjoint
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 wiresproperly.
2.3	To prepare a Western union joint using a single strand Al. Cable	● Overlap the two wiresproperly ● Twist the binding wiresproperly
2.4	To prepare a Pig tail joint using a single strand Copper Cable	● Place the wires inV-shape. ● Twist the wires in clock wisedirection.
2.5	To control one lamp by one 1-way switch with PVC surface conduit wiring system	● Draw wiringdiagram ● Identify the size of cable, PVC pipe, type of1-way switch and lampholder. ● Make Connections as per WiringDiagram

2.6	To control two lamps by two 1-way switches with PVC surface conduit wiring system	● Draw wiringdiagram ● Handle the screw driver, electrician Knife, line tester to fix the PVC pipe using saddles and junctionboxes. ● 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 andearth. ● Connect phase wire throughswitches.
2.8	Stair-case wiring	● Select two 2-wayswitches ● Connect 2- way switches as per circuitdiagram. ● Test with 1-phase, 230V, 50 Hz supply to the circuit connected through ICDPswitch.
2.9	Go-down wiring scheme	● Draw wiringdiagram ● Connect the circuit as per thediagram. ● Observe sequence of operation ofswitches ● 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 wiringdiagram. ● Draw wire through PVC pipeproperly ● Observe glow intensity of lamps for series and parallelconnections
2.11	Control two sub circuits through Energymeter,MCB'sandtwo1-way switches	● Draw wiringdiagram. ● Identify the size of cable,1-way switch, PVC pipe, MCB, capacity of Inverter andSocket ● Read the specifications of MCB, capacity of Inverter andSocket ● Make connections as per wiringdiagram. ● Draw wire through PVC pipeproperly. ● Connect supply to Inverter through MCBproperly. ● Select appropriate socket with switchcontrol. ● Make earth wire connections for requiredpoints.
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 lampholder ● Make connections as per wiringdiagram. ● Draw wire through PVC pipeproperly. ● 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 ICDPswitch. ● Test by changing any two phases of inputsupply
2.13	Wiring practice of fluorescent lamp	● Make connections as per wiringdiagram. ● Connect top point and bottom point of the choke to tube lightproperly. ● Note the importance and working ofstarter.

2.14	Connect computer by main switch board with a miniature circuit breaker.	● Draw wiringdiagram. ● Identify the size of cable, 1-way switch, PVC pipe, MCB andSockets ● Read the specifications of MCB andSockets ● Make connections as per wiringdiagram. ● Connect supply to Computer through MCB properly. ● Select appropriate sockets with 1-way switch control. ● Make earth wire connections for requirepoints.
3.1	Testing and repair of domestic appliances	● Inspect the appliancevisually. ● Check for anydiscrepancies. ● Perform the disassemblingoperation ● Test the inner parts for anyfaults ● Rectify the faults if any. ● Replace the parts ifnecessary. ● Perform theassembling. ● Test theDomestic 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 Familiarise 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(PNjunction 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.

PHYSICS & CHEMISTRY LAB

PHYSICS LAB

Course Code	Course title	No. of Periods/week	Total no of periods	Marks For FA	Marks For SA
26EE109L	Physics Lab	1.5	45	20	30

TIME SCHEDULE

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

COURSE OBJECTIVES

Upon completion of the course the student shall be able to

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

COURSE OUTCOMES

CO1	109.1	Apply measurement techniques to improve accuracy; Explain forces maintaining equilibrium in physical systems.
CO2	109.2	Determine acceleration due to gravity experimentally; Investigate refraction of light at curved surfaces; Relate the gas pressure to volume variations at constant temperature.
CO3	109.3	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	109.4	Apply Kirchhoff's laws to compute the resistivity of a wire; Examine the projectile motion parameters; Observe and Interpret beat generation phenomenon.

LEARNING OUTCOMES

Upon completion of the course the student shall be able to

1. **Apply** measurement techniques using Vernier Calipers to **determine** the volumes of a cylinder and a sphere.
2. **Use** a screw gauge to **measure** and **determine**the thickness of a glass plate and the cross-sectional area of a wire.
3. **Verify** Lami's Theorem by **analyzing** 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

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

CO-PO MAPPNG STRENGTH

Common-109	**Physics Lab**				**No of periods: 90**
POs	Mapped with CO No	CO periods addressing PO in Column 1		Level 1,2,3	Remarks
		No	%		
PO1	CO1,CO2,CO3,CO4	15	33.3%	2	>40% level 3 (highly addressed)
PO2	CO1,CO2,CO3,CO4	6	13.3%	1	
PO3	CO1,CO2,CO3,CO4	5	11.1%	1	25% to 40% level2 (moderately addressed)
PO4	CO1,CO2,CO3,CO4	6	13.3%	1	
PO5	CO1,CO2,CO3,CO4	5	11.1%	1	5% to 25% level1 (Low addressed)
PO6	CO1,CO2	3	6.7%	1	
PO7	CO1,CO2,CO3,CO4	5	11.1%	1	<5% (not addressed)

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) Tech fest (vii) Mini project (viii) Group discussions (ix) Virtual labs (x) Library visit for e-books

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 thicknessand cross-sectional area	• Analyze scale readings for zero error • Compute thickness and area from measurements • Apply micrometer data to solve practical problems
3. Verification of Lami's Theorem	• Setup experimental arrangement • Apply appropriate weights • Measure angles between forces • Analyze data to verify theorem	• Interpret directions and angles of forces • Evaluate force relationships • Validate Lami's Theorem using experimental data
4. Simple Pendulum	• Arrange the pendulum properly • Measure the time taken for 20 oscillations • 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	• Detect resonance points • Compute velocity using

	lengths • Calculate velocity of sound at room temperature and at 0°C.	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**

CHEMISTRY LAB

Course code	Course title	No. Of periods/ week	Total No. of periods	Marks for FA	Marks for SA	Credits
26EE109L	CHEMISTRY LAB	3	45	20	30	2

TIME SCHEDULE

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

COURSE OBJECTIVES

Upon completion of the course the shall be able to:	
(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, estimate copper using electrolysis, measure water turbidity, demonstrate the working of a galvanic cell and prepare a polymer.

COURSE OUTCOMES

CO1	110.1	Perform fundamental analytical chemistry techniques, identify chemical substances using sensory cues and accurately prepare standard solutions.
CO2	110.2	Evaluate and judge the neutralization point in acid base titration.
CO3	110.3	Evaluate the endpoint of reduction and oxidation reaction.
CO4	110.4	Judge the stable end point of complex formation, stable precipitation.
CO5	110.5	Determine the pH of compounds, estimate copper using electrolysis, measure water turbidity, demonstrate the working of a galvanic cell and prepare a polymer.

LEARNING OUTCOMES:

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

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

2.0 Identify the chemical compounds and solutions by senses.

3.0 Practice making standard Na_2CO_3 solutions.

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

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

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

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

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

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

10.0 Carry out the electrolysis process to estimate the amount of Copper deposited on an object.

11.0 Conduct the test on given samples of solutions (coloured and non-coloured) to determine their turbidity in NTU.

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

13.0 Understand the process of polymerization by preparing Bakelite, a thermosetting polymer and study its formation through a condensation reaction.

14.0 Collect water sample from nearby water body and test for any two parameters.

15.0 Collect water sample from nearby sewage/industrial effluent and test for any two parameters.

[Note: 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) Determination of Alkalinity of Water Sample (03) Estimation of Mohr's Salt Using Standard $KMnO_4$ 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 endpoint. • Making accurate

Determination of Total Hardness of Water Using Standard EDTA Estimation of Chlorides Present in Water Sample by Using Standard $AgNO_3$ Solution. (03)	stand • Effectively Controlling the flow of the titrant. • Identifying the endpoint. • Making accurate observations. • Calculating the results.	observations.
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.
Estimation of Amount of Copper Deposited 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 experimental	• Set up and perform an electrolysis experiment accurately and safely. • Analyze experimental data to calculate deposition of copper

Determination of Turbidity of Water Sample by Using Nephelometer. (03)	• Familiarize with instrument. • Choose appropriate 'Mode' / 'Unit'. • Prepare standard solutions / buffers, etc. • Standardize the instrument with appropriate standard solutions. • Make measurements	• Prepare standard solutions etc. • Standardize the instrument with appropriate standard solutions. • Make measurements accurately.
Construction and Working of Galvanic Cell. (03)	• Prepare standard solutions. • Selection of electrodes. • Making of salt bridge. • Construct a simple galvanic cell using appropriate electrodes and electrolyte solutions. • Explain the working principle of a galvanic cell, including electron flow, redox reactions,	• Construct a simple galvanic cell using appropriate electrodes and electrolyte solutions. • Explain the working principle of a galvanic cell, including electron flow, redox reactions, and the function of the salt bridge.
Preparation of a Polymer (Bakelite). (03)	• Identify and handle the raw materials (phenol and formaldehyde) used in Bakelite preparation safely. • Perform the polymerization reaction under controlled conditions. • Observe and describe the physical changes during polymer formation. • Develop laboratory skills related to synthesis and handling of polymers.	• Perform the polymerization reaction under controlled conditions. • Develop laboratory skills related to synthesis and handling of polymers.

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, nephelometer and digital balance) correctly.	• Prepares solutions accurately (molarity, dilutions, standardizations). • Uses instruments relevant to the experiment (e.g., pH meter, nephelometer 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)	• Calibrates and maintains instruments when needed. • Interprets instrumental output with understanding of underlying chemical principles. • Makes accurate, timely and detailed observations of chemical reactions (e.g., color changes, precipitate formation). • Records quantitative and qualitative data systematically. • Maintains an organized and complete lab notebook. • Works effectively in pairs or groups; shares responsibilities and discusses findings collaboratively. • Presents results through oral discussion, lab reports, or visual presentations using proper chemical terminology.	

REFERENCE BOOKS

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

TABLE SPECIFYING THE SCOPE OF SYLLABUS TO BE COVERED FOR UNIT TEST – I & UNIT TEST – II

Unit Test	Learning Outcomes to be Covered
Unit Test – 1	From Experiment 1 to 5
Unit Test – 2	From Experiment 6 to 10

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COMPUTER & DIGITAL SKILLS LAB

Course code	Course Title	No. of Periods / Week	Total No. of periods	Marks for FA	Marks for SA
26EE110L	COMPUTER & DIGITAL SKILLS LAB	3	90	40	60

TIME SCHEDULE:

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

COURSE OBJECTIVES	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	At the end of the course students will be able to		
	CO1	CM-107.1	Identify hardware and software components
	CO2	CM-107.2	Prepare documents with given specifications using word processing software
	CO3	CM-107.3	Use Spread sheet software to make calculation and to draw various graphs/charts.
	CO4	CM-107.4	Use Power point software to develop effective presentation for a given theme or topic.
	CO5	CM-107.5	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 row sand 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

11. To get familiarized with AI Tools
12. To get familiarized with working of Chat GPT
13. Identify Objects using AI Tools based on CNN, YOLO, SSD,R-CNN
14. To paraphrase text using AI Tools (PEGASUS,GPT, T5)
15. To use text-to-Image Generation AI Tools (DALL-E,MID JOURNEY)
16. To use voice command simulation AI Tools (SPEECH-TO-TEXT)
17. To get familiarized with ML Tools
18. To get familiarized with Quantum Computing Tools
19. To familiarize with quantum bits (qubits) using Dirac notation
20. To familiarize the behavior of single and multiple qubit gates.
21. To familiarize with Qubit as a Coin / Spin Analogy

Key competencies:

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

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/Graphs	a. Create charts and Bar graphs, Pie Charts and format.	a. Creating 3D Bar Graphs in PowerPoint b. Working with the Power Point Datasheet c. Formatting a PowerPoint Chart Axis d. Formatting the Bars of a Chart e. Creating Power Point Pie Charts f. Using Pie Chart Segments g. Creating 2D Bar Charts in Power Point h. Formattingthe2DChart 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, Roboflow, Edge Impulse, Hugging Face Demos). c) Observing and comparing the speed, accuracy, and bounding box behavior of different models.

36	Paraphrase text using AI Tools(PEGASUS,GPT,T5)	a. Get awareness about AI-powered text paraphrasing techniques. b. To explore the usage and functioning of transformer-based models like **PEGASUS**, **GPT**, and **T5**	a) Recognizing of Natural Language Processing (NLP) tasks and how transformer models like PEGASUS, GPT, and T5 can be used. b) Using AI tools to generate reworded versions of sentences or paragraphs while retaining the original meaning. c) Interacting with user-friendly interfaces like: • Hugging Face demos • ChatGPT • Quillbot • Parrot.ai
37	Text-to-Image Generation using AI Tools (DALL-E,MIDJOURNEY)	a) Get awareness about**text-to-image generation** using advanced AI models. b) To explore the usage of tools like **DALL·E** and **Mid journey** convert text prompts into realistic or artistic images.	a. Learning usage of how AI models generate visual content from natural language prompts. b. Formulating effective, clear, and creative text prompts to generate meaningful images. c. Enhancing creative thinking by translating ideas into visual representations using AI. 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 recognitio n 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**.	• Identify and interpret the basic qubit states: • $\|0\rangle = \begin{bmatrix}1\\0\end{bmatrix}$ • $\|1\rangle = \begin{bmatrix}0\\1\end{bmatrix}$ • Understand that a qubit can exist in a **superposition**: • $\|\psi\rangle = \alpha\|0\rangle + \beta\|1\rangle$, where α and β are complex numb 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**: ○ **Pauli-X (NOT)**: flips $\|0\rangle \leftrightarrow \|1\rangle$ ○ **Hadamard (H)**: creates superposition ○ **Pauli-Z**: applies a phase flip • **Multi-qubit gates**: ○ **CNOT**: flips target qubit based on control ○ **Toffoli (CCNOT)**: controlled-controlled NOT ○ **SWAP**: exchanges the states of two qubits
43	To familiarize with Qubit as a Coin / Spin Analogy	a) To introduce the concept of a **qubit** using intuitive physical analogies. b) To help students understand **quantum superposition** through the **coin toss** or **spin-½ particle** analogy.	a. Relate a **qubit in superposition** to a **coin spinning in the air**: • Classical coin: heads (0) or tails (1) • Spinning coin: both until observed ($\|0\rangle$ and $\|1\rangle$ at once) b.Use **spin analogy**: a particle with spin "up" ($\|0\rangle$) or "down" ($\|1\rangle$), or in between (superposition)

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

	Subject Code	Subject	Periods per week	Total Periods	Credits	Scheme of Examination			
						Duration (Hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY SUBJECTS	26EE301T	Electrical Machines - I	6	90	4	3	30	70	100
	26EE302T	Electronics Engineerig	6	90	4	3	30	70	100
	26EE303T	Electrical Circuits & Measuring Instruments	6	90	4	3	30	70	100
	ELECTIVE SUBJECT								
	26EE304E	Engineering Mathematics - II	3	45	2	3	30	70	100
	26EE305E	Electrical Engineering Drawing	3	45	2	3	30	70	100
	26EE306E	Electrical Installation & Estimation	3	45	2	3	30	70	100
	AUDIT SUBJECT								
	26EE307A	Renewable Energy Sources	2	30	--	--	--	--	--
	TOTAL THEORY		**23**	**345**	**14**	--	**120**	**280**	**400**
PRACTICAL SUBJECTS	26EE308L	Electrical Machines - I Laboratory	6	90	2	3	40	60	100
	26EE309L	Programming in "C" Laboratory	6	90	2	3	40	60	100
	26EE310L	Electronics Engineering Laboratory	4	60	1.5	3	40	60	100
	--	Student Centric Activity	3	45	0.5	--	--	--	--
	TOTAL PRACTICAL		**19**	**285**	**6**	--	**120**	**180**	**300**
GRAND TOTAL			**42**	**630**	**20**	--	**240**	**460**	**700**

ELECTRICAL MACHINES-I

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

TIME SCHEDULE

S. No	Unit title	No. of period s	Weightage allocated	No. of Short Answer Questions	No. of Essay Questions	CO'S Mapped
1	Fundamentals of D.C Generators, Armature reaction and Characteristics	20	25	3	2	CO1
2	Fundamentals of DC motors	14	22	2	2	CO2
3	Speed Control and Testing of D.C Motors	12	11	1	1	CO3
4	Single phase transformers	30	22	2	2	CO4
5	Three phase transformers and Auto Transformers	14	14	2	1	CO5
Total		**90**	**94**	**10**	**8**	

Course Objectives	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**	26EE301T.1	Describe the parts of a DC machine, its usages and analyse armature reaction and commutation for its effects.
	CO2	26EE301T.2	Describe the working of a D.C motor and analyse the characteristics for its performance
	CO3	26EE301T.3	Familiarise the usage of starter for different DC motors and selecting specific methods of speed control for D.C motor and to analyse various tests on D.C motors.
	CO4	26EE301T.4	Explain the working of single transformers and understand equivalent circuit parameters, efficiency and regulation.
	CO5	26EE301T.5	Familiarise the three phase transformers, types and cooling methods.

Learning Outcomes:

1. Fundamentals of D.C Generators, Armature reaction and Characteristics

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 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 and testing of D.C Motors

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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 Describe the 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 and Auto 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 MATRIX:

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO 3
CO1	3							3	2	
CO2	3	3						3		
CO3	3		2		2			3	2	1
CO4	3							3	1	
CO5	3	2		1	1			3		
Average	3	2.5	2	1	1.5			3	1.67	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

HYPONATED COURSE CONTENT

1. Fundamentals of D.C Generators, Armature reaction and Characteristics

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 - Electrical and mechanical characteristics of D.C Shunt and Series motors - Applications of D.C motors.

3. Speed Control and testing 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 & Auto 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.

REFERENCE BOOKS

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

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	Marks for FA	Marks for SA
26EE302T	ELECTRONICS ENGINEERING	6	90	30	70

TIME SCHEDULE

S.No	Unit title	No. of period s	Weightage allocated	No. of Short Answer Questions	No. of Essay Questions	CO'S Mapped
1	Semiconductor devices and PCBs	25	22	2	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	22	2	2	CO4
5	Linear Integrated Circuits	15	14	2	1	CO5
Total		**90**	**94**	**10**	**8**	

COURSE OBJECTIVES	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.

	CO1	26EE302T.1	Understand the concepts of BJTs and FETs and to familiarize with PCB making process
	CO2	26EE302T.2	Explain the rectifiers and voltage

COURSE OUTCOMES			regulators.
	CO3	26EE302T.3	Analyze the concept of amplifier, small signal amplifier, large signal amplifier and feedback amplifier.
	CO4	26EE302T.4	Analyze various oscillators and A/D &D/A converters.
	CO5	26EE302T.5	Analyze the op-amp application circuits.

CO-PO /PSO MATRIX

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.
3.6 State the need of negative feedback
3.7 Explain the negative feedback amplifier with block diagram.
3.8 Explain the need of power amplifier.
3.9 Explain the working of class-A, Class-B, Class-C and Class-AB amplifier with waveforms
3.10 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 CONTENTS:

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 phaseshift 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.

REFERENCE BOOKS

1. NN Bhargava – Basic Electroncis and linear circuits – TTTI, chandigarh
2. V.K. Mehta,Rohitmehta-Principles of Electronics, S Chand & Co.
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 test:

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 Per Week	Total No Of Periods	Marks For FA	Marks For SA	Credits
26EE303T	ELECTRICAL CIRCUITS & MEASURING INSTRUMENTS	6	90	30	70	4

TIME SCHEDULE

S. No	Unit title	No. of period s	Weightage allocated	No. of Short Answer Questions	No. of Essay Questions	CO'S Mapped
1	DC Network Theorems	15	14	2	1	CO1
2	AC Fundamentals, Single Phase AC Circuits	27	25	3	2	CO2
3	Polyphase Circuits	10	11	1	1	CO3
4	Fundamentals of Measurement and Analog Instruments	22	22	2	2	CO4
5	Electronic and Digital Measuring Instruments	16	22	2	2	CO5
Total		**90**	**94**	**10**	**8**	

Course Objectives	• To introduce the fundamental concepts and laws of DC and AC electrical circuits. • To enable students to analyze and solve simple and complex DC circuits using various network theorems. • To familiarize students with the characteristics of alternating current and its applications in single-phase and polyphase systems. • To develop the ability to calculate and interpret electrical quantities in AC circuits, including power and power factor. • To provide a strong foundation for advanced studies in electrical engineering. • To introduce the fundamental principles and working of various electrical, electronic, and digital measuring instruments. • To enable students to select and use appropriate measuring instruments for different applications.

	• To familiarize students with the sources of errors in measurements • To develop skills in handling and calibrating common measuring instruments.

Course outcomes	**CO1**	26EE303T.1	Analyze and solve DC circuits using fundamental laws, various network theorems, and source transformation techniques.
	CO2	26EE303T.2	Understand and apply the concepts of AC fundamentals and single-phase AC circuits, including power and power factor calculations.
	CO3	26EE303T.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	26EE303T.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	26EE303T.5	Describe the working principles and applications of electronic and digital measuring instruments (e.g., CRO, DVM, DMM) and various transducers.

CO-PO /PSO Matrix

Course Outcome (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 StateThevenin'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: AC Fundamentals, 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 Obtain relation between frequency, speed and no of poles.
2.4 Explain the concepts of Phase-and-Phase-Difference: Leading, lagging, in-phase concepts
2.5 Mathematical representation of AC Quantities as $v=V_m\sin(\omega t+\varphi)$, $i=I_m\sin(\omega t+\varphi)$.
2.6 Solve simple problems on above
2.7 Understand j-operator
2.8 Convert polar quantities into rectangular quantities and Vice-versa. Solve simple problems
2.9 Obtain voltage -current relationships with phasor diagrams for Resistance(R) in in AC circuits
2.10 Obtain voltage -current relationships with phasor diagrams for Inductance (L) in AC Circuits
2.11 Define inductive reactance X_L
2.12 Obtain voltage -current relation ships with phasor diagrams for Capacitance (C) in AC Circuits
2.13 Define capacitive reactance Xc
2.14 State Power in AC Circuits as Instantaneous Power, Average Power (Active Power (P)), Reactive Power (Q) , Apparent Power (S)
2.15 Draw Power Triangle and establish Relationship between P, Q and S.
2.16 Define Power factor.
2.17 State its significance as lagging and leading power factor.
2.18 Understand the concepts of impedance, power, and power factor in R-L, R-C, and R-L-C series AC circuits.
2.19 Apply appropriate formulas and methods to calculate impedance, current, voltage drops, power, and power factor for R-L, R-C, and R-L-C series AC circuits.
2.20 Construct accurate phasor diagrams for R-L, R-C, and R-L-C series AC circuits.
2.21 Solve related problems on R-L, R-C, and R-L-C series AC circuits.
2.22 Analyze the characteristics of series R-L-C resonant circuits, including resonant frequency, Q-factor, and bandwidth, and solve related problems.
2.23 State the Concept of Admittance (Y), Conductance (G) and Susceptance (B).

2.24 Apply appropriate formulas and methods to calculate impedance, Current division, power, and power factor for parallel R-L, and R-C AC circuits.

2.25 Construct accurate phasor diagrams for R-L and R-C parallel AC circuits.

2.26 Solve problems on parallel R-L, and R-C AC circuits.

2.27 Analyze the characteristics of resonant parallel circuit., including resonant frequency, Q-factor, and bandwidth Resonance.

Unit 3: Polyphase 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 Differentiate between Star (Y) and Delta (Δ) connection configurations based on their voltage, current, and power characteristics.

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

3.8 Determine the total power in a three-phase circuit using readings from the two-wattmeter method.

Unit 4: Fundamentals of Measurement and Analog Instruments

4.1 Explain the importance and significance of accurate measurements in various engineering and scientific applications.

4.2 Define key performance characteristics of measuring instruments i.e accuracy, precision, resolution, and sensitivity.

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

4.4 Explain the purpose and interaction of the essential forces (deflecting, controlling, and damping) required for the operation of analog measuring instruments.

4.5 Identify and differentiate between the various types of deflecting torques and provide examples of instruments where each is utilized.

4.6 State and explain different controlling torques

4.7 Distinguish between spring control and gravity control methods for producing controlling torque.

4.8 Explain the working principles of different damping methods, including air friction, fluid friction, and eddy current damping.

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

4.10 Apply the principles of shunts and multipliers to extend the ranges of ammeters and voltmeters, respectively

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

4.12 Differentiate between PMMC and Moving Iron instruments based on their construction, working, and applications

4.13 Explain the Ammeter-Voltmeter method for resistance measurement.

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

4.15 Explain the construction and working of a Megger.

4.16 Describe the construction and working principle of an Electrodynamometer type Wattmeter

Unit 5: Electronic and Digital Measuring Instruments:

5.1 State the advantages of electronic voltmeters over conventional voltmeters.

5.2 Describe the basic block diagram and working principle of a DC electronic voltmeter.

5.3 Explain the concept of an AC electronic voltmeter (rectifier-type)

5.4 Explain the function of each block in Cathode-Ray-Oscilloscope (CRO), including the CRT, vertical/horizontal deflection systems, time base generator, and power supply.

5.5 Discuss various applications of CRO in different fields.

5.6 Explain the advantages of Digital Voltmeters (DVMs) over conventional analog voltmeters.

5.7 Explain the working of Digital Multimeter (DMM) based on its simplified block diagram

5.8 State the applications of a Digital Multimeter (DMM)

5.9 Define and classify transducers

5.10 Distinguishing between active and passive transducers.

5.11 Explain the brief working principles and applications of LVDT,

5.12 Explain the brief working principles and applications of Thermistor

5.13 Explain the brief working principles and applications of Thermocouple

HYPONATED COURSE CONTENTS

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: AC Fundamentals, 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- Relation between poles, speed and frequency- 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 relation ships 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- Concept of conductance, susceptance and admittance - Simple Parallel circuits .

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- Measurement of 3 phase power by two wattmeter and power factor in balanced circuits.

Unit 4: Fundamentals of Measurement and Analog Instruments

Definition of measurement, importance-define- Accuracy, Precision, Resolution, Sensitivity, Drift, Hysteresis, Calibration- Classification-of-Instruments- Deflection, Controlling and Damping torques in the indicating Instruments - working of Permanent magnet moving coil-advantages, disadvantages and applications - working moving iron instruments – advantages and disadvantages – Dynamometer type instrument- construction -working of Meggar and Dynamometer type wattmeter.

Unit 5: Electronic and Digital Measuring Instruments:

Advantages of electronic voltmeters- block diagram and working principle of a DC electronic voltmeter- concept of an AC electronic voltmeter- function of each block in the Cathode-Ray-Oscilloscope (CRO)- applications-advantages of Digital Voltmeters (DVMs)- working of Digital Multimeter (DMM)-applications- Define and classify transducers- Distinguish between active and passive transducers- Working principles and applications of LVDT, Thermistor and Thermocouple

Reference Books:

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. Parker Smith -Problems in ElectricalEngineering.
4. Abhijit Chakrabarthi- **Circuit Theory**- Dhanapat Rai and co.
5. A.Sudhakar and Shyammohan S Palli," **Electric Circuit Analysis**"-TataMcGraw-Hill,5th edition.
6. A.K. Sawhney- **Electrical and Electronic Measurements and Instrumentation-** Dhanpat Rai & Co.
7. J.B. Gupta - **A Course in Electrical and Electronic Measurements and Instrumentation-** , S.K. Kataria & Sons.
8. Albert D. Helfrick and William D. Cooper- **Modern Electronic Instrumentation and Measurement Techniques-** Pearson Education.

Syllabus for Unit Tests:

Unit Test	Learning Outcomes to be Covered
Unit Test-I	From1.1 to 3.3
Unit Test-II	From3.4 to 5.13

ENGINEERING MATHEMATICS-II
(Common to all Branches)

Course Code	Course Title	No. of Periods/ week	Total No. of periods	Marks for FA	Marks for SA	Credits
26EE304T	Engineering Mathematics-II	3	45	30	70	3

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

TIME SCHEDULE

S.No.	Chapter/Unit title	No. of Periods	Marks Allotted	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 and non-homogeneous linear differential equations	5	11	1	1	CO2
Unit – III: Probability and Statistics						
8	Probability	5	11	1	1	CO3
9	Measures of Dispersion	6	14	2	1	CO3
10	Correlation	4	8	0	1	CO3
	Total	45	94	10	8	
			Marks	30	64	

COURSE OBJECTIVES

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

LEARNING OUTCOMES

Unit-I

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

L.O.1.1 Find the area bounded by a curve and axes.
1.2 Determine the volumes of solids of revolution along the x-axis.
1.3 Obtain the Mean and R.M.S values of simple functions.
1.4 Solve the problems of areas using Numerical Integration.

Unit-II

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

L.O.2.1 Define a Differential equation, its order and degree.
2.2 Find order and degree of a given differential equation.
2.3 Form a differential equation by eliminating arbitrary constants.
2.4 Solve the first order and first degree differential equations by variables separable method.
2.5 Solve linear differential equation of the form $\frac{dy}{dx} + Py = Q$, where P and Q are functions of x only or constants.

Syllabus for Unit test-I completed

2.6 Solve Differential equations of the type $(aD^2 + bD + c)\, y = 0$ where $a (\neq 0)$, b, and c are real numbers.
2.7 Define complementary function, particular integral and general solution of a non-homogeneous linear differential equation of second order with constant coefficients.
2.8 Describe the method of solving $f(D)y = e^{ax}$, where f(D) is a polynomial of second order.

Unit-III

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

L.O.3.1 Recall the basic probability principles.
3.2 State addition theorem of probability for two mutually exclusive and exhaustive events.
3.3 Solve simple problems on addition theorem.
3.4 Explain conditional event and conditional probability.
3.5 Solve simple problems on conditional probability.

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

Syllabus for Unit test-II completed

CO/PO – 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:

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 CONTENTS

Unit-I: 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.

Unit -II: Differential Equations

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

Unit III: 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.

TEXTBOOK

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

REFERENCE BOOKS

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

SUGGESTED E-LEARNING REFERENCES

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

UNIT TEST SYLLABUS

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 ENGINEERING DRAWING

Course code	Course title	No.of periods / week	Total no. of periods	Marks for FA	Marks for SA	Credits
26EE305E	ELECTRICAL ENGINEERING DRAWING	3	45	30	70	2

TIME SCHEDULE

S. No	Unit title	No. of periods	Weightage allocated	No. of Short Answer Questions	No. of Essay Questions	CO'S Mapped
1	Graphical symbols, couplings, and Guarding systems	9	10	2	0	CO1
2	D.C. Machines	12	30	1	1	CO2
3	Induction Motors	12	25	0	1	CO3
4	Transformers	12	30	1	1	CO4
Total		**45**	**95**	**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**	26EE305E .1	Understand different types of symbols, couplings and guarding system in electrical drawing.
	CO2	26EE305E .2	Comprehend and draw different views of DC machine.
	CO3	26EE305E .3	Comprehend and draw different views of Induction motors.
	CO4	26EE305E .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 MATRIX

CO.NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
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.

HYPONATED COURSE CONTENTS

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.

REFERENCE BOOKS

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

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 3.1 to 4.2

ELECTRICAL INSTALLATION AND ESTIMATION

Course code	Course title	No. of periods /week	Total no. of periods	Marks for FA	Marks for SA	Credits
26EE306E	ELECTRICAL INSTALLATION AND ESTIMATION	3	45	30	70	2

TIME SCHEDULE:

S. No	Unit title	No. of periods	Weightage allocated	No. of Short Answer Questions	No. of Essay Questions	CO'S Mapped
1	Wiring Systems	6	17	3	1	CO1
2	Estimation of Lighting and Power Loads	16	30	2	3	CO2
3	Estimation of OH Lines and Earthing systems	13	30	2	3	CO3
4	Departmental Tests	10	17	3	1	CO4
Total		**45**	**94**	**10**	**8**	

Course Objectives	(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**	26EE306E.1	Describing the specifications of various wiring accessories and different components of wiring system
	CO2	26EE306E.2	Estimate the materials required and their cost in domestic installation and power wiring installation.
	CO3	26EE306E.3	Estimate the electrical materials required for OH lines, Earthing systems.

	CO4	26EE306E.4	Extending the knowledge on Calculation of Transformer ratings for Rural electrification

Learning Outcomes:

1. Wiring systems

1.1 Mention the use of wires, cables, Types of Installations and wiring Accessories**.**
1. 2 Explain (i) Surface conduit system (ii) Concealed wiring system.
1.3 State merits and demerits of (i) Surface conduit system (ii) Concealed wiring system.
1.4 List different types of knife switches.
1.5 List MCB types with specifications and mention their applications (MCCB, ELCB AND RCCB)
1.6 List different types of fuses and specify the materials used.
1.7 List different ratings of fuses and state their applications.
1.8 State the reasons for not using fuse in Neutral wire.

2. **Estimation of Lighting and Power Loads**

2.1 Define service mains and explain 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 Estimate 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 Prepare the estimate of the materials for the 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 Prepare an estimate for electrifying an irrigation pump set scheme.

3. **Estimation of OH Lines and Earthing systems**

3.1 Select the type of insulators to be used for over headlines.
3.2 Calculate the total number of insulators required for the given OH Line.
3.3 Select the type, size and number of cross arms required for the over headline.
3.4 Determine the size and total length of overhead conductor required for the line giving due Consideration for the sag to be allowed.
3.5 Estimate the quantity of all materials required for given 11 kV and 400V overhead lines.
3.6 Draw and estimate the quantity of materials required for 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 Estimate the materials required for pipe and plate earthing.

4. **Departmental Tests**

4.1 Specify insulation resistance desirable for a given electrical installation.
4.2 Specify 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 Explain the Survey of load particulars in a village for
(i) Domestic (ii) industrial (iii) agricultural loads.

4.7 Estimate the quantity of materials required for the erection of distribution lines and 11 kV feeder

4.8 Calculate the capacity of a transformer required assuming suitable diversity factor.

4.9 Determine the location point of transformer and calculate the tail end voltage regulations.

CO-PO/PSO MATRIX

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO 1	PSO 2	PSO 3
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	1	3	2	1
Average	**3**	**2.25**	**2**	**2**	**1**	**1.5**	**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

HYPONATED COURSE CONTENT

1. Wiring Systems

Introduction-Size of wires-Standard wires-Types of wires - Various wiring systems - Distribution boards - Main switches – Different types of fuses and fuse carriers.

2. **Estimation of Lighting and power loads**

Estimation of domestic lighting installation service main - Specification - Quantity of materials required for service main – 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 - Types of starter and control panel used for irrigation pump set installation.

3. Estimation of OH Lines and Earthing

Distribution lines of 11 kV and 400 Volt OH lines estimation only -Quantity of materials required for lines of length 1 km - 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**

Electrical installation testing - - desirable insulation resistance for domestic and power circuits - Procedure for conducting continuity tests - Design of rural electrification scheme - Load survey-determination of capacity of transformer - estimation of quantity of materials required for the

erection of distribution lines and 11 kV feeder - Determination of location point of transformer – calculation of tail end voltage regulations.

REFERENCE BOOKS:

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

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 4.9

RENEWABLE ENERGY SOURCES

Course Code	Course Title	No. of periods/ Week	Total No. of Periods	Marks for FA	Marks for SA	Credits
26EE 307A	RENEWABLE ENERGY SOURCES	2	30	--	--	--

COURSE OUTCOMES MAPPING

S.No	Unit Titles	No. of periods	CO's 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	1. Understanding the need for Renewable, Introduce Fundamental Concepts of Renewable Energy. 2. Analyze Solar Energy Systems, Examine Wind Energy Conversion, Explore Biomass Energy Technologies 3. Review Other Renewable Energy Sources, Promote Sustainable Energy Practices

COURSE OUTCOMES	CO1	26EE 307A.1	Explain the significance of renewable energy
	CO2	26EE 307A.2	Describe the working principles, components, and applications of solar energy systems
	CO3	26EE 307A.3	Analyze the fundamentals of wind energy conversion systems
	CO4	26EE 307A.4	Evaluate the various biomass energy conversion techniques
	CO5	26EE 307A.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

1.24 Introduction
1.25 Define Solar radiation – concepts and measurements
1.26 List different types of Solar collectors
1.27 State Solar photovoltaic (PV) systems – types of panels, components
1.28 State Advantages and limitations of Photovoltaic systems
1.29 State the recent trends in solar systems
1.30 Activity1: Case Study: Solar parks in India
1.31 Activity2: Site visiting of nearest solar power plant

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

4.13 define Biomass and list the different types of biomass sources
4.14 State Biomass conversion technologies
4.15 State the operation of biomass power plant
4.16 State Environmental and economic benefits
4.17 State Government policies and incentives of biomass plant
4.18 Activity1: Video on working of biomass plant
4.19 Activity2: Biomass usage in rural India

5. Other Energy Sources

5.1 Define hydro power and list different types of hydro power plants
5.2 State Geothermal energy – principles, plants, Challenges
5.3 State Tidal and wave energy – concepts, technologies
5.4 State Hydrogen and fuel cells- basics, applications
5.5 Activity1: Group Presentation on each source
5.6 Activity2: Future of Hydrogen vs Solar

CO PO/PSO'S 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 - = No Contribution

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

HYPONATED COURSE CONTENTS

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

REFERENCE BOOKS:

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 Wing Energy Explained: Theory, Design and Application
5. Bent Sorensen- Hydrogen and Fuel Cells: Emerging Technologies and Applications

Syllabus to be covered for Formative Assessments ::

Formative Assessment (FA)	Learning Outcomes to be Covered
FA-1	From 1.1 to 3.3
FA-2	From 3.4 to 5.5

ELECTRICAL MACHINES - I LABORATORY

Course code	Course title	No. of periods/ week	Total No.of periods	Marks for FA	Marks for SA	Credits
26EE308L	Electrical Machines – I Laboratory	6	90	40	60	2

S.No	Unit Title	No. of Periods	CO'S 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 Outcomes:

Course outcomes	**CO1**	26EE308L.1	Demonstrate the skill of planning and organizing experimental setup for D.C Generators, performing operations for investigating performance and to sketch graphically.
	CO2	26EE308L.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	26EE308L.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. Identify the terminals of the following DC Machines i) DC Shunt Machine ii) DC Series Machine
2. Obtain OCC of a DC shunt Generator at below, rated and above rated speeds.
3. Obtain Internal and External characteristics of DC Shunt Generator.

2. Testing and Speed Control of D.C Motors

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

2. Obtain performance characteristics by conducting Brake Test on DC Shunt Motor

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

4. Speed control of DC Shunt Motor by i) Rheostatic control method ii) Field control method
5. Obtain the performance of a DC Shunt Motor by conducting Swinburne's test.
6. Analyze speed control of BLDC motor using PWM Technique. (Running & Reversing phenomenon and electric braking of BLDC Motor).
7. Analyze Regenerative charging and braking phenomenon of PMDC Motor**.**

3. Performance and testing of Transformers

1. Determination of the polarity and voltage transformation ratio of a single phase transformer.
2. Conduct load test on 1-phase Transformer and calculate efficiency and regulation.
3. Conduct O.C. and S.C. tests on 1-phase transformer and from the result Calculate efficiency at various loads and power factor.
4. Conduct Oil testing using oil testing kit to know the dielectric strength of given transformer oil.
5**.** Conduct Parallel operation of two single phase Transformers.

HYPONATED 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 -Lload 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	Measure the resistance across different terminals using multi meter. Identification of armature and shunt field / series field resistance according to resistance values observed.

		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. 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	Make the connections according to circuit diagram Observe and note the readings in a tabular form. Draw the graph between I_aVsE_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. Draw performance curves of motor	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

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 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	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

		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	Observe the regenerative charging and braking procedure.

		regenerative braking and charging	
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

COURSE OUTCOMES MAPPING
CO-PO/PSO MATRIX

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

ROGRAMMING IN C LABORATORY

Course Code	Course Title	No. of periods / Week	Total No.of Periods	Marks for FA	Marks for SA	Credits
26EE309L	PROGRAMMING IN C LABORATORY	4	60	40	60	2

COURSE OUTCOMES MAPPING

S.No	Unit Titles	No. of periods	CO's Mapped
1.	C Programming Basics	9	CO1
2.	Decision & Loop Control Statements	12	CO2
3.	Exercises on functions	12	CO3
4	Arrays, Strings and Pointers in C	18	CO4
5.	Structures and Unions	9	C05
	Total	60	

COURSE OBJECTIVES	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	26EE309L.1	Design problems solving with flow chart and algorithm.
	CO2	26EE309L.2	Practice conditional and iterative statements to write C programs.
	CO3	26EE309L.3	Execute C programs that use functions.
	CO4	26EE309L.4	Execute C programs using arrays and strings
	CO5	26EE309L.5	Practice on structures, unions.

LEARNING OUTCOMES

1. C Programming Basics

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

2. ***Decision & Loop Control Statements***

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***

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

4. ***Arrays, Strings and Pointers in C***

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 returningpointers.

5. ***Structures and Unions***

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

CO-PO/PSO MATRIX

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.

HYPONATED COURSE CONTENTS

1. C Programming Basics

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

2. ***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*	• Opening of new file in Turbo C • Understand about arrays and their usage	• Usage of one dimensional and multi dimensional arrays

	C	• Understand about strings and their usage • 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 string handling functions • 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

ELECTRONICS ENGINEERING LABORATORY

Course Code	Course Title	No. of periods / Week	Total No. of Periods	Marks for FA	Marks for SA
26EE310L	ELECTRONICS ENGINEERING LABORATORY	4	60	40	60

S.No	Title	No. of periods	CO's Mapped
1.	Semiconductor devices and PCBs	15	CO1
2.	Power Supplies	12	CO2
3.	Amplifiers	12	CO3
4.	Oscillators and A/D &D/A converters	12	C04
5	Linear Integrated Circuits	9	CO5
	Total	**60**	

COURSE OUTCOMES MAPPING

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	26EE310L.1	Acquire knowledge on BJTs, FETs and PCBs
	CO2	26EE310L.2	Developing Power Supply Circuits.
	CO3	26EE310L.3	Designing amplifier and using them in various applications.
	CO4	26EE310L.4	Practice on various oscillator and A/D & D/A converter circuits.
	CO5	26EE310L.5	Practicing linear integrated circuits to develop various applications.

LEARNING OUTCOMES

1. Semiconductor devices and PCB making

1. Draw the I/O characteristics of CB configuration
2. Draw the I/O characteristics of CE configuration
3. Draw the Drain characteristics of JFET
4. Draw the Transfer characteristics of JFET
5. Prepare PCBs for given circuits

2. Power Supplies

1. Implement Half Wave rectifier with and without filter.
2. Implement Full Wave rectifier with and without filter.
3. Implement Bridge Wave rectifier with and without filter.
4. Build a regulated power supply with (a) Zener Diode and (b) Voltage Regulator IC.

3 Amplifiers

1. Plot the frequency response characteristics of RC coupled amplifier.
2. Plot the frequency response characteristics of transformer coupled amplifier.
3. Study the working of different power Amplifiers

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

1. Measure the frequency of RC-Phase shift oscillator
2. Measure the frequency of Colpitts oscillator.
3. Measure the frequency of Crystal oscillator.
4. Implement D/A conversion using R-2R ladder network and observe the output.
5. Implement A/D converter using successive approximation method and observe the output.

5. Linear Integrated Circuits

2. Implement Inverting Amplifier with IC 741 OpAmp.
3. Implement non-Inverting with IC 741 OpAmp.
4. Implement summer with IC 741 OpAmp
5. Implement differentiator with IC 741 OpAmp
6. Implement integrator with IC 741 OpAmp

HYPONATED COURSE CONTENTS

1. Semiconductor devices and PCB making

V-I characters of BJT, V-I characters 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 Wave 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 MATRIX

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
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**

IV SEMESTER

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING

SCHEME OF INSTRUCTIONS AND EXAMINATIONS

FOURTH SEMESTER

	Subject Code	Subject	Periods per week	Total Periods	Credits	Scheme of Examination			
						Duration (Hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY SUBJECTS	26EE401T	Electrical Machines - II	6	90	4	3	30	70	100
	26EE402T	Power Systems - I	6	90	4	3	30	70	100
	26EE403T	Digital Electronics & Micro Controllers	6	90	4	3	30	70	100
	ELECTIVE SUBJECT								
	26EE404E	Industrial Automation	3	45	2	3	30	70	100
	26EE405E	Electrical Vehicle Technology	3	45	2	3	30	70	100
	AUDIT SUBJECT								
	26EE406A	Internet of Things in EEE	2	30	--	--	--	--	--
	TOTAL THEORY		**23**	**345**	**14**	--	**120**	**280**	**400**
PRACTICAL SUBJECTS	26EE407L	Electrical Machines -II Laboratory	6	90	2	3	40	60	100
	26EE408L	Communication & Employability skills Laboratory	4	60	2	3	40	60	100
	26EE409L	Digital Electronics & Micro Controllers Laboratory	3	45	1	3	40	60	100
	26EE410L	Auto CAD & Simulation Tools Laboratory	6	90	1	3	40	60	100
	TOTAL PRACTICAL		**19**	**285**	**6**	--	**160**	**240**	**400**
GRAND TOTAL			**42**	**630**	**20**	--	**280**	**520**	**800**

ADD ON COURSE	**Extra credits are awarded to the students who completes ADD ON course as per course duration.**

ELECTRICAL MACHINES-II

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

S.no	Title	No. of periods	weightage	No. of short questions (3 marks)	No. of Essay questions (8 marks)	CO'S Mapped
1	3- Phase Induction Motors	25	30	2	3	CO1
2	1-Phase Induction Motor and Special A.C. Motors	18	11	1	1	CO2
3	Alternators	16	20	4	1	CO3
4	Parallel operation of Alternators	16	11	1	1	CO4
5	Synchronous motors	15	22	2	2	CO5
		90	**94**	**10**	**08**	

Course Objectives:

Course Objectives	1) To familiarize with the knowledge of Induction Motors and Fractional Horse Power Motors 2) To understand the working of Alternators and its parallel operation 3) To Understand the working of Synchronous motors

Course outcomes:

Course outcomes	CO1	26EE401T.1	Explain the working of 3-phase induction motors and understand equivalent circuit parameters, power, torque, efficiency.
	CO2	26EE401T.2	Explain the working of fractional Horse power motors
	CO3	26EE401T.3	Describe construction and working principle of Alternator.
	CO4	26EE401T.4	Manipulate paralleling and synchronisation methods of Alternators.
	CO5	26EE401T.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-phaseSystem.
1.2 Explain the construction of Induction motor- slip ring 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 inductor 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 and Special A.C motors.

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 synchro scope 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 MATRIX

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

HYPONATED 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 and Special A.C. 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 – principles of working – Universal motor- principle of working- Stepper motor – principles 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 & synchro scope 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.

REFERENCE BOOKS:

1. B.L. Theraja-Electrical Technology - Vol –II S.Chand &Co.
2. M.G Say –AC machines
3. DP Kothari, IJ Nagrath – Electric Machines-Mc.Graw.Hill
4. P.S. Bhimbra -Electrical machines – Khanna Publishers
5. MV Deshpande-Electric machines – Wheeler publishing.

POWER SYSTEMS – I

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

S. No.	Title	No. of Periods	weightage	No. of short questions (3 marks)	No. of Essay questions (8 marks)	CO'S Mapped
1.	Non-renewable energy sources of power generation	24	22	2	2	CO1
2.	Renewable energy sources of power generation	18	14	2	1	CO2
3.	Integrated operation and Economics of Power station	16	22	2	2	CO3
4.	Switchgear and Protection	16	22	2	2	CO4
5.	Lightning arresters, Protection of Alternators and Transformers	16	14	2	1	CO5
Total		90	**94**	**10**	**8**	

Course Objectives	(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.

Course outcomes	CO1	26EE402T.1	Analyse the working of Thermal, Hydro, Nuclear and Gas power stations
	CO2	26EE402T.2	Understand the significance and working of renewable energy power generation methods
	CO3	26EE402T.3	Understand the concept of load dispatching and analyse various tariffs.
	CO4	26EE402T.4	Analyse the applications of relays and the working of various circuit breakers
	CO5	26EE402T.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.
1.3 Draw the detailed line diagram of a condensing type thermal power station and explain the working of each component of thermal power station.
1.4 State the advantages of (i) Pulverisation (ii) Cooling towers.
1.5 State the causes of pollution and methods to control them.
1.6 State the advantages and disadvantages of Thermal power plants.
1.7 State the principle of working of Hydro power station.
1.8 State the factors required for selection of site for Hydro power station.
1.9 Explain Hydrograph.
1.10 Define hydraulic terms i) Head ii)Flow rate(discharge)
1.11 Write water power equation
1.12 Classify the Hydro Electric Plants based upon head, duty, location and hydraulic considerations.
1.13 Explain with layout diagram working of i) High Head ii) Medium Head iii) Low Head Power stations.
1.14 Explain the Function of (i) Surge Tank ii) Forebay iii) Spill gates.
1.15 State the advantages and disadvantages of hydroelectric power station.
1.16 State merits and risks involved in using nuclear energy
1.17 List out the nuclear fuels.
1.18 Explain fission and fusion reactions.
1.19 Explain sustained chain reaction.
1.20 Explain the working of a moderate type nuclear power station with a block diagram.
1.21 Explain the need and working of coolant, reflector, and control rods. Mention the materials used for them.
1.22 List the types of Reactors used in Nuclear Power Station.
1.23 Explain the principle of working of gas power station with the help of schematic diagram and mention its merits and demerits.

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)Geo thermal Power plant.
2.3 Differentiate between Renewable energy sources and Non-renewable energy sources.
2.4 Appreciate the need of energy conservation and its methods.

3. Integrated Operation and Economics of Power Stations.

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 Understand 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 Stat 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 and Protection.

4.1 Define faults and list types of faults in power systems.
4.2 Define and classify switch gear.
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 over current relay (ii) Directional over current 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.
4.11 State the principle of M.O.C.B and explain its working.
4.12 State properties of SF_6 gas and explain the working of SF_6 circuit breaker.
4.13 Explain working principle of Vacuum circuit breaker (V.C.B).
4.14 Define current limiting reactors and state their importance.

5. Lightning arresters, Protection of Alternators and Transformers

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
5.7 List the probable faults in Stator and rotor of Alternator.
5.8 Explain the differential protection for alternator stator.
5.9 List the possible faults and their types in a transformer.
5.10 Explain the working of Buchholz relay in a transformer.

CO-PO/PSO MATRIX

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

HYPONATED COURSE CONTENTS

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, fore bay, 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 geo thermal power plants- Differentiate between renewable and Non-renewable energy sources - Need for energy conservation and their methods.

3. **Integrated Operation and economics of Power Stations**
   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. **Switch Gear and Protection**
   Faults in power systems - Switch gear 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. **Lightning arresters, Protection of Alternators and Transformers**
   Surge Protection -Surge types and causes for production Need for Surge Protection and its methods – Scheme of surge protection with diagram - Types of lightning arrestors – 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.

REFERENCE BOOKS

1. Electrical Power by S.L.Uppal
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

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 3.6 to 5.10

DIGITAL ELECTRONICS AND MICRO CONTROLLERS

Course code	Course Title	No. of Periods / Week	Total No. of Periods	Marks for FA	Marks For SA	Credits
26EE403T	DIGITAL ELECTRONICS AND MICRO CONTROLLERS	6	90	30	70	4

S. No	Title	No. of periods	Weightage	No. of Short Answer Questions	No. of Essay Questions	CO's Mapped
1.	Basics of Digital Electronics	18	14	2	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	30	2	3	CO5
	Total	90	94	10	08	

COURSE OBJECTIVES	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	26EE403T.1	Understand number systems, basic operation and compare performance of various digital electronic circuits.
	CO2	26EE403T.2	Design and analyse digital electronic circuits and learn to select suitable circuits by assessing the requirements of application fields.
	CO3	26EE403T.3	Identify the critical areas in application levels and derive typical alternative solutions, select suitable digital electronic circuits to control industry grade apparatus.
	CO4	26EE403T.4	Select 8051 microcontroller for given application and develop assembly program for a given application
	CO5	26EE403T.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 to 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. Micro controller

4.1 State the need of Micro controllers.
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 application of microcontrollers.
5.18 Explain how microcontrollers helps in power monitoring of electrical devices
5.19 Explain how microcontrollers helps in monitoring of energy meters

CO-PO/PSO MATRIX

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 CONTENTS

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. Micro Controllers

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.

REFERENCE BOOKS

1. Digital Computer Electronics by Malvino and leach TMH
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

Syllabus to be Covered for Unit Tests

Unit Test No	Syllabus to be covered
Unit Test-1	1.0 to 3.16
Unit Test-2	4.1 to 5.19

INDUSTRIAL AUTOMATION

Course Code	Course Title	No. of Periods/ Week	Total No. of Periods	Marks for FA	Marks for SA	Credits
26EE404E	INDUSTRIAL AUTOMATION	03	45	30	70	2

S. No	Topics	Periods	weightage	No. of Short Answer Questions	No. of Essay Questions	CO's Mapped
1.	Basic Concepts of Automation	10	25	3	2	CO1
2.	Sensors and Actuators	14	25	3	2	CO2
3.	PLC	15	33	3	3	CO3
4.	SCADA	6	11	1	1	CO4
	Total	**45**	94	**10**	**8**	

COURSE OBJECTIVES	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	26EE404E.1	Understand the concept of industrial automation
	CO2	26EE404E.2	Explain the functions of Sensors and Actuators
	CO3	26EE404E.3	Explain the basics of PLC
	CO4	26EE404E.4	Explain the basics of SCADA

LEARNING OUTCOMES

1.0 Basic Concepts of Automation

1.1 Define Automation

1.2 Discuss 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 implementation of Automation

1.6 Describe the social implications of Industrial Automation on Employment and skill Changes
1.7 List the basic components of an Automation system
  (i) Sensors (Input devices)
  (ii) Actuators (Output Devices)
  (iii) Controllers (Processing Devices)
  (iv) Human Machine-Interface
1.8 List the application of Automation in Industry.
1.9 Explain the importance of control Engineering in day-to-day life and industry
1.10 Explain the concept of control systems used in Automobiles, Speed control of AC and DC motor, Water level Controller.

2.0 Sensors and Actuators

2.1 Define Sensor and Actuators.
2.2 List various types of sensors and actuators.
2.3 Classify sensors and actuators.
2.4 Explain the operating principles of temperature, pressure, proximity and light sensors.
2.5 Explain the following characteristics of sensors.
  1. Accuracy 2. Precision 3. Sensitivity 4. Resolution 5. Linearity and range
2.6 Explain 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, robotics and control systems.
2.8 Explain the working of AC and DC Solenoids.
2.9 Explain the working of Thermal relay, Latching relay, Electromagnetic relay, Solid state relay and Reed Relay.

3.0 PLC

3.1 Define Programmable Logic Controller (PLC) and state the advantages of PLC
3.2 Explain the different parts of PLC by drawing the Block diagram and state the purpose of each part.
3.3 State the applications of PLC
3.4 Explain Ladder diagram
3.5 Explain contacts and coils used in PLC
3.6 Draw ladder diagrams for
  (i) AND gate (ii) OR gate (iii) NOT gate
  (iv) NAND gate (iv) NOR gate (iv) X-OR gate
3.7 Explain the following Timers and counters used in PLC
  (i) T ON (ii) T OFF (iii) Retentive timer (iv) CTU (v) CTD
3.8 Draw ladder diagrams using Timers and counters
3.9 Explain PLC Instruction set
3.10 Explain ladder diagrams for following
  (i) DOL starter and STAR-DELTA starter (ii) Stair case lighting
  (iii) Water level control (iv) Temperature Controller

4.0 SCADA

4.1 Explain the need of data acquisition.
4.2 State the advantages of supervisory control.
4.3 List the software's used for SCADA and explain them.
4.4 State various communication methods used in SCADA.

4.5 Explain the working of SCADA with PLC and applications of SCADA

CO-PO/PSO MATRIX

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

HYPONATED COURSE CONTENT

1. **Basic Concepts of Automation**

   Definition of automation – Evolution of automation – Need for automation – Types of automation: Fixed, Programmable and Flexible – Challenges in implementing automation – Social implications of automation on employment and skill change – Basic components of automation systems: Sensors (input), Actuators (output), Controllers, HMI – Applications of automation in industries – Importance of control engineering – Control systems in automobiles, AC/DC motor speed control, water level control.

2. **Sensors and Actuators**

   Definition of sensors and actuators – Types and classification of sensors and actuators – Operating principles: temperature, pressure, proximity, light sensors – Characteristics of sensors: Accuracy, Precision, Sensitivity, Resolution, Linearity, Range – Types and working of actuators: Electric motors, Solenoids, Hydraulic, Pneumatic, Transducers – Applications of sensors and actuators in automation, robotics and control – Working of AC & DC solenoids – Working of Thermal, Latching, Electromagnetic, Solid State and Reed relays.

3. **PLC**

   Definition and advantages of PLC – Block diagram and parts of PLC – 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 – Ladder diagrams for: DOL, Star-Delta starter, Staircase lighting, Water level control, Temperature control.

4. SCADA

Data acquisition needs – Advantages of SCADA – SCADA software – Communication methods – SCADA integration with PLC – Applications of SCADA.

REFERENCE BOOKS

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

Syllabus for Unit Tests

Unit Test	Learning Outcomes to be Covered
Unit Test-I	From 1.1 to 2.9
Unit Test-II	From 3.1 to 4.5

ELECTRIC VEHICLE TECHNOLOGY

Course Code	Course Title	No. of periods / Week	Total No. of Periods	Marks for FA	Marks for SA	Credits
26EE405E	ELECTRIC VEHICLE TECHNOLOGY	3	45	30	70	2

COURSE OUTCOMES

S.No	Title	No. of periods	Weightage	No. of Short Answer Questions	No. of Essay Questions	CO's Mapped
1.	Introduction to Electric Vehicles	07	25	3	2	CO1
2.	Types of Electric Vehicles	10	25	3	2	CO2
3.	Energy Storage Systems and Charging Technologies for EVs	13	33	3	3	CO3
4	Electric Motor Technologies and Braking Systems in EVs	15	11	1	1	CO4
	Total	**45**	**94**	**10**	**8**	

COURSE OBJECTIVES	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	26EE405E.1	Explain the working of IC engines, compare them with electric vehicles, and identify the components and advantages of EVs.
	CO2	26EE405E.2	Classify various types of electric vehicles (BEV, HEV, PHEV, and FCEV) and compare their construction and working principles.
	CO3	26EE405E.3	Describe battery types, charging methods, BMS components, and analyze energy storage technologies used in EVs.
	CO4	26EE405E.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. Introduction to 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 describe 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 Battery Electric Vehicles (BEVs) with conventional vehicles based on their design and operation.
1.7 Draw and explain the major components of an electric vehicle 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 Systems, Charging Technologies for 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, and Cycle Life.
3.3 List the main requirements for Electric Vehicle (EV) batteries, emphasizing safety and energy density.
3.4 Explain the working principle of Lithium-Ion (Li-Ion) battery systems with neat sketches.
3.5 List the advantages and disadvantages of alternative energy storage devices such as Ultra capacitors 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. Electric Motor Technologies and Braking systems in EVs

4.1 Describe the fundamental role of electric motors in Electric Vehicle (EV) propulsion.

4.2 State the key requirements of traction motors for EV applications, including high torque, speed control, and efficiency.

4.3 State the types of motors used in Electric Vehicles.

4.4 Explain the construction, working principle, and characteristics of Brushless DC (BLDC) Motors

4.5 Explain the construction, working principle, and characteristics of Permanent Magnet Synchronous Motors (PMSM)

4.6 Classify the motor configurations used in Electric Vehicles.

4.7 State the different types of braking applied to electric motors in general.

4.8 List the advantages of electric braking over conventional friction braking systems in Electric Vehicles.

4.9 List the different methods of electric braking.

4.10 Explain the Plugging, Rheostatic and Regenerative braking methods for DC Shunt motors with braking current and torque equations.

4.11 Solve basic problems related to electric braking systems.

4.12 Describe how regenerative braking contributes to the efficiency and range of Electric Vehicles.

CO–PO/PSO MATRIX

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

HYPONATED COURSE CONTENTS

1. Introduction to 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 - BEV vs Conventional 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 Systems and Charging Technologies for EVs

Electrochemical Cells, Primary and Secondary Classification - Battery Terminology Definitions (Battery Capacity, Specific Energy Density, State of Charge, Cycle Life)- EV Battery Main Requirements (Safety, Energy Density) - Lithium-Ion (Li-Ion) Battery Systems Working with legible Sketches- Advantages and Disadvantages of Ultra capacitor 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. Electric Motor Technologies and Braking systems in EVs

Electric Motors Role in EV Propulsion - Traction Motor Requirements (High Torque, Speed Control, Efficiency)- Types of motors used in EV- Construction, Working Principle and Characteristics of BLDC Motors, Permanent Magnet Synchronous Motors (PMSM) - 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 - Solve Problems on Electric Braking - Regenerative Braking Contribution to EV Efficiency and Range

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)

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 4.12

INTERNET OF THINGS IN EEE

Course Code	Course Title	No. of Periods/Week	Total No. of Periods	Marks for FA	Marks for SA
26EE406A	Internet of Things in EEE	2	30	-	-

S. No.	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

COURSE OBJECTIVES	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	26EE406A.1	Describe the evolution of industrial revolutions and explain the role and architecture of IoT in Industry 4.0.
	CO2	26EE406A.2	Identify various IoT hardware components such as sensors, actuators, and microcontrollers and explain their working and interfacing in electrical systems.
	CO3	26EE406A.3	Explain and compare different IoT communication protocols (Bluetooth, Wi-Fi, Zigbee, LoRa, MQTT, Modbus) used in electrical applications.
	CO4	26EE406A.4	Describe real-world applications of IoT in smart metering, smart grids, energy management, fault detection, and automation in electrical systems.
	CO5	26EE406A.5	Demonstrate the implementation of IoT systems through practical exposure using sensors, ESP32, cloud platforms, and develop case-study-based electrical projects.

LEARNING OUTCOMES

Unit 1: Introduction to IoT

1.1 Discuss 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 Explain the role of sensors & actuators in IoT systems.
2.3 Compare microcontrollers: Arduino, NodeMCU, ESP32.
2.4 Illustrate sensor–controller interfacing with a legible block diagram.
2.5 Discuss 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 Discuss Zigbee and LoRa protocols with use cases.
3.4 Explain the MQTT protocol and 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 Discuss 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 MATRIX

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

HYPONATED 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.

REFERENCE BOOKS

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	Marks for FA	Marks for SA	Credits
26EE407L	ELECTRICAL MACHINES – II LABORATORY	6	90	40	60	2

S.No	Title	No. of Periods	CO'S Mapped
1	Tests on 3-phase Induction Motors	42	**CO1**
2	Tests on 1-Phase induction Motors & special motors	30	**CO2**
3	Tests on Alternators and Synchronous Motors	18	**CO3**
Total Periods		**90**	

Course Objectives:

Course Objectives	(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:

Course outcomes	CO1	26EE407L.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	26EE407L.2	Analyse the experimental results from the load test data of 1 phase induction motors and special motors to calculate the machine parameters
	CO3	26EE407L.3	Conduct of various tests on Alternators and Synchronous Motors to know their performance

Learning outcomes:

1. Tests on 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. Tests on single phase induction Motors & special 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. Tests on 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 Synchro scope 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.
2	Measure insulation resistance of the 3-phase induction motor	▪ 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 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.	▪ Safely prepare and connect the motor for insulation resistance 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 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 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

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 troubleshootin g 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 a curriculum or train.	▪ 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.

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 MATRIX

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

Hyponated Course Contents:

Tests on three 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.

Load Tests on single phase induction motors and special 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

Tests on 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

COMMUNICATION AND EMPLOYABILITY SKILLS

Course code	Course title	No.of periods/ week	Total no. of periods	Marks for FA	Marks for SA	Credits
26EE408L	COMMUNICATION AND EMPLOYABILITY SKILLS	4	60	40	60	2

Course Objectives
❖ To impart verbal and non-verbal communication skills
❖ To foster employability skills among the students for career building

Course Outcomes	
CO1	Practise appropriate body language and etiquette
CO2	Listen and comprehend the listening inputs related to different genres effectively
CO3	Interpret data and give oral and written presentations in academic and professional contexts
CO4	Communicate effectively in interpersonal interactions, interviews, and group discussions
CO5	Exhibit employability skills: job hunting, resume writing, attending interviews

Sl. No.	Title	Teaching Hours
1	ABC of Communication	6
2	Let's Learn to Listen	6
3	I am...	4
4	Let's Talk About...	4
5	JAM	6
6	Interpreting Data	6
7	Your Perfect Profile	4
8	Group Discussion	8
9	Interview Skills	8
10	Making Presentations	8
Total		60

Learning Outcomes:

UNIT 1: ABC of Communication **6 periods**

1. Identify and practice the process of communication.
2. Demonstrate befitting body language traits to enhance communication.
3. Apply appropriate strategies to minimize various barriers of communication.
4. Communicate effectively in a given situation with a purpose.

UNIT 2: **Let's Learn to Listen** **6 periods**

1. Identify and distinguish different phonic sounds in English language.
2. Practice active listening in the process of communication.
3. Comprehend diverse listening inputs in academic, professional and everyday situation using appropriate strategies.

UNIT 3: I am... **4 periods**

1. Prepare an organized self-introduction for formal and informal situations.
2. Introduce yourself in job interviews effectively.
3. Use appropriate body language while introducing yourself.

UNIT 4: Let's Talk About… **4 periods**

1. Describe objects, places, events and people using appropriate adjectives.
2. Use appropriate sentences and expressions while describing anything.
3. Use suitable adjectives to convey mood or tone.

UNIT 5: JAM **6 periods**

1. Generate ideas on a given topic.
2. Organize the ideas sequentially for an effective JAM speech.
3. Speak spontaneously and fluently on a given topic within the stipulated time.

UNIT 6: Data Interpretation **6 periods**

1. Identify different forms of graphs, charts, diagrams and tables.
2. Analyse and interpret data.
3. Present the inferences and findings in spoken and written communication.

UNIT 7: Your Perfect Profile **4 periods**

1. Draft a customised professional resume.
2. Create a professional Applicant Tracking System (ATS) compliant Resume.
3. Draft a cover letter to communicate with prospective employers.

UNIT 8: Group Discussion **8 periods**

1. Identify the significance of group discussion and differentiate the various stages involved.
2. Practice various roles and skills involved in group discussion.
3. Demonstrate appropriate body language for effective participation in group discussion.

UNIT 9: Interview Skills **8 periods**

1. Practice proper interview demeanour.
2. Respond effectively to frequently asked interview questions (FAQs).
3. Demonstrate readiness to job opportunities.

UNIT 10: Making Presentations **8 periods**

1. Demonstrate the features of a good presentation.
2. Use appropriate presentational aids.
3. Prepare and give presentations on various topics effectively.

Mapping Course Outcomes with Programme Outcomes:

PO	1	2	3	4	5	6	7
CO	NOT APPLICABLE					1, 2, 3, 4, 5	NOT APPLICABLE

CO –PO Mapping

CO	**Course Outcome**	**COs / Unit Mapped**	**POs Mapped**
CO 1	Practise appropriate body language and etiquette	Unit 1	6
CO2	Listen and comprehend the listening inputs related to different genres effectively	Unit 2	6
CO3	Interpret data and give oral and written presentations in academic and professional contexts	Units 6, 10	6
CO4	Communicate effectively in interpersonal interactions, interviews, and group discussions	Units 3, 4, 5, 8	6
CO5	Exhibit employability skills: job hunting, resume writing, attending interviews	Units 7, 9	6

Source: Textbook "**Communication and Employability Skills"** prepared by the SBTET, AP

Reference Books:

A Textbook of English Phonetics for Indian Students by T. Balasubramaian
Better English Pronunciation by J.D. O'Connor
Group Discussion for Admissions and Jobs by Anand. S. Ganguly
Communicative English by E. Suresh Kumar and P. Sreehari

DIGITAL ELECTRONICS AND MICROCONTROLLERS LABORATORY

Course Code	Course Title	No. of periods / Week	Total No. of Periods	Marks for FA	Marks for SA	Credits
26EE409L	DIGITAL ELECTRONICS AND MICROCONTROLLERS LABORATORY	3	45	40	60	1

S. No	Title	No. of periods	CO's 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

COURSE OBJECTIVES	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	26EE409L.1	Understand theory of Boolean Algebra & the under lying features of various number systems.
	CO2	26EE409L.2	Apply the concepts of Boolean Algebra for the analysis & design of various combinational & sequential logic circuits.
	CO3	26EE409L.3	Analyse the sequential logic circuits design both in synchronous and asynchronous modes for various complex logic and switching devices.
	CO4	26EE409L.4	Interpret various peripheral devices to the microcontrollers.
	CO5	26EE409L.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'S AND PO'S MAPPING STRENGTH

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**

HYPONATED COURSE CONTENTS

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
3	Sequential Logic Circuits	• Ability to detect and respond to clock signals • Connection of circuit diagram on kit with proper input sources • Using CRO to observe frequency response waveform patterns	• Ability to detect and respond to changes 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	• Ability to write and debug assembly language programs

		• Knowledge of communication protocols	
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

CAD AND SIMULATION LABORATORY

Course code	Course title	No. of periods/ week	Total no. of periods	Marks for FA	Marks for SA	Credits
26EE410L	CAD AND SIMULATION LABORATORY	06	90	40	60	1

S. No	Title	No. of periods	CO's Mapped
1.	Exercise on various tool bars, menus and standard Commands, Practice on dimensioning and formatting commands, insert commands and view commands.	18	CO1
2.	Exercise on drawing isometric drawings in 2D and introduction to 3D	12	CO1
3.	Exercise on drawing of electrical wiring, electrical poles, towers, earthing systems, core sections of transformers and substations.	21	CO2
4.	Exercise on PSpice Environment, Basic Operations and simulation of circuits	18	CO3
5	Exercise on Familiarization with MATLAB software and simulation of basic circuits	21	CO4
	Total	**90**	

COURSE OBJECTIVES	• 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. • Students will learn to create, analyze, and visualize electrical designs and concepts using industry-relevant software tools.

COURSE	CO1	26EE410L.1	Apply fundamental CAD software tools for creating and modifying electrical engineering drawings and schematics.
	CO2	26EE410L.2	Design and represent electrical wiring diagrams, infrastructure layouts, and isometric views using CAD software, adhering to basic electrical standards.

OUTCOMES	CO3	26EE410L.3	Simulate and analyse the behaviour of DC and AC electrical circuits using PSpice software.
	CO4	26EE410L.4	Perform basic mathematical operations and simulate fundamental electrical circuits using MATLAB and Simulink.

LEARNING OUTCOMES

1. Exercise on various tool bars, menus and standard Commands, Practice on dimensioning and formatting commands, insert commands and view commands.

1. Study components in menu bar, Customise and arrange tool bar, Display the drawing created in the working area
2. Study of user coordinate system (UCS), Increase or decrease layouts
3. Give the inputs in the command bar, Display name and purpose of the tools, Study cross hair to locate the cursor
4. Invoke the commands, Getting started with AutoCAD, Create a new file, Open a file, Save a file, Close a file
5. Delete the object or text, Copy the object or text, Paste entities, Zoom an object.
6. Use LINE command, MLINE command, POLYLINE command
7. Draw a circle using CIRCLE command, with centre point and radius, POLYGON command, HELIX command
8. Draw a rectangular, Triangular and quadrilateral areas filled with a solid, colour with the help of plane tool
9. Understand SPLINE command, ELLIPSE command, DIV command
10. Understand INSERT command, HATCH command, MIRROR command, ARRAY command
11. Understand STRETCH command, TRIM command, BREAK command, JOINT command,
12. Understand FILLET command, CHAMFER command, EXPLODE command, GROUP command.
13. 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.
14. 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.
15. Insert blocks into current drawing file using INSERT command
16. Understand ATTACH RASTER IMAGE command, REDRAW command
17. Draw the ortho graphic views (side view, top view, front view) of any object
18. Draw the isometric views of any object, SHADE command, HIDE command.

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

1. Visualise the isometric view SW, NE isometric views, Isometric SNAP and GRID
2. Use set snap spacing, Change the default axis colours, size of the crosshair display by using Cross hair tab.
3. Create an isometric circle on the current isometric plane using Ellipse Iso circle

3.Exercise on drawing Electrical symbols, electrical wiring, electrical poles, towers, earthing systems, core section of transformer, pole and plinth mounted sub stations.

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 electrical wiring circuit of godown wiring
4. Drawing of electrical wiring circuit of series parallel control circuits
5. Drawing of different electrical poles with cross-arms, insulators and stay sets

6. Drawing of pipe earthing with dimensions
7. Drawing of plate earthing with dimensions
8. Drawing of plan and elevation of different stepped cores of transformer.
9. Drawing of Pole mounted substation and Plinth mounted substation with dimensions

4. Exercise on PSpice Environment, Basic Operations and simulation of circuits

1. Introduction to the PSpice environment (OrCAD Capture CIS/Schematics, PSpice A/D).
2. Basic workflow: Schematic capture, simulation setup, waveform viewing.
3. Navigating the PSpice graphical interface (menus, toolbars, project manager).
4. Placing components from libraries (resistors, capacitors, inductors, independent voltage/current sources).
5. Wiring components, creating connections.
6. Editing component properties (values, tolerance).
7. Saving and opening PSpice projects.
8. Zooming, panning, and navigating in the schematic editor.
9. Simulate simple DC series and parallel circuits, voltage dividers, current dividers.
10. Simulate simple RC, RL, and RLC series/parallel circuits under AC excitation
11. Simulate and analyze half-wave and full-wave rectifiers with and without filters.

5. Exercise on Familiarization with MATLAB software and simulation of basic circuits

1. Introduction to command window and perform simple math calculations
2. Introduction to Simscape/SIM Power systems
3. Working with different blocks of Simscape/SIM Power systems
4. Verify Thevenin's Theorem in a simple DC Circuit using SIMULINK
5. Simulation of Single phase full wave converter circuit with R and RL load

CO-PO Mapping Table:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO.1&2	2	2	3	3	1	1	2	3	1	1
CO.3	2	2	3	3	2	1	2	3	1	2
CO.4	3	3	2	3	1	1	2	1	3	2
CO.5	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

HYPONATED COURSE CONTENTS

1. Exercise on various tool bars, menus and standard Commands, Practice on dimensioning and formatting commands, insert commands and view 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 Electrical symbols, electrical wiring, electrical poles, towers and earthing systems.**

Drawing of electrical wiring circuit of one lamp controlled by one switch-stair case wiring- godown wiring-series parallel control circuits - Drawing of different electrical poles with cross-arms-insulators and stay sets-transmission towers - Drawing of pipe earthing and Plate earthing with dimensions. Drawing of plan and elevation of different stepped cores of single-phase transformer - Drawing of Pole mounted substation and Plinth mounted substation with dimensions.

4. **Exercise on PSpice Environment, Basic Operations 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 on Familiarization with 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.

Reference books

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.

V SEMESTER

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

	Subject Code	Subject	Periods per week	Total Periods	Credits	Scheme of Examination			
						Duration (Hours)	Sessional Marks	End Exam Marks	Total Marks
THEORY SUBJECTS	26EE501T	Electrical Utilisation & Traction	6	90	4	3	30	70	100
	26EE502T	Power Systems - II	6	90	4	3	30	70	100
	26EE503T	Power Electronics	6	90	4	3	30	70	100
	ELECTIVE SUBJECT								
	26EE504E	Basics of Artificial Intelligence	3	45	2	3	30	70	100
	26EE505E	Industrial Management & Smart Technologies	3	45	2	3	30	70	100
	AUDIT SUBJECT								
	26EE506A	Smart Grid Technology	2	30	--	--	--	--	--
	TOTAL THEORY		**23**	**345**	**14**	--	**120**	**280**	**400**
PRACTICAL SUBJECTS	26EE507L	Power Electronics & PLC Laboratory	6	90	2	3	40	60	100
	26EE508L	IOT Laboratory	6	90	2	3	40	60	100
	26EE509P	Project Work	4	60	1.5	3	40	60	100
	--	Student Centric Activity	3	45	0.5	--	--	--	--
	TOTAL PRACTICAL		**19**	**285**	**6**	--	**120**	**180**	**300**
GRAND TOTAL			**42**	**630**	**20**	--	**240**	**460**	**700**

ELECTRICAL UTILIZATION AND TRACTION

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

COURSE OUTCOME MAPPING

S.No	Unit Title	No. of periods	Weightage of marks	No.of short Ans Questions	No. of Essay Questions	CO's Mapped
1	Electric Lighting	17	18	2	1.5	CO1
2	Electric Heating	14	18	2	1.5	CO2
3	Energy saving devices	12	11	1	1	CO3
4	Electric Drives	15	14	2	1	CO4
5	Electric Traction	32	33	3	3	CO5
	Total	**90**	**94**	**10**	**8**	

COURSE OBJECTIVES

Upon completion of the course the student shall be able to	
Course Objectives	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

Course Outcomes	CO1	26EE501T-1	Design lighting schemes for a given application
	CO2	26EE501T-2	Ability to identify the type of Electric heating suitable for any specific application
	CO3	26EE501T-3	Ability to draw Automatic Temperature and Illumination control circuits.
	CO4	26EE501T-4	Understand the different electrical drives used for different applications and methods of electric braking
	CO5	26EE501T-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:

By the end of this course, students will be able to:

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. 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. Describe different methods of track electrification

5.2. List the types of traction services and sketch the speed-time curves

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. List the factors affecting the scheduled speed

5.6. 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 Derive the expression for tractive effort for acceleration to overcome

gravity pull and train resistance and solve problems.

5.9. Explain the mechanics of transfer of power from motor to driving wheel

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

5.13. List the important Overhead Equipment (OHE) used in Traction

5.14. State the important requirements of traction motor

5.15. Explain the suitability of different motors (D.C., 1-Ø A.C, 3-Ø A.C., Composite & Kando systems) for traction

5.16. State the need for Booster Transformer in Traction

5.17. Describe the following major Equipment at traction Substation

a) Transformer b) Circuit Breaker c) Interrupter

5.18. State the importance of location and spacing of Substation

5.19. Explain

a) End on Generation b)Mid on Generation c) Head on Generation

5.20. State the requirements of Train lighting

5.21. Mention the requirements of railway coach air conditioning

CO-PO/PSO MATRIX

CO.No	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PS0 1	PS0 2	PS0 3
26EE501T-1	3	1	1			1		3		
26EE501T-2	3				1		1	3		1
26EE501T-3	3				1	1		3		
26EE501T-4	3		1	2			1	3	1	1
26EE501T-5	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

HYPONATED 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 andcoreless type - applications - Dielectric heating - principle – applications

3. 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

Single-phase A.C. and Composite systems -Types of services (main line, suburban , Metro and urban) - speed-time curves for the above services - Maximum speed, average speed and scheduled speed - Factors affecting the 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 & its derivation – Mechanism of transfer of power from motor to driving wheel - 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) - State the important requirements of traction motor - suitability of different motors (D.C., 1-Ø A.C, 3-Ø A.C., Composite & Kando systems for traction – Need of Booster Transformer - Major Equipment at traction Substation – Importance of Location and Spacing of Substations - End on Generation - Mid on Generation - Head on Generation - Requirements of Train lighting - requirements of railway coach air conditioning.

REFERENCES

1. J B Gupta – Utilisation of Electric Power and Electric Traction – Katson Books
2. R.K. Gang - Utilisation of Electric energy
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

Syllabus to be covered for Unit Tests

Unit Test	Learning Outcomes to be Covered
Unit Test - 1	From 1.1 to 3.7
Unit Test – 2	From 4.1 to 5.21

POWER SYSTEMS – II

Course code	Course title	No. of periods/ week	Total no. of periods	Marks for FA	Marks For SA	Credits
26EE502T	POWERSYSTEMS–II	6	90	30	70	04

COURSE OUTCOME MAPPING

Chapter No.	Title	No. of Periods	Weightage of marks	No.of short Ans Questions	No. of Essay Questions	CO'S Mapped
1	Transmission lines	25	25	3	2	CO1
2	Line structures and Underground cables	30	25	3	2	CO2
3	Substations and Distribution	20	22	2	2	CO3
4	Protection of Transmission lines	7	11	1	1	CO4
5	Modern Trends in power systems	8	11	1	1	CO5
TOTAL		**90**	94	10	8	

COURSE OBJECTIVES

Upon completion of the course the student shall be able to	
COURSE OBJECTIVES	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

COURSE OUTCOMES	CO1	26EE502T.1	Describe the concepts of power transmission, distribution systems and HVDC transmission systems
	CO2	26EE502T.2	Explain different structures, insulators, laying of lines including calculation of Sag and evaluation of underground cables
	CO3	26EE502T.3	Explain various substations and basic concepts of distribution
	CO4	26EE502T.4	Understand basic concepts of transmission line protection
	CO5	26EE502T.5	Enhance the knowledge of the students with the recent trends in emerging power system operation

LEARNING OUTCOMES

By the end of this course, students will be able to:

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. Describe corona discharge, factors affecting and methods to reduce it.
1.17. Explain the concept of HVDC transmission, its types, advantages, and disadvantages.

2. Line Structures and Underground Cables

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 discuss the factors affecting it.
2.5. Derive sag equations for supports at equal and solve related problems.
2.6. Explain the disadvantages of excessive sag in transmission lines.
2.7. Describe the function and requirements of insulators used in overhead lines.
2.8. Explain applications of different types of insulators (pin, strain, suspension, shackle).
2.9. Compare pin type and suspension type insulators based on mechanical and electrical characteristics.
2.10. Define flashover, puncture, and string efficiency
2.11. Solveproblemsondistributionofvoltageacrossstringandstringefficiency
2.12. List techniques to improve string efficiency.
2.13. State the need for arcing horns and guard rings.
2.14. State the causes of insulator failure in power systems.
2.15. Describe the construction of underground cables and classify them based on configuration, voltage, insulation, and stress control.
2.16. Compare overhead lines with underground cables in terms of reliability, cost, and installation.
2.17. Derive the insulation resistance of a cable and solve numerical problems.

3. Substations and Distribution

3.1. Explain the purpose of substations in electrical power systems.
3.2. Compare indoor and outdoor substations.
3.3. Describe the role of major substation equipment, including transformers, switchgear, relays, meters, bus-bars, arrestors, and cables.
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. Explain the importance of bus-bar protection and causes of bus-bar faults.
4.2. Describe different methods of transmission line protection.
4.3. Explain the working of distance relays in protecting transmission lines.
4.4. Describe the use of pilot wire systems for protection schemes.
4.5. 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 MATRIX:

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

HYPONATED COURSE CONTENTS

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 andefficiency-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 theabovemethods- -Ferranti's effect- Corona in transmission lines -Effects of corona –methods of reducing corona-Hot line technique -concept and application-High voltage DC Transmission**:** Basic Concepts and Types of HVDC transmission- Advantages and disadvantages of HVDC transmission.

2. Line structures and Cables:

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. Sub-stations and Distribution

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 arrestors, 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.

Reference Books:

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
6. KR Padiyar –HVDC Power Transmission system Technology.

Syllabus to be covered for Unit Tests

ASSESMENTS	**Learning Outcomes to be Covered**
Formative Assessment-1	From1.1 to 2.13
Formative Assesment-2	From 2.14 to 5.6

POWER ELECTRONICS

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

COURSE OUTCOME MAPPING:

S. No.	Unit Title	No. of Periods	Weightage of marks	No.of short Answer Questions	No. of Essay Questions	CO'S Mapped
1.	Power Electronic devices	20	22	2	2	CO1
2.	Converters	12	22	2	2	CO2
3.	AC Voltage controllers & Choppers	15	14	2	1	CO3
4.	Inverters	20	14	2	1	CO4
5.	Applications of Power Electronic circuits	23	22	2	2	CO5
Total		**90**	**94**	10	**8**	

COURSE OBJECTIVES

Course Objectives	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 OBJECTIVES

Course outcomes	CO1	26EE503T.1	Explain the construction, working, and characteristics of power electronic devices such as SCR, TRIAC, DIAC, MOSFET and IGBT.
	CO2	26EE503T.2	Analyze the operation of single-phase and three-phase converters with various types of loads.
	CO3	26EE503T.3	Apply the principles of AC voltage controllers and choppers in controlling power to electrical loads.
	CO4	26EE503T.4	Describe the working of inverters and compare various Pulse Width Modulation (PWM) techniques used in inverter control.
	CO5	26EE503T.5	Apply power electronic circuits for motor control, UPS, and other practical systems, and evaluate their performance in real-world applications.

LEARNING OUTCOMES

By the end of this course, students will be able to

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 , over current, 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 semi conductors
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 Rload.
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. AC voltage controllers and Choppers

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 MATRIX

CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
26EE503T.1	3	1						3		
26EE503T.2	3	2	2					3		
26EE503T.3	3	2	2					3	2	
26EE503T.4	3	2	2					3	2	
26EE503T.5	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

HYPONATED COURSE CONTENTS

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 & TRAIC-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. AC Voltage controllers & Choppers

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 invertors control) - Devices used to suppress spikes in supply system.- Working of UPS with block diagram – Charging station- SolarBattery charger Circuit using SCR - power factor improvement circuit –Power electronics in automation- power electronics converters in renewable energy systems.

REFERENCE BOOKS

1. Power Electronics – P.S. Bimbhra
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

Syllabus to be covered for Unit Tests

Unit Test	Learning Outcomes to be Covered
Unit Test – 1	From 1.1 to 3.11
Unit Test – 2	From 4.1 to 5.16

BASICS OF ARTIFICIAL INTELLIGENCE

Course code	Course title	No. of periods/ week	Total no. of Periods	Marks for FA	Marks for SA	Credits
26EE504E	BASICS OF ARTIFICIAL INTELLIGENCE	03	45	30	70	2

COURSE OUTCOME MAPPING

S. No.	Unit Title	No. of Periods	Weightage of marks	No.of short Ans Questions	No. of Essay Questions	CO's Mapped
1.	Introduction to Artificial Intelligence and AI Models	12	25	3	2	CO1
2	Basics of Machine Learning (ML) and Role of Data	12	25	3	2	CO2
3	AI applications in Electrical and Electronics Engineering	12	19	1	2	C03
4	Ethics in AI, Future Scope of AI and Career awareness in AI	9	25	3	2	CO4
Total		**45**	**94**	**10**	**8**	

COURSE OBJECTIVES:

Course Objectives	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:

Course outcomes	CO1	26EE504E.1	Understand the fundamentals and evolution of Artificial Intelligence (AI) and various AI models
	CO2	26EE504E.2	Demonstrate the basics of Machine Learning (ML) and the importance of data in AI
	CO3	26EE504E.3	Analyse applications of AI and ML in Electrical, Electronicsand allied engineering fields
	CO4	26EE504E.4	Evaluate the ethical concerns, future scope, and career opportunities in AI

LEARNING OUTCOMES:

1.0 Introduction to Artificial Intelligence and AI Models

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. Health Care, 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 Basics of Machine Learning (ML) and Role of Data

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 and Electronics 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 Ethics in AI, Future Scope of AI and Career awareness in 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.

HYPONATED COURSE CONTENTS

1. Introduction to Artificial Intelligence and AI Models –

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: Health Care, 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. Basics of Machine Learning (ML) and Role of Data –

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 and Electronics 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. Ethics in AI, Future Scope and Career Awareness –

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

REFERENCE BOOKS

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

CO-PO/PSO MATRIX

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	1.25	1.5	1	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.

Syllabus to be Covered for Unit Tests

Assessment	Learning Outcomes to be Covered
Formative Assessment – I	From 1.1 to 2.11
Formative Assessment – II	From 3.1 to 4.8

INDUSTRIAL MANAGEMENT & SMART TECHNOLOGIES

Course Code	Course Title	No of Periods/ Week	Total Number of Periods	Marks for FA	Marks for SA	Credits
26EE505E	INDUSTRIAL MANAGEMENT & SMART TECHNOLOGIES	3	45	30	70	02

COURSE OUTCOME MAPPING

S No.	Title	No. of Periods	Weightage of marks	No.of short Ans Questions	No. of Essay Questions	CO'S Mapped
1	Basics of Industrial Management and Organisation structure	15	**25**	**3**	**2**	CO1
2	Material management and industrial safety management	12	**25**	**3**	**2**	CO2
3	Entrepreneurship Development and Total Quality Management	8	**22**	2	2	CO3
4	Smart Technologies	10	**22**	2	2	CO4
TOTAL		**45**	94	**10**	8	

COURSE OBJECTIVES

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

COURSE OUTCOMES

COURSE OUTCOMES	CO1	26EE505E.1	Understand the fundamentals of industrial management and organizational structure
	C02	26EE505E.2	Describe the different aspects of production, materials management and ensure industrial safety
	C03	26EE505E.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	26EE505E.4	Understand and evaluate the role of smart technologies in industry

LEARNING OBJECTIVES

1. Basics of Industrial Management and Organisation Structure

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 and industrial safety 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. Entrepreneurship development and Total 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/PSO MATX

CO. NO.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	**PSO 3**
26EE505E.1	3	2	2	-	-	2	-	2	1	-
26EE505E.2	2	3	2	2	3	3	2	3	2	-
26EE505E.3	2	2	3	2	2	1	-	2	2	3
26EE505E.4	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

HYPONATED COURSE CONTENT

1. Basics of Industrial Management and Organisation Structure

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 and industrial safety 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. Entrepreneurship development and Total 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

SYLLABUS TO BE COVERED FOR UNIT TESTS

ASSESSMENT	Learning Out comes to be Covered
FORMATIVE ASSESSMENT -I	From 1.1 to 2.13
FORMATIVE ASSESSMENT -II	From 3.1 to 4.5

SMART GRID TECHNOLOGY

Course code	Course title	No. of periods/week	Total no. of periods	credits
26EE506A	SMART GRID TECHNOLOGY	2	30	0

COURSE OUTCOME MAPPING

Chapter No.	Title	No. of periods	CO'S Mapped
1	Fundamentals of smart grid technology	06	CO1,CO2
2	Smart Grid Components and Communication Technologies	12	CO2,CO3
3	Applications and Emerging Trends in Smart Grids	12	CO4,CO5
	TOTAL NO.OF PERIODS	**30**	

COURSE OBJECTIVE

Upon completion of course student may able to :	
COURSE OBJECTIVES	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

COURSE OUTCOMES	**CO1**	6EE506A.1	plain the concept, evolution, and need for smart grids and differentiate them from conventional power grids.
	CO2	6EE506A.2	scribe the architecture and key components of smart grids such as smart meters, PMUs, RTUs, and automation systems.
	CO3	6EE506A.3	ntify and explain the communication technologies and control tools (e.g., SCADA, AMI) used in smart grid operation.

	CO4	6EE506A.4	alyze the integration of renewable energy sources and electric vehicles within smart grid systems for efficient energy management.
	CO5	6EE506A.5	scuss cyber security measures, real-world case studies, and emerging technologies such as IoT, AI, and Blockchain in smart grid applications.

LEARNING OUTCOMES:

1. Fundamentals of smart grid technology

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 and Communication Technologies**

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 and Emerging Trends in 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 cyber security concerns and protection methods in smart grids.
3.4. Describe key features of smart cities, micro grids, 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 MATRIX:

CO NO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
26EE506A.1	3	2	1		2	2		3	2	1
26EE506A.2	3	3	2	2		1		3	2	1
26EE506A.3	3	3	3	3	2	2		3	3	2
26EE506A.4	3	3	2	2	2	3	1	3	3	2
26EE506A.5	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**

HYPONATED COURSE CONTENT

1. **Fundamentals of Smart Grid technology**

   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. Smart Grid Components & Communication

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. Applications & Emerging Trends

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

REFERENCE BOOKS

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 & PLC LABORATORY

Course code	Course title	No. Of periods/ week	Total No. of periods	Marks for FA	Marks for SA	Credits
26EE507L	POWER ELECTRONICS & PLC LABORATORY	6	90	40	60	2

COURSE OUTCOME MAPPING

S.No.	Unit Title	No. of Periods	CO'S Mapped
1.	Characteristics of different Power Electronic Devices	15	CO1
2.	Study the working of different Power Electronic circuits	15	CO2
3.	Speed control of the DC motor and AC motor using the Power Electronic Devices	18	CO3
4.	Execution of the different Ladder Diagrams	12	CO4
5.	Execution of ladder diagrams with model applications	30	CO5
Total		**90**	

COURSE OBJECTIVES

Course Objectives	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. iv) To execute ladder diagrams by using Program Logic Controller

COURSE OUTCOMES:

CO1	26EE507L.1	Conduct suitable experiment to draw characteristics of various power semiconductor devices.
CO2	26EE507L.2	Analyze working of power electronics circuits.
CO3	26EE507L.3	Conduct test to control the speed of electrical motors using power electronic devices.
CO4	26EE507L.4	Analyze PLC software to prepare ladder diagram.
CO5	26EE507L.5	Construct ladder diagrams for logic gates using timers and counters.

LEARNING OUTCOMES

1. **Plot the Characteristics of the different Power Electronic Devices**
   (a) Plot the Characteristics of SCR, DIAC, TRIAC
   (b) Plot the Characteristics of IGBT, MOSFET.
2. **Demonstrate the working of different Power Electronic circuits**
   (a) A single-phase half-wave controlled converter using SCR and analyze its output voltage waveform.
   (b) A single-phase full-wave fully controlled converter using SCRs and examine its output voltage waveform
3. **Speed control of the DC motor and AC motor using the Power Electronic Devices**
   (a) Speed Control of DC motor using single phase full wave controlled converter
   (b) Speed Control of DC motor using Chopper
   (c) Speed Control of 1-phase AC motor using ac voltage controller.
   (d) V/F control of 3-phase induction motor using inverter
4. **Execute the different Ladder Diagrams**
   (a) Demonstrate PLC and Ladder diagram-Preparation, downloading and running.
   (b) Execute Ladder diagrams for different Logical Gates.
   (c) Execute Ladder diagrams using timers & counters.
5. **Execute the Ladder Diagrams with model applications**
   (a) Execute Ladder diagrams with model applications (i) DOL starter (ii)Star-Delta starter
   (b) Execute Ladder diagrams with model applications (i) Stair case lighting (ii) Traffic light controller

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

CO-PO/PSO MATRIX:

CO NO	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
26EE507L.1	3	1						3		
26EE507L.2	3	1						3		
26EE507L.3	3	1	1					3	1	
26EE507L.4	3	1						3		
26EE507L.5	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

HYPONATED COURSE CONTENTS

1. **Characteristics of Power Electronic Devices**

   Plot the Characteristics of SCR, DIAC, TRIAC, MOSFET and IGBT
2. **Performance of different converter circuits**

Single phase half wave controlled converter and single phase full wave fully controlled bridge converter.

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

   Speed Control of DC motor by using single phase bridge converter ,speed Control of 1-phase AC induction motor using AC voltage controller, V/f control of three phase induction motor using inverter.

4. **Basics of PLC**

   Demonstrate about PLC, ladder diagrams preparation, logic gates

5. **Ladder diagrams with model applications**

   Ladder diagrams execution for DOL starter, Star delta starter, Traffic light controller and stair case wiring

Competencies & Key competencies to be achieved by the student

S.No.	Experiment Title	Competencies	Key Competencies
1	i) Characteristics of SCR, DIAC, TRIAC ii) Characteristics of IGBT and Power MOSFET	Identify different power electronic devices such as SCR, DIAC, TRIAC, IGBT, and MOSFET. Demonstrate understanding of datasheets and safe handling..	Draw symbols and identify terminals. Follow safety procedures while connecting components. Make circuit connections as per the diagram. Record voltage and current values. Plot device characteristics on graph sheets.
2	i) Single-phase half-wave controlled converter ii) Single-phase full-wave fully controlled bridge converter	Demonstrate working of power converter circuits. Analyze output waveform for different loads and firing angles. Perform fault analysis if output is unexpected.	Draw circuit diagrams for both converters. Identify required components and CRO connections. Connect the circuit with R and R-L loads. Observe and record waveforms for varying firing angles.
3	i) Speed control of DC motor using bridge converter ii) Speed control of 1-phase AC motor iii) V/f control of 3-phase induction motor using inverter	Control speed of various motors using converters and inverters. Measure and analyze speed versus triggering angle. Troubleshoot speed control performance issues.	Draw circuit diagrams for each method. Identify apparatus and set up connections. Change firing angles and record motor speed. Plot Speed vs Triggering Angle graphs. Execute V/f control with inverter. Compare with simulation where feasible.
4	i) PLC introduction ii) Ladder diagrams for logic gates, timers & counters	Use PLC software for ladder diagram preparation and execution. Understand basic logic design and timers. Debug simple logic programs.	Install and configure PLC software. Prepare and download ladder diagrams. Simulate and execute logic gates, timers, and counters. Troubleshoot program logic for expected output.

5	i) Ladder diagrams for DOL starter, Star-Delta starter ii) Staircase lighting and traffic light controller	Design and implement ladder logic for real-time industrial applications. Apply IEC 61131-3 principles where possible. Maintain proper documentation.	Develop ladder diagrams for each application. Verify circuit performance in software/hardware. Debug and correct logic errors. Prepare clear documentation with ladder diagram, description, and output results.

IOT LABORATORY

Course code	Course title	No. of periods/ week	Total no. of periods	Marks for FA	Marks For SA	credits
26EE508L	IoT laboratory	6	90	40	60	02

COURSE OUTCOME MAPPING

Chapter No.	Major Topics	No. of Periods	CO'S Mapped
1	Introduction to IoT	12	CO1
2	Domestic applications using IoT	42	CO2
3	Applications of IoT in industry using IoT	36	CO3
TOTAL		**90**	

COURSE OBJECTIVES:

Upon completion of the course the student shall be able to	
Course Objectives	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

Course Outcomes	**CO1**	26EE508L-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	26EE508L-2	Demonstrate the use of IoT technology in controlling and monitoring domestic appliances
	CO3	26EE508L-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 Ardunio IDE software (or related software)
    1.3. Familiarize with Blynk app

2. **Domestic applications using 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. **Applications of IoT in industry**

    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
26EE508L-1	3	2	1	-	2	-	-	3	2
26EE508L-2	2	2	3	2	3	1		3	3
26EE508L-3	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

HYPONATED COURSE CONTENT

1. Introduction to IoT

1.1 . Getting started with IoT hardware – common components
1.2 . Familiarization with Arduino IDE software (or related platforms)
1.3. Familiarization with the Blynk mobile app for IoT control

2. Domestic Applications Using IoT

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

3. Applications of IoT in Industry

3.1. IoT-based temperature tracking of an electric motor
3.2. IoT-based gas leakage detection system
3.3. Servo motor angular position control (0° to 180°) using IoT
3.4. 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 Using IoT	Design and implement IoT-based home automation circuits using sensors	• Interface sensors and actuators for home automation (LEDs, fans,

		(temperature, motion, water level, etc.). □ Control output devices (LEDs, fans, relays) using mobile applications connected via Wi-Fi (ESP8266/ESP32). □ 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.	relays, pumps). • Develop mobile-controlled applications using IoT platforms like Blynk. • Implement threshold-based automation (e.g., temperature, motion, water level). • Optimize home systems for energy efficiency
3	Applications of IoT in Industry	□ 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	• 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).

		robustness in industrial IoT applications, considering environmental factors.	

PROJECT WORK

Course Code	Course Title	No. of periods /week	Total No. Of Periods	Marks for FA	Marks for SA	Credits
26EE509P	PROJECT WORK	4	60	40	60	1.5

COURSE OBJECTIVES

COURSE OBJECTIVES	• To apply theoretical and practical knowledge of Electrical and Electronics Engineering in identifying, analyzing and solving real-world problems through structured project execution. • To develop professional skills such as teamwork, communication, independent learning, project planning and exposure to project management tools, industry standards and documentation practices that prepare students for higher studies and professional careers. • To nurture innovation, creativity, ethical practices, social responsibility, sustainability and entrepreneurial mindset while executing and presenting engineering projects.

COURSE OUTCOMES

COURSE OUTCOMES	CO1	Apply engineering knowledge and technical skills to identify, analyze and solve real-time Electrical/Electronics problems through systematic project execution.
	CO2	Communicate project ideas, procedures, and results effectively using oral, written and digital tools in a professional manner.
	CO3	Collaborate as a team member or leader by sharing responsibilities, managing tasks and contributing constructively to achieve project goals.
	CO4	Demonstrate self-directed learning, resource fullness and adaptability to manage project work and enhance performance through continuous learning.
	CO5	Practice professional ethics, safety and sustainability in all project activities while recognizing the broader impact of engineering solutions on society.

PO-CO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3
CO1	3	2	2			2		3	2	
CO2					2				3	2
CO3				3				2	2	
CO4				3	2			2	3	
CO5						3	3			3
Average	3	2	2	3	2	2.5	3	2.3	2.5	2.5

3: High, 2: Moderate,1: Low

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.

LEARNING OUTCOMES:

Project work plays a vital role in bridging the gap between theoretical knowledge and real-world application. It provides students with an opportunity to apply concepts learned in various subjects to solve practical engineering problems. Through project work, students enhance their problem-solving skills, teamwork, communication and time management. It also nurtures innovation, creativity and independent thinking qualities essential for industry readiness. Moreover, it fills a sense of responsibility, ethics and awareness of safety and sustainability in engineering practice.

Upon completion of the course the student shall be able to

1. Problem Solving and Technical Proficiency:

1.1 Generate and develop innovative ideas based on electrical and electronics engineering principles.

1.2 Identify, define and analyze engineering problems related to the project.

1.3 Gather and interpret relevant technical information from various sources.

1.4 Evaluate alternative solutions or design approaches.

1.5 Apply appropriate engineering concepts to develop and implement the project.

1.6 Use laboratory equipment, hardware, software and simulation tools proficiently.

1.7 Demonstrate skills in measurement, testing and troubleshooting.

1.8 Interpret results effectively and draw valid technical conclusions.

1.9 Demonstrate innovative thinking and entrepreneurial approach in developing project solutions

2. Communication and Reporting:

2.1 Communicate technical ideas and project outcomes clearly through oral and written forms.

2.2 Present project content in a structured, logical and coherent manner.

2.3 Prepare professional technical reports and documentation.

2.4 Use appropriate digital tools (e.g., PowerPoint, simulation demos) for effective presentations.

2.5 Communicate project outcomes effectively to academic, industry, and societal audiences.

3. Teamwork and Leadership:

3.1 Work collaboratively as part of a team to achieve project objectives.
3.2 Share, discuss, and refine ideas with team members.
3.3 Coordinate tasks, roles and responsibilities effectively.
3.4 Resolve team conflicts constructively and support team decisions.
3.5 Exhibit leadership qualities, when required, in organizing and managing project work.

4. Independent and Lifelong Learning:

4.1 Demonstrate initiative and self-direction in carrying out project work.
4.2 Learn and adapt from sources beyond the prescribed syllabus.
4.3 Analyze and reflect on project performance to identify improvements.
4.4 Compare multiple approaches to determine the most sustainable and effective solution.
4.5 Manage time and resources efficiently during the execution of the project.
4.6 Maintain systematic documentation of project processes and results.
4.7 Adapt to challenges and unforeseen situations during the project lifecycle.
4.8 Explore and adopt emerging technologies, software, and standards relevant to project work.

5. Ethics and Social Responsibility:

5.1 Show respect to classmates, faculty, team members and others involved.
5.2 Follow ethical practices in communication, documentation and teamwork.
5.3 Understand and adhere to safety, health, and environmental regulations.
5.4 Recognize and manage the constraints of limited resources responsibly.
5.5 Develop and apply sustainable engineering practices.
5.6 Avoid plagiarism and give due credit to others' contributions.
5.7 Evaluate the social and environmental impact of the project outcomes.
5.8 Practice intellectual honesty by ensuring originality and respecting IPR (Intellectual Property Rights).

COURSE CONTENT:

1.0 Projects involving Design, Development, Assembly, Performance Analysis or Case Studies in core and emerging areas of Electrical and Electronics Engineering.

2.0 Core and emerging areas include:

2.1 Renewable Energy Systems (e.g., solar/wind micro-projects).
2.2 IoT-based Electrical Monitoring and Smart Control.
2.3 Automation using PLCs, Arduino or Microcontrollers.
2.4 Power Electronics Applications (converters, inverters, drives).
2.5 Electrical Safety and Energy Auditing.
2.6 Any other innovative project relevant to electrical and electronics engineering.

ASSESSMENT AND EVALUATION FRAMEWORK FOR PROJECT WORK:

Weightage of marks for Assessment of Learning Outcomes of Project work and evaluation framework is as follows.

S. No	Item	Marks
1	**Internal Marks:** Completion of Assigned task in the group/individual to complete the project. i) Progress Reviews / Regularity (10) ii) Quality of Work / Innovation (15) iii) Teamwork, Participation & Contribution (5) iv) Documentation & Interim Report (10)	**40**
	End Examination Marks: i) Demonstration of Skill relevant to the project (25) ii) Final Project Report (format, depth, originality) (15) iii) Presentation (PPT / Communication skills) (10) iv) Viva Voce (technical understanding & Q&A) (10)	**60**
Total marks		**100**

I. Panel Composition:

The end examination shall be conducted by a panel consisting of:

i) Head of the Department of EEE / Senior Faculty Member (Convener).
ii) The project guide(s) who guided the project.
iii) One external examiner from industry or Head/Senior Faculty of EEE from another Polytechnic/Engineering College.
iv) All examiners shall sign the evaluation sheet to authenticate marks awarded.

II. Evaluation Criteria:

The panel shall assess based on:

i) Technical Content & Innovation (problem-solving, methodology, originality).
ii) Skill Demonstration (practical execution, use of tools/equipment).
iii) Report Quality (documentation, structure, references).
iv) Communication & Presentation Skills.
v) Viva Performance (understanding, analysis, Q&A).

Note: The project work assessment framework shall be periodically reviewed by the project guide and updated based on feedback from students, ensuring effective preparation and presentation during the end examination.

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VI SEMESTER

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

Subject Code	course Title	Duration	Scheme of Valuation			Remarks / credits
			Item	Nature	Max Marks	
26EE601I	Industrial Training	Six Months	First assessment	Assessment of Learning Outcomes by both the faculty and training mentor of the Industry.	120	6
			Second assessment	Assessment of Learning Outcomes by both the faculty and training mentor of the Industry.	120	6
			Final Assessment	Training Report	20	3
				Demonstration	30	3
				Viva -Voce	10	2
TOTAL					**300**	**20**

INDUSTRIAL TRAINING

Subject Code	Subject Title	Duration	Credits
26EE601I	Industrial Training	06 months	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	06 months

COURSE OBJECTIVES

1. Expose to real time working environment
2. Enhance knowledge and skill already learnt in the institution.
3. 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

The student shall be able to display the following skill sets

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

Sl. No	Course Title	Duration	Scheme of evaluation		
			Item	Nature	Max. Marks
1	Industrial Training	06 months	1.First Assessment at Industry (After 12 Weeks)	Assessment of Learning outcomes by both the faculty and training Mentor of the industry	120
			2.Second Assessment at the Industry (After 20 weeks))	Assessment of Learning outcomes by both the faculty and training Mentor of the industry	120
			Final Summative assessment at institution level	Training Report	20
				Demonstration of any one of the skills listed in learning outcomes	30
				Viva Voce	10
TOTAL MARKS					**300**

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: 6 months.
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 6 months 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 6 months 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 misbehaviour 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.**

RUBRICS FOR ASSESSMENT

DEPARTMENT OF TECHNICAL EDUCATION, AP

INDUSTRIAL TRAINING ASSESSMENT

PROFORMA

1. Name of the institution :
2. PIN :
3. Name of the student :
4. Assessment Period (I / II) : FROM: TO:

Skill Set Sl. No	SKILL SET	Max Marks Allotted For each parameter	Precisely completes the task	Completes the task, mistakes are absent, but not Precise	Completes the task, Mistakes are a few	Makes attempt, Mistakes are many
1	**Technical Skills (Manufacturing/Service/Name plate details /Identification of Tools components etc.,) (20)**					
	(i) Identification of components and tools.	5	5	3	2	1
	(ii) Identification of name plate details of machine/equipment.	5	5	3	2	1
	(iii) Explaining manufacturing procedure.	5	5	3	2	1
	(iv) Identification of service requirement.	5	5	3	2	1
2	**Reading, Observing, drawing and analysing Specifications. (15)**					
	(i) Analysing specifications of machine/ equipment.	5	5	3	2	1
	(ii) Drawing circuit diagram/schematic diagram of the manufacturing process.	5	5	3	2	1
	(iii) Observing readings of various parameters.	5	5	3	2	1
3	**Using of Tools/Instruments /Materials/Machines (20)**					
	(i) Use of proper Tools/Instruments	10	10	7	6	3
	(ii) Materials/Machinery required for the process	10	10	7	6	3

4	**Assembling, dismantling, testing, repair and maintenance skills (20)** (i) Assembling and Dismantling (ii) Testing (iii) Repair and maintenance	10 5 5	10 5 5	7 3 3	6 2 3	3 1 2
5	**Assess and Control of quality parameters, Practice of Safety measures and Precautions while handling the Electrical equipment (20)** (i) Assess and control of quality parameters. (ii) Safety and precautions for handling the equipment.	10 10	10 10	7 7	6 6	3 3
6	**Planning, Organizing, Recording, Communicating, Supervising and report submission Skills (25)** (i) Planning and organizing. (ii) Maintenance of records in the work place. (iii) Communication and Supervising skill. (iv) Reporting technical issues.	10 5 5 5	10 5 5 5	7 3 4 3	6 3 3 3	4 2 2 2
TOTAL MARKS OBTAINED FOR 120						

NOTE: Mistakes are with reference to Technique, Procedure & precautions, while precision refers to technique, procedure, precautions, time & result.

Marks awarded in words: (**)**

Signature of the Training In-charge (Mentor)

Name:

Designation:

Signature of the Faculty In-Charge (Guide)

Name:

Designation: