



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE TEMPLATE

1	Department	ELECTRICAL AND ELECTRONICS ENGINEERING				
2	Course Title	PROFESSIONAL COMMUNICATION				
3	Course Code	AHSD01				
4	Program	B.Tech				
5	Semester	I Semester				
6	Regulation	BT23				
7	Structure of the course	Theory			Practical	
		Lecture 3	Tutorials 0	Credits 3	Lab -	Credits -
8	Type of course (Tick type of course)		Professional Elective -	Open Elective -	VAC -	MOOCs -
9	Course Offered	Odd Semester <input checked="" type="checkbox"/>		Even Semester <input type="checkbox"/>		
10	Total lecture, tutorial and practical hours for this course (16 weeks of teaching per semester)					
	Lectures: 64		Tutorials: Nil		Practical: Nil	
11	Course Coordinator	Dr Jan Mohmad Pandit				
12	Date Approved by BOS	24/08/2023				
13	Course Webpage	https://www.iare.ac.in/sites/default/files/BT23/AHSD01.pdf				
14	Course Prerequisites	Level	Course Code	Semester	Prerequisites	
		Intermediate	-	-	English Language and Grammar	

15. Course Overview

The principle aim of the course is that the students will get awareness about the importance of English language in the contemporary times and also, it emphasizes the students to learn this language as a skill (listening skill, speaking skill, reading skill and writing skill). Moreover, the course benefits the students how to solve their day-to-day problems in speaking English language. Besides, it assists the students to reduce the mother tongue influence and acquire the knowledge of neutral accent. The course provides theoretical and practical knowledge of English language and it enables students to participate in debates about informative, persuasive, didactic, and commercial purposes.

16. COURSE OBJECTIVES:

The students will try to learn:

I	Standard pronunciation, appropriate word stress, and necessary intonation patterns for effective communication towards achieving academic and professional targets.
II	Appropriate grammatical structures and also using the nuances of punctuation tools for practical purposes.
III	Critical aspect of speaking and reading for interpreting in-depth meaning between the sentences.
IV	Conceptual awareness on writing in terms of unity, content, coherence, and linguistic accuracy.

17. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	Demonstrate Demonstrate the prime necessities of listening skills and communication skills for academic and non-academic purposes.	Understand
CO 2	Communicate effectively in spoken English on issues and ideas with a reasonable degree of fluency and accuracy in different social settings.	Understand
CO 3	Strengthen acceptable language for developing life skills to overcome the challenges at professional platform.	Understand
CO 4	Interpret the grammatical and lexical forms of English and use these forms excellently in specific communicative contexts.	Understand
CO 5	Articulate main ideas and important details of literary text at advanced reading levels.	Understand
CO 6	Extend writing skills for fulfilling academic and work-place requirements of various written communicative functions.	Understand

18. Topic Learning Outcome (TLOs):

S.No	Topic(s)	TLO No	Topic Learning Outcome's	Course Outcome	Blooms Level
1	Introduction to communication skills	1	Interpret fundamental concepts of communication skills through a procedural approach	CO 1	Understand
		2	Aware the techniques of perfect communication within and outside the classroom	CO 1	Understand
		3	Identify the parameters of the communication within the classroom as well as outside the classroom.	CO 1	Understand

S.No	Topic(s)	TLO No	Topic Learning Outcome's	Course Outcome	Blooms Level
		4	Practice ethical communication to embrace a diverse range of individuals, communities, and viewpoints	CO 1	Understand
3	Communication Process	5	Examine the process of effective communication at different social situations.	CO 1	Understand
		6	Articulate the process of effective communication different social situations	CO 1	Understand
4	Listening Skills	7	Demonstrate various kinds of listening setbacks within the classroom.	CO 1	Understand
		8	Understand in-depth meaning of audio clips	CO 1	Understand
5	Introduction to phonetics	9	Familiar with – and be able to Understand – technical terms for describing and analyzing English pronunciation and be able to read and produce phonemic transcriptions and transcription of intonation patterns.	CO 1	Understand
		10	Articulate acceptable language at various academical platforms.	CO 2	Understand
6	Significance of speaking skills	11	Reinforce effective oral presentation skills as well as acceptable behavioral traits.	CO 2	Understand
		12	Maintain global civic attitude at work place and feel as a responsible citizen.	CO 2	Understand
		13	Plan as a professional speaker before going to deliver an academic presentation.	CO 2	Understand
7	Generating talks based on visual prompts	14	Get consciousness about the importance of using flash cards, handouts and images to have an effective comprehension.	CO 2	Understand
8	Oral presentation using power point slides	15	Understand properly making effective PPTs in order to give a successful presentation.	CO 2	Understand
9	Delivering speech effectively	16	Anticipate problems with discussion groups	CO 2	Understand
10	Essentials of speaking skills	17	Show acceptable attitude at learning place as well as at work place.	CO 3	Understand
11	Exposure to structured talks	18	Pay appropriate attention as a learner of English as a second language.	CO 3	Understand
12	The concept of word formation	19	Enhance lexical ability to experience of IELTS, TOEFL, GRE tests.	CO 4	Understand





S.No	Topic(s)	TLO No	Topic Learning Outcome's	Course Outcome	Blooms Level
13	Idioms and phrases	20	Recognize and understand the meaning of idioms and phrases.	CO 4	Understand
		21	Able to create own idiom story using story jumper	CO 4	Understand
14	Sentence structure	22	Able to write syntactical organization of given functions in non-periodic interval	CO 4	Understand
15	Usage of punctuation marks	23	Understand well using proper punctuation tools to deliver the topic successfully.	CO 4	Understand
16	Advanced level prepositions	24	Identify and define prepositions, prepositional phrases and objects of the preposition.	CO 4	Understand
17	Tenses	25	Use tenses syetematically to deliver the message without the ambiguity.	CO 4	Understand
18	Subject verb agreement	26	Learn the most common rules for subject/verb agreement and also identify proper and improper subject / verb agreement in the peer writing.	CO 4	Understand
19	Degrees of comparison	27	Able to use the positive, comparative, and superlative degrees of the regular and irregular adjectives and adverbs.	CO 4	Understand
20	Direct and indirect speech	28	Define direct speech and indirect speech and distinguish between direct and indirect speech and classify the rules for converting direct speech to indirect speech and indirect speech to direct speech.	CO 4	Understand
21	Questions tags.	29	Use the correct polarity (positive or negative), depending on the polarity of the statement.	CO 4	Understand
22	Significance of reading skills	30	Accelerate the ability of reading comprehension in advanced learning	CO 5	Understand
23	Techniques of reading	31	Know Vrious parameters of reading skills	CO 5	Understand
		32	Use different literary reading tools to establish his/her argument effectively.	CO 5	Understand
		33	Extends consolidates and sustains vocabulary growth	CO 5	Understand
24	Significance of writing skills	34	Aware the importance of writing skills particuarly at academic domain	CO 6	Understand
25	Effectiveness of writing	35	Understand well using proper writing tools to deliver his/her thesis	CO 6	Understand

S.No	Topic(s)	TLO No	Topic Learning Outcome's	Course Outcome	Blooms Level
26	The role of a topic sentence and supporting sentences in a paragraph	36	Write effective topic sentence as well as supporting sentences to convey a message to his/her readers/audience.	CO 6	Understand
27	Organizing principles of paragraphs in a document	37	Generate fa paragraph effectively using prime principles	CO 6	Understand
		38	Describe the principles of paragraph writing and properities of paragraphs	CO 6	Understand
29	Report writing	39	Present an original thesis on a significant topic within a well defined subject area	CO 6	Understand
30	E-mail writing	40	Use effectively technical writing tools at workplace	CO 6	Understand
31	Various formats for letter writing	41	Knows how to concise a written text without changing the core idea	CO 6	Understand

19. Employability Skills

Example: Communication skills / Programming skills / Project based skills /
Subject: Employment advantage: Effective English language and communication skills are crucial in many aspects of life, including education, business, workplace and social interactions. Proficient English language skills enable individuals to express themselves clearly, understand others, and engage in meaningful conversations. As the primary language of communication across the globe, proficiency in English is a highly sought-after skill in the international workplace and one of the benefits of learning English is therefore that it significantly boosts our job opportunities.

20. Content Delivery / Instructional Methologies:

✓	 Power Point Presentation	✓	 Chalk & Talk	✓	 Assignments	x	 MOOC
x	 Open Ended Experiments	x	 Seminars	x	 Mini Project	✓	 Videos

21. Evaluation Methodology:

The course will be evaluated for a total of 100 marks, with 40 marks for Continuous Internal Assessment (CIA) and 60 marks for Semester End Examination (SEE). CIA is conducted for a total of 40 marks, with 20 marks for Continuous Internal Examination (CIE), and 05 marks for each Definitions and Terminology / Quiz and remaining 10 marks for Tech Talk / Assignments.

Table 4: Outline for Continuous Internal Assessments (CIA - I and CIA - II) and SEE

Activities	CIA - I	CIA - II	SEE	Total Marks
Continuous Internal Examination (CIE)	10 Marks	10 Marks		20 Marks
Definitions and Terminology / Quiz	05 Marks	05 Marks		10 Marks
Tech Talk / Assignment	05 Marks	05 Marks		10 Marks
Semester End Examination (SEE)	-	-	60 Marks	60 Marks
Total	-	-	100 Marks	

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 12 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
35%	Understand
55%	Apply

22. SYLLABUS:

MODULE I	GENERAL INTRODUCTION AND LISTENING SKILLS Number of Lectures: 13
	Introduction to communication skills; communication process; elements of communication; listening skills; significance of listening skills; stages of listening; barriers and effectiveness of listening; Introduction to phonetics; listening comprehension.
MODULE II	SPEAKING SKILL Number of Lectures: 13
	Significance of speaking skills; essentials of speaking skills; verbal and non-verbal communication; generating talks based on visual prompts; public speaking; exposure to structured talks; delivering speech effectively; oral presentation using power point slides; soft skills and hard skills; importance of soft skills for engineers.
MODULE III	VOCABULARY AND GRAMMAR Number of Lectures: 13
	The concept of word formation; idioms and phrases; one-word substitutes, sentence structure (simple, compound and complex); usage of punctuation marks; advanced level prepositions; tenses; subject verb agreement; degrees of comparison; direct and indirect speech; questions tags.
MODULE IV	READING SKILL Number of Lectures: 12
	Significance of reading skills, techniques of reading, skimming-reading for the gist of a text, scanning-reading for specific information, intensive, extensive reading, reading comprehension, metaphor and figurative language.
MODULE V	WRITING SKILL Number of Lectures: 13
	Significance of writing skills; effectiveness of writing; the role of a topic sentence and supporting sentences in a paragraph; organizing principles of paragraphs in a document; writing introduction and conclusion; techniques for writing precis, various formats for letter writing (block format, full block format, and semi bloc format); e-mail writing, report writing.

TEXTBOOKS

1. Anjana Tiwari, “*Communication Skills in English*,” Khanna Publishing House: New Delhi, 2022.

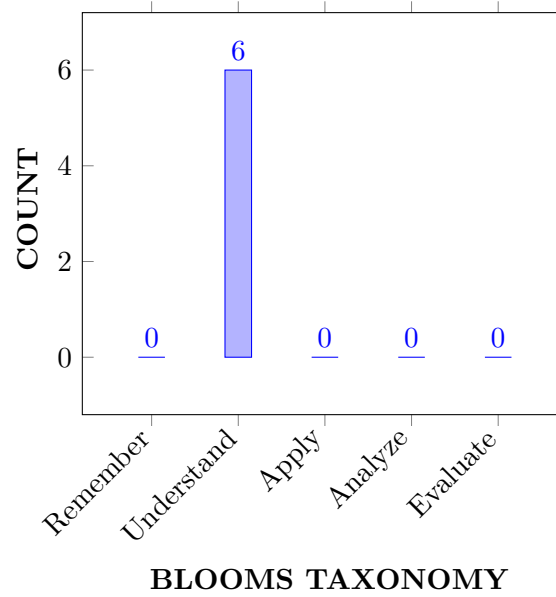
REFERENCE BOOKS:

1. Norman Whitby, “*Business Benchmark: Pre-Intermediate to Intermediate – BEC Preliminary*,” Cambridge University Press, 2nd Edition, 2008.
2. Devaki Reddy, Shreesh Chaudhary, “*Technical English*,” Macmillan, 1st Edition, 2009.
3. Rutherford, Andrea J, “*Basic Communication Skills for Technology*,” Pearson Education, 2nd Edition, 2010.
4. Raymond Murphy, “*Essential English Grammar with Answers*,” Cambridge University Press, 2nd Edition, 2010

MATERIALS ONLINE:

1. Lecture notes, ELRV videos and power point presentations
2. Answers / solutions to all questions / problems in the textbook
3. Online exercises
4. Problems and solutions in files

23. COURSE KNOWLEDGE COMPETENCY LEVEL



24. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
1	Introduction to communication skills	CO 1	T1; R1
2	Communication process	CO 1	T1; R1
3	Elements of communication	CO 1	T1; R1
4	Significance of listening skills	CO 1	T1; R1
5	Different stages of listening	CO 1	T1, R1
6	Different stages of listening	CO 1	T1, R1
7	Listening comprehension	CO 1	T1, R1
8	Introduction to phonetics	CO 1	T1, R1
9	Significance of speaking skills	CO 2	T1, R1
10	Essentials of speaking skills	CO 2	T1, R1
11	Verbal and non-verbal communication	CO 2	T1; R1, R2
12	Generating talks based on visual prompts	CO 2	T1; R1, R2
13	Public speaking	CO 1	T1; R1, R2
14	Exposure to structured talks	CO 2	T1; R1, R2
15	Oral presentation using power-point slides	CO 2	T1; R1, R2
16	Soft skills and hard skills	CO 3	T1; R1, R2
17	Importance of soft skills for engineers	CO 3	T1; R1, R2
18	Concept of word formation	CO	T1; R1, R2
19	Idioms and phrases	CO 4	T1; R3, R4
20	One-word substitutes	CO 4	T1; R3, R4
21	Sentence structure	CO 4	T1; R3, R4
22	Usage of punctuation marks	CO 4	T1; R3, R4
23	Advanced level prepositions	CO 4	T1; R3, R4
24	Functions of tenses	CO 4	T1; R3, R4
25	Subject verb agreement	CO 4	T1; R3, R4
26	Degrees of comparison	CO 4	T1; R1, R2
27	Direct and indirect speech	CO 4	T1; R1
28	Question tags	CO 4	T1; R1
29	Significance of reading skills	CO 5	T1; R1
30	Techniques of reading	CO 5	T1; R1
31	Skimming and Scanning	CO 5	T1; R1
32	Intensive and extensive reading	CO 5	T1; R1
33	Significance of writing skills	CO 6	T1; R1

S.No	Topics to be covered	CO's	Reference
34	Effectiveness of writing	CO 6	T1; R1
35	The role of a topic sentence	CO 6	T1; R1
36	Supporting sentences to develop a paragraph	CO 6	T1; R1
37	Organizing principles of paragraphs in a document	CO 6	T1; R4
38	Writing introduction and conclusion	CO 6	T1; R4
39	Metaphor and figurative language	CO 6	T1; R4
40	Technicalities of writing precis, Letter, e-mail, report and Various formats for letter writing	CO 6	T1; R4
PROBLEM SOLVING/ CASE STUDIES			
1	The aspects to improve listening comprehension Discuss in detail.	CO 1	TI:10,11
2	Different types of listeners with examples.	CO 1	TI: 19,21
3	The sounds of English language.	CO 1	TI:23,27
4	verbal communication or written communication.	CO 2	TI: 27,30
5	Various difficulties in public speaking.	CO 2	TI: 32,33
6	Different ways of greeting people in formal and informal situation and discuss how do they matter in communication?	CO 2	TI: 35,37
7	'Oral presentation requires a good planning'.	CO 2	TI:36,38
8	Power point presentation and the ways to make Power point presentation.	CO 3	TI: 37,38
9	Methods that are used to establish the process of building vocabulary with examples from the most used words in spoken English.	CO 4	TI:39,41
10	The usage of idioms and phrases in spoken English.	CO 4	TI: 47,50
11	'Structure proposition-evaluation' -Reading technique.	CO 5	TI:56,58
12	Active reading, detailed reading, and speed-reading techniques used in different situations.	CO 5	TI: 79,81
13	The elements of paragraph writing in detail.	CO 6	TI:100,102
14	Logical bridges and Verbal bridges in writing.	CO 6	TI: 102,104
15	The role of topic sentence to develop a paragraph.	CO 6	TI:105, 115
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Soft skills and Interpersonal Communication	CO 3	TI 8,9
2	Language acquisition is a process.	CO 2, CO3	TI: 11,12
3	Communication.	CO 3, CO 4	TI: 20, 25
4	Time management.	CO 5	TI: 36, 42
5	Stress management.	CO 3	T: 55, 68
DISCUSSION OF TUTORIAL QUESTION BANK			
1	Soft Skills for difficult situations in terms of reassurance and reliability.	CO 3	TI
2	Verbal and non-verbal communication.	CO 3	TI
3	Honesty, Respect, Self-Control and Accountability their role in building long lasting interpersonal skills?	CO 3	TI

S.No	Topics to be covered	CO's	Reference
4	Etiquette and manners. Its importance in social, personal and professional communication.	CO 3	TI
5	Problem solving and decision making.	CO 3	TI

25. PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES:

Program Outcomes	
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	Design/Development of Solutions: Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Program Outcomes	
PO 12	Life-Long Learning: Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
Program Specific Outcomes	
PSO 1	Design, Develop, Fabricate and Commission the Electrical Systems involved in Power generation, Transmission, Distribution and Utilization.
PSO 2	Focus on the Components of Electrical Drives with its Converter Topologies for Energy Conversion, Management and Auditing in Specific applications of Industry and Sustainable Rural Development
PSO 3	Gain the Hands-On Competency Skills in PLC Automation, Process Controllers, HMI and other Computing Tools necessary for entry level position to meet the Requirements of the Employer.

26. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Strength	Proficiency Assessed by
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. 1. Clarity (Writing); 2. Grammar/Punctuation (Writing); 3. References (Writing); 4. Speaking Style (Oral); 5. Subject Matter (Oral).	5	CIE/Quiz/AAT

27. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Strength	Proficiency Assessed by
PSO 1	Design, Develop, Fabricate and Commission the Electrical Systems involved in Power generation, Transmission, Distribution and Utilization.	-	
PSO 2	Focus on the Components of Electrical Drives with its Converter Topologies for Energy Conversion, Management and Auditing in Specific applications of Industry and Sustainable Rural Development.	-	
PSO 3	Gain the Hands-On Competency Skills in PLC Automation, Process Controllers, HMI and other Computing Tools necessary for entry level position to meet the Requirements of the Employer	-	

3 = High; 2 = Medium; 1 = Low

28. MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOME	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-

29. JUSTIFICATIONS FOR CO – PO / PSO MAPPING - DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 10	Discuss the heeds of functional grammar and punctuation tools in speaking and writing by generating the clarity of an audio text.	5
CO 2	PO 10	Apply the mathematics, science and Engineering fundamentals to problems involving frictional force additionally in system of forces using the knowledge of mathematics and science fundamentals.	5
CO 3	PO 10	Apply the mathematics, science and Engineering fundamentals for locating centroid and centre of gravity using the knowledge of mathematics and science fundamentals.	5

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 4	PO 10	Interpret the grammatical knowledge and punctuation marks systematically towards providing clarity in speaking and writing.	5
CO 5	PO 10	Demonstrate the role of grammar and punctuation marks to understand the meaning between the sentences as well as paragraphs in speaking or writing for clarity.	5
CO 6	PO 10	Describe the clarity of grammatical usage and the obligation of punctuation marks in speaking and writing.	5

30. TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-

31. PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-

32. COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

2 - $40\% < C < 60\%$ –Moderate

1-5 $< C \leq 40\%$ – Low/ Slight

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
TOTAL	-	-	-	-	-	-	-	-	-	18	-	-	-	-	-
AVERAGE	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-

33. ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	✓				








34. ASSESSMENT METHODOLOGY INDIRECT:






x	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback
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35. Relevance to Sustainability goals

Write brief description about the course and how its relevance to SDGs.

1		
2		
3		

4	 <p>QUALITY EDUCATION</p>	<p>English language has become linguafranca across the globe. For that reason, it is compelsory to learn this language at advanced level. In MNC commpanies, those who have excellent communication skills ,their carrer graph goes to the higher level very quickly. Hence ,the role of English language has become a part of the life.</p>
5	 <p>GENDER EQUALITY</p>	
6	 <p>CLEAN WATER AND SANITATION</p>	
7	 <p>AFFORDABLE AND CLEAN ENERGY</p>	
8	 <p>DECENT WORK AND ECONOMIC GROWTH</p>	
9	 <p>INDUSTRY, INNOVATION AND INFRASTRUCTURE</p>	
10	 <p>REDUCED INEQUALITIES</p>	

11	 <p>SUSTAINABLE CITIES AND COMMUNITIES</p>	
12	 <p>RESPONSIBLE CONSUMPTION AND PRODUCTION</p>	
13	 <p>CLIMATE ACTION</p>	
14	 <p>LIFE BELOW WATER</p>	
15	 <p>LIFE ON LAND</p>	

16		
17		

Approved by: Board of Studies in the meeting conducted on _____.

Signature of Course Coordinator
 Dr Jan Mohmad Pandit, Assistant Professor

HOD



INSTITUTE OF AERONAUTICAL ENGINEERING (Autonomous)

Dundigal, Hyderabad - 500 043

COURSE TEMPLATE

1	Department	ELECTRICAL AND ELECTRONICS ENGINEERING				
2	Course Title	MATRICES AND CALCULUS				
3	Course Code	AHSD02				
4	Program	B.Tech				
5	Semester	I Semester				
6	Regulation	BT23				
7	Structure of the course	Theory			Practical	
		Lecture 3	Tutorials 1	Credits 4	Lab -	Credits -
8	Type of course (Tick type of course)	Core ✓	Professional Elective -	Open Elective -	VAC -	MOOCs -
9	Course Offered	Odd Semester <input checked="" type="checkbox"/>		Even Semester <input type="checkbox"/>		
10	Total lecture, tutorial and practical hours for this course (16 weeks of teaching per semester)					
	Lectures: 48 hours		Tutorials: 16 hours		Practical: 0 hours	
11	Course Coordinator	Mr. P. Shantan Kumar				
	Course Instructor	Ms L. Indira				
12	Date Approved by BOS	23 August 2023				
13	Course Webpage	https://www.iare.ac.in/sites/default/files/BT23/AHSD02.pdf				
14	Course Prerequisites -	Level	Course Code	Semester	Prerequisites	
		10+2	-	-	Basic Principles of Algebra and Calculus	

15. Course Overview

This course is a foundation for all engineering branches. It includes concepts of Matrices, Eigen Values, Eigen Vectors, Functions of Single, Several Variables, Fourier Series and Multiple Integrals. This course is applicable for simulation, colour imaging processing and optimal solutions in all engineering problems.

16. Course Objectives:

The students will try to learn:

I	The Concept of the rank of a matrix, eigen values, eigen vectors and solution of the system of linear equations.
II	The Geometrical approach to the mean value theorems and applications.
III	The Fourier series expansion in periodic and non-periodic intervals.
IV	The Evaluation of multiple integrals and applications.

17. Course Outcomes:

After successful completion of the course, students should be able to:

CO 1	Determine the rank and solutions of linear equations with elementary operations.
CO 2	Utilize the Eigen values, Eigen vectors for developing spectral matrices.
CO 3	Make use of Cayley-Hamilton theorem for finding powers of the matrix.
CO 4	Interpret the maxima and minima of given functions.
CO 5	Apply the Fourier series expansion of periodic functions for harmonic series.
CO 6	Determine the volume of solid bounded regions by using the integral calculus.

18. Topic Learning Outcome (TLOs):

S.No	Topic(s)	TLO No	Topic Learning Outcome's	Course Outcome	Blooms Level
1	Rank of a matrix	1	Calculate the rank of a matrix by using determinants	CO 1	Apply
		2	Calculate the rank of a matrix by using elementary operations	CO 1	Apply
2	Inverse of a matrix by Gauss-Jordan method	3	Compute the inverse of the given matrix by elementary operations	CO 1	Apply
3	System of non-homogeneous equations	4	Identify the use of matrix theory to solve the system of linear equations in various engineering problems	CO 1	Apply
		5	Examine the system of homogeneous equations by its augmented form	CO 1	Apply
		6	Examine the system of non homogeneous equations for its augmented form	CO 1	Apply
4	Characteristic equation	7	Recall the concepts of characteristic equations of matrices	CO 2	Remember
5	Eigenvalues and Eigenvectors	8	Recall the concepts of eigenvalues for future engineering applications	CO 2	Remember
		9	Recall the concepts of eigenvectors for future engineering applications	CO 2	Remember








S.No	Topic(s)	TLO No	Topic Learning Outcome's	Course Outcome	Blooms Level
		10	Utilize the characteristic polynomials to compute the eigenvalues and eigenvectors	CO 3	Apply
6	Cayley-Hamilton theorem, Diagonalization of a matrix	11	Make use of the Cayley-Hamilton to find inverse of a matrix	CO 3	Apply
		12	Make use of the Cayley-Hamilton to find powers of a matrix	CO 3	Apply
		13	Make use of the Cayley-Hamilton to find diagonalization of a matrix	CO 3	Apply
7	Continuous functions	14	Explain the geometrical interpretation of continuous functions on closed and bounded intervals	CO 4	Understand
8	Mean value theorems	15	Interpret the mean value theorems on bounded functions	CO 4	Understand
9	Partial differentiation	16	Recall the partial differentiation for the functions of several variables	CO 4	Remember
10	Jacobian transformations	17	Make use of Jacobian transformations for the functions are to be dependent or independent	CO 4	Apply
11	Maxima and minima of a function	18	Identify the maxima and minima of a function with several variables by using partial derivatives	CO 4	Apply
12	Euler coefficients	19	State the Euler coefficients for Fourier expansion of periodic functions in a given interval	CO 5	Remember
13	Fourier series in periodic interval	20	Extend the Fourier series of given functions in a given periodic interval $(-\pi, \pi)$	CO 5	Understand
		21	Extend the Fourier series of given functions in a given periodic interval $(0, 2\pi)$	CO 5	Understand
14	Fourier series in non -periodic interval	22	Compute the Fourier series of given functions in non-periodic interval $(0, 2l)$	CO 5	Apply
15	Half- range Fourier series	23	Extend the half- range Fourier series expansions of a function in a given periodic interval $(0, \pi)$	CO 5	Apply
		24	Extend the half- range Fourier series expansions of a function in a given arbitrary interval $(0, l)$	CO 5	Apply

S.No	Topic(s)	TLO No	Topic Learning Outcome's	Course Outcome	Blooms Level
16	Double integrals	25	Solve the double integrals of functions in given constant limits	CO 6	Apply
		26	Solve the double integrals of functions in cartesian coordinates with given limits	CO 6	Apply
		27	Solve the double integrals of functions in polar coordinates with given limits	CO 6	Apply
17	Change order of integration	28	Identify the change order of integration of double integrals in cartesian form	CO 6	Remember
18	Triple integrals	29	Calculate the triple integrals of function in given constant limits	CO 6	Apply
		30	Calculate the triple integrals of function in cartesian coordinates with given limits	CO 6	Apply

19. Employability Skills

1. Linear Algebra: Employability/ Skill development: Apply the concepts of Linear Algebra in programming languages
2. Matrices and Differential Calculus: Employability/ Skill development: Uses the basic of matrices and Calculus calculation concept in the field of Engineering
3. Integral Calculus: Employability/ Skill development: Uses the concept of definite integral in engineering problems
4. Multivariable calculus: Employability/ Skill development: Can solve the different Multivariable calculus

20. Content Delivery / Instructional Methodologies:

✓	 Power Point Presentation	✓	 Chalk & Talk	✓	 Assignments	x	 MOOC
x	 Open Ended Experiments	x	 Seminars	x	 Mini Project	✓	 Videos

21. Evaluation Methodology:

The course will be evaluated for a total of 100 marks, with 40 marks for Continuous Internal Assessment (CIA) and 60 marks for Semester End Examination (SEE). CIA is conducted for a total of 40 marks, with 20 marks for Continuous Internal Examination (CIE), and 05 marks for each Definitions and Terminology / Quiz and remaining 10 marks for Tech Talk / Assignments.

Semester End Examination (SEE): The SEE is conducted for 60 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with “either” or “choice” will be drawn from each module. No choice is given from first two modules. Each question carries 12 marks. There could be a maximum of two sub divisions in a question.

Outline for Continuous Internal Assessments (CIA - I and CIA - II) and SEE :

Activities	CIA - I	CIA - II	SEE	Total Marks
Continuous Internal Examination (CIE)	10 Marks	10 Marks		20 Marks
Definitions and Terminology / Quiz	05 Marks	05 Marks		10 Marks
Tech Talk / Assignment	05 Marks	05 Marks		10 Marks
Semester End Examination (SEE)	-	-	60 Marks	60 Marks
Total	-	-	100 Marks	

22. Course content - Number of modules: Five

MODULE I	MATRICES Number of Lectures: 09
	Rank of a matrix by echelon form and normal form; inverse of non-singular matrices by Gauss-Jordan method; system of linear equations: solving system of homogeneous and non-homogeneous equations.
MODULE II	EIGEN VALUES AND EIGEN VECTORS Number of Lectures: 10
	Eigen values; Eigen vectors and their properties (without proof); Cayley-Hamilton theorem (without proof), verification; finding inverse and power of a matrix by Cayley-Hamilton theorem; diagonalization of a matrix.
MODULE III	FUNCTIONS OF SINGLE AND SEVERAL VARIABLES Number of Lectures: 10
	Mean value theorems: Rolle's theorem; Lagrange's theorem; Cauchy's theorem-without proof. Functions of several variables: Partial differentiation; Jacobian; functional dependence; maxima and minima of functions of two variables and three variables; method of Lagrange multipliers.
MODULE IV	FOURIER SERIES Number of Lectures: 09
	Fourier expansion of periodic function in a given interval of length 2π ; Fourier series of even and odd functions; Fourier series in an arbitrary interval; half-range Fourier sine and cosine expansions.
MODULE V	MULTIPLE INTEGRALS Number of Lectures: 10
	Evaluation of double integrals (cartesian and polar coordinates); change of order of integration (only cartesian coordinates); evaluation of triple integrals (cartesian coordinates).

Text Books

1. B. S. Grewal, "*Higher Engineering Mathematics*", Khanna Publishers, 44/e, 2017.
2. Erwin Kreyszig, "*Advanced Engineering Mathematics*", John Wiley & Sons, 10/e, 2011.

Reference Books:

1. R. K. Jain and S. R. K. Iyengar, “*Advanced Engineering Mathematics*”, 3/ed Narosa Publications, 5th Edition , 2016.
2. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas,, “*Calculus*”, Uma Publications, 13/e Edition, Pearson Publishers, 2013.
3. N.P. Bali and Manish Goyall “*A text book of Engineering Mathematics*”, Laxmi Publication, Reprint, 2008.
4. Dean G. Duffy, “*Advanced Engineering Mathematics with MATLAB*”, PCRC Press
5. Peter O’Neil, “*Advanced Engineering Mathematics*”, Cengage Learning.
6. B.V. Ramana, “*Higher Engineering Mathematics*”, McGraw Hill Education

Electronic Resources:

1. https://onlinecourses.nptel.ac.in/noc23_ma88/preview
2. https://onlinecourses.nptel.ac.in/noc23_ma86/preview
3. https://www.efunda.com/math/math_home/math.cfm
4. <https://www.ocw.mit.edu/resources/#Mathematics>
5. <https://www.sosmath.com>
6. <https://www.mathworld.wolfram.com>

Materials Online:

1. Course template
2. Tech-talk topics
3. Assignments
4. Definition and terminology
5. Tutorial question bank
6. Model question paper – I
7. Model question paper – II
8. Lecture notes
9. Early lecture readiness videos (ELRV)
10. Power point presentations

23. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping		
CONTENT DELIVERY (THEORY)			
1	Theory of Matrices: Types of Real Matrices	CO 1	T1:2.4 R3:3.11
2	Elementary Operations: Elementary Row and Column Transformations	CO 1	T1:2.7.2 R3:3.34
3	Rank of a Matrix by Echelon Form	CO 1	T1:2.7.4 R3:3.38
4	Rank of a Matrix by Normal Form	CO 1	T1:2.7.7 R3:3.38
5	Inverse of a Matrix by Gauss-Jordan Method	CO 1	T1:2.7.6 R3:3.37
6	Solving system of Non-Homogeneous equations	CO 1	T1:2.10.1 R3:3.39
7	Solving system of Homogeneous equations	CO 1	T1:2.10.3 R3:3.39
8	Solving system of Non Homogeneous equations(Unknown Values)	CO 1	T1:2.10.3 R3:3.39
9	Eigen Values of a Matrix	CO 2	T1:2.13.1 R3:3.46
10	Eigen Vectors of a Matrix	CO 2	T1:2.13.2 R3:3.47
11	Properties of Eigen values and Eigen Vectors of a Matrix Problems	CO 2	T1:2.14 R3:3.47
12	Cayley-Hamilton Theorem- Statement, Verification	CO 3	T1:2.15 R3:3.48
13	Applications of Cayley – Hamilton: Finding Inverse and Powers of a Matrix	CO 3	T1:2.15 R3:3.48
14	Diagonalization of Matrix by Linear Transformation	CO 3	T1:2.16.1 R3:3.49
15	Linear Dependence and Independence of Vectors	CO 3	T1:2.3 R3:3.2
16	Mean Value Theorems:1: Rolle's Theorem	CO 4	T1:4.3.1 R6:2.1
17	Mean Value Theorems:2: Lagrange's Theorem	CO 4	T1:4.3.2 R6:2.2
18	Mean Value Theorems:3: Cauchy's Theorem	CO 4	T1:4.3.3 R6:2.3

S.No	Topics to be covered	CO's	Reference
19	Functions of Several Variables: Partial Differentiation	CO 4	T1:5.2 R3:5.1
20	Jacobian Transformations	CO 4	T1:5.7.1 R3:5.10
21	Functional Dependence	CO 4	T1-5.7.4 R3:5.11
22	Maxima and Minima of Functions with Two Variables	CO 4	T1:5.11.1 R3:5.13
23	Maxima and Minima of Functions with Three Variables	CO 4	T1-5.11.1 R3:5.14
24	Method of Lagrange Multipliers	CO 4	T1-5.12 R3:5.15
25	Euler Coefficeints for Fourier Expansion of Periodic Function in a Given Interval of Length $(-\pi, \pi), (0, 2\pi)$	CO 5	T1-10.2 R3:10.3
26	Fourier Series of Even Functions in a Given Interval of Length $(-\pi, \pi)$	CO 5	T1-10.6.1 R3:10.3
27	Fourier Series of Odd Functions in a Given Interval of Length $(-\pi, \pi)$	CO 5	T1-10.6.2 R3:10.3
28	Fourier Series of Neither Functions in a Given Interval of Length $(-\pi, \pi)$	CO 5	T1-10.6.2 R3:10.3
29	Fourier Series in an Arbitrary Interval $(0, 2l)$	CO 5	T1-10.6.1 R3:10.6
30	Fourier Series in an Arbitrary Interval $(-l, l)$	CO 5	T1-10.6.2 R3:10.6
31	Half- Range Fourier Sine Expansions in a Given Interval of Length $(0, \pi)$	CO 5	T1-10.7 R3:10.7
32	Half- Range Fourier Cosine Expansions in a Given Interval of Length $(0, \pi)$	CO 5	T1-10.7 R3:10.7
33	Double Integrals in Constant Limits	CO 6	T1-7.1 R3:6.1
34	Double Integrals in Variable Limits	CO 6	T1-7.1 R3:6.2
35	Double Integrals in cartesian coordinates (Area enclosed by plane curves)	CO 6	T1-7.4 R3:6.2
36	Double Integrals in polar coordinates	CO 6	T1-7.3 R3:6.3
37	Change of order of integration (only Cartesian form)	CO 6	T1-7.2 R3:6.4
38	Triple Integrals in Constant Limits	CO 6	T1-7.5 R3:6.5
39	Triple Integrals in Variable Limits	CO 6	T1-7.5 R3:6.5

S.No	Topics to be covered	CO's	Reference
40	Double and Triple Integrals	CO 6	T1-7.1 R3:6.5
PROBLEM SOLVING/ CASE STUDIES			
1	Rank of the Matrix by Echelon and Normal Form	CO 1	T1-2.7 R3:3.38
2	Homogeneous and Non Homogeneous Equations	CO 1	T1-2.10 R3:3.39
3	Eigen Values and Eigen Vectors of the Matrix	CO 2	T1-2.13 R3:3.46
4	Eigen Values and Eigen Vectors of the Matrix	CO 2	T1-2.16 R3:3.49
5	Cayley Hamilton Theorem Problems	CO 3	T1-2.15 R3:3.48
6	Powers of the Matrix by Cayley Hamilton Theorem	CO 3	T1-2.15 R3:3.48
7	Powers of the Matrix by Cayley Hamilton Theorem	CO 4	T1-4.3 R6:2.1
8	Jacobians, Functional Relationship	CO 4	T1-5.7 R3:5.10
9	Maxima and minima problems	CO 4	T1-5.11 R3:5.13
10	Fourier Series expansion of Periodic Function in a Given Interval of Length 2π	CO 5	T1-10.2 R3:10.3
11	Fourier Expansion of Periodic Function in a Given Interval of Length $(-\pi, \pi)$	CO 5	T1-10.6 R3:10.3
12	Fourier Series in an Arbitrary Interval $(-1,1)$, Fourier Sine, Cosine Series in Interval $(0,1)$	CO 5	T1-10.6 R3:10.6
13	Finding Double Integrals in Cartesian and Polar Coordinates	CO 6	T1:7.1 R3:6.1
14	Change of order of integration	CO 6	T1-7.2 R3:6.4
15	Triple Integrals	CO 6	T1-7.5 R3:6.5
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Rank of a Matrix, Homogeneous and Non-Homogeneous equations	CO 1	T1-2.7 R3:3.39
2	Eigen Values and Eigen Vectors, Diagonalization	CO 2, CO3	T1-2.13 R3:3.46
3	Mean Value Theorems, Jacobian Transformations, Functionally Dependent and Independent	CO 4	T1-4.3 R6:2.1
4	Fourier Series (Even, Odd, Neither Functions)	CO 5	T1-10.2 R3:10.3

S.No	Topics to be covered	CO's	Reference
5	Multiple Integrals (Double and Triple)	CO 6	T1-7.1 R3:3.6.1
DISCUSSION OF TUTORIAL QUESTION BANK			
1	Matrices	CO 1	T1-2.4 R3:3.11
2	Eigen Values and Eigen Vectors	CO 2, CO 3	T1-2.13 R3:3.46
3	Functions of Several Variables	CO 4	T1-5.2 R3:5.1
4	Fourier Series	CO 5	T1-10.2 R3:10.3
5	Multiple Integrals	CO 6	T1-7.1 R3:6.1

24. PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES:

Program Outcomes	
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	Design/Development of Solutions: Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Program Outcomes	
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Life-Long Learning: Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
Program Specific Outcomes	
PSO 1	Design, Develop, Fabricate and Commission the Electrical Systems involved in Power generation, Transmission, Distribution and Utilization
PSO 2	Focus on the Components of Electrical Drives with its Converter Topologies for Energy Conversion, Management and Auditing in Specific applications of Industry and Sustainable Rural Development.
PSO 3	Gain the Hands-On Competency Skills in PLC Automation, Process Controllers, HMI and other Computing Tools necessary for entry level position to meet the Requirements of the Employer

25. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Strength	Proficiency Assessed by
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz/AAT
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	CIE/Quiz/AAT

26. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Strength	Proficiency Assessed by
PSO 1	Design, Develop, Fabricate and Commission the Electrical Systems involved in Power generation, Transmission, Distribution and Utilization..	-	-

PSO 2	Focus on the Components of Electrical Drives with its Converter Topologies for Energy Conversion, Management and Auditing in Specific applications of Industry and Sustainable Rural Development.	-	-
PSO 3	Gain the Hands-On Competency Skills in PLC Automation, Process Controllers, HMI and other Computing Tools necessary for entry level position to meet the Requirements of the Employer.	-	-

3 = High; 2 = Medium; 1 = Low

27. MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOME	PROGRAM OUTCOMES												PSO'S			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	
CO 1	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-

28. JUSTIFICATIONS FOR CO – PO / PSO MAPPING - DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Explain the role of rank and inverse of real and complex matrices in solving complex engineering problems by using elementary transformation methods (principles of mathematics).	2
CO 2	PO 1	Determine the Eigen values, Eigen vectors, Spectral matrix complex engineering problems modelled by matrices with help of Characteristic Equation (principles of mathematics).	2
	PO 2	Model the problem into matrices, prepare precise statement of the problem and apply the concepts of Eigen values and Eigen vectors to develop the solution and interpret, validate the results through proper documentation.	6
CO 3	PO 1	Make use of Cayley Hamilton theorem for finding positive and negative powers of the matrix and apply them in the complex engineering problems modelled by matrices (principles of mathematics).	2

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 4	PO 1	Explain the mean-value theorems for the single variable functions and the extreme values for functions of several variables apply them in the complex engineering problems Partial derivatives of (principles of mathematics).	2
CO 5	PO 1	Build the Fourier series expansion for the complex engineering problems modelled by given periodic, even and odd functions in various intervals with the help of Fourier coefficients formulae (principles of mathematics).	2
	PO 2	Model the problem with the help of suitable periodic functions, prepare precise statement of the problem and apply Fourier series expansions to develop the solution and interpret, validate the results through proper documentation..	6
CO 6	PO 1	Determine the solution of complex engineering problems modelled by Double and Triple Integrals by using substitution method and principles of mathematics.	2
	PO 2	Model the problem with the help of ordinary integrations, prepare precise statement of the problem and apply on double and triple integrations by method of ordinary integration and other analytical methods to develop the solution and interpret, validate the results through proper documentation.	6

29. TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	6	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	6	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	2	6	-	-	-	-	-	-	-	-	-	-	-	-	-

30. PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	66.6	60	-	-	-	-	-	-	-	-	-	-	-	-	-

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	
CO 3	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	66.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	66.6	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	66.6	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-

31. COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

2 - $40\% < C < 60\%$ – Moderate

1-5 $< C \leq 40\%$ – Low/ Slight

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 6	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	18	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AVERAGE	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

32. ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Term Paper	-	Tech-Talk / 5 Minutes Video	✓	Open Ended Experiments	-
Definitions and Terminology	✓	Quiz	✓	Assignments	✓











33. ASSESSMENT METHODOLOGY INDIRECT:


x	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback
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34. Relevance to Sustainability goals:

Brief description about the course and how its relevance to SDGs.

Mathematics plays an important role in the achievement of the Sustainable Development Goals (SDG) and at the same time these allow working with real situations in the subject of mathematics, providing the student with active learning. Sustainability is used to make the student see the usefulness of mathematics while instilling values and attitudes towards it.

×		-
×		-
×		-
✓		Quality Education: Minimizing school dropout: The teaching of mathematics plays an important role in the implementation of sustainable education to achieve future goals: to make learning mathematics more relevant and applicable, as well as to support the development of 21st century skills.
×		-
×		-
×		-
×		-
×		-
×		-

×	 <p>SUSTAINABLE CITIES AND COMMUNITIES</p>	-
×	 <p>RESPONSIBLE CONSUMPTION AND PRODUCTION</p>	-
×	 <p>CLIMATE ACTION</p>	-
×	 <p>LIFE BELOW WATER</p>	-
×	 <p>LIFE ON LAND</p>	-
×	 <p>PEACE, JUSTICE AND STRONG INSTITUTIONS</p>	-
×	 <p>PARTNERSHIPS FOR THE GOALS</p>	-

Approved by: Board of Studies in the meeting conducted on _____.

Signature of Course Coordinator
Mr. P.Shantan, Assistant Professor

HOD



INSTITUTE OF AERONAUTICAL ENGINEERING (Autonomous)

Dundigal, Hyderabad - 500 043

COURSE TEMPLATE

1	Department	ELECTRICAL AND ELECTRONICS ENGINEERING				
2	Course Title	ELECTRICAL CIRCUITS				
3	Course Code	AEEC02				
4	Program	B.Tech				
5	Semester	I Semester				
6	Regulation	BT-23				
7	Structure of the course	Theory			Practical	
		Lecture 3	Tutorials 0	Credits 3	Lab 2	Credits 1
8	Type of course (Tick type of course)	Core ✓	Professional Elective -	Open Elective -	VAC -	MOOCs -
9	Course Offered	Odd Semester <input checked="" type="checkbox"/>		Even Semester <input type="checkbox"/>		
10	Total lecture, tutorial and practical hours for this course (16 weeks of teaching per semester)					
	Lectures: hours		Tutorials: hours		Practical: hours	
11	Course Coordinator	Dr. L.Rajasekhar Goud				
12	Date Approved by BOS	22/08/2023				
13	Course Webpage	www.iare.ac.in/—/—				
14	Course Prerequisites	Level	Course Code	Semester	Prerequisites	
		B.Tech	AHS00	I	Engineering Physics	

15. Course Overview

The course introduces the basic concepts of circuit analysis which is the foundation for all subjects of the electrical and electronics engineering. It includes the basic fundamental laws of electricity and magnetism with an emphasis on resistors, inductors and capacitors (RLC) circuits applied to alternating current (AC) or direct current (DC) of electrical networks. Further This course provides network theorems with different excitations, two-port network and network topology to solve for real- time applications.

16. COURSE OBJECTIVES:

The students will try to learn:

I	The network reduction techniques such as source transformation, mesh analysis, nodal analysis and network theorems to solve different networks.
II	The basic concept of AC circuits for optimization of household and industrial circuitry
III	The principles of electromagnetic induction and its related electrical systems
IV	The characteristics of two-port networks and network topologies

17. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	Define the terminology used to study the characteristics of DC and AC electrical networks.	Remember
CO 2	Discuss the laws and indirect quantities associated with electrical circuit for branch currents and nodal voltages.	Understand
CO 3	Summarize the network theorems to reduce complex network into simple equivalent network with DC and AC excitation.	Understand
CO 4	Describe the electromagnetic induction, magnetic flux, self and mutual inductance in the single coil and coupled coils magnetic circuits to estimate total ampere turns.	Understand
CO 5	Recognize the two port parameters and network topology for graphical and digital representation of complex circuits to be measure easily, without solving for all the internal voltages and currents in the different networks.	Remember
CO 6	Illustrate the dual networks for compare both mesh and nodal network.	Remember

18. Topic Learning Outcome (TLOs):

S.No	Topic(s)	TLO No	Topic Learning Outcome's	Course Outcome	Blooms Level
1	Introduction to electrical circuits	1	Interpret fundamental concepts of circuits through a procedural approach	CO 1	Understand
		2	Aware the ohm's law with in the class room	CO 1	Understand
		3	Identify the independent and dependent within the classroom as well as outside the classroom.	CO 1	Understand
		4	Practice Voltage current relations for paassive elements with in the class room	CO 1	Understand









S.No	Topic(s)	TLO No	Topic Learning Outcome's	Course Outcome	Blooms Level
3	Single phase AC Circuits	5	Examine Voltge and current relations of RL Circuit within the classroom and outside world	CO 1	Understand
		6	Examine Voltge and current relations of RC Circuit within the classroom and outside world	CO 1	Understand
4	Periodic waveforms	7	Demonstrate Triangle waveforms within the classroom.	CO 1	Understand
		8	Demonstrate Triangle waveforms within the classroom	CO 1	Understand
5	AC Circuits	9	Familiar with Concept of Impedance and be able to calculte impedance o different circuits	CO 1	Understand
		10	Understand Concept of Admittaance able to calculte impedance o different circuits	CO 2	Understand
6	Circuit Analysis	11	Understand Kirchoff;s laws within the classroom and outside world.	CO 2	Understand
		12	Understand Source traansformation techniques within the classroom and outside world	CO 2	Understand
		13	Understand Passive elements likeRLC within the classroom and outside world	CO 2	Understand
7	Star delta trasformation	14	Understand importance of star delta transformation solving complex problems within the classroom and outside world	CO 2	Understand
8	Mesh and Nodal Analysis	15	Understand importance of Mesh and Nodal Analysis solving problems within the classroom and outside world	CO 2	Understand
9	Super Mesh and Super Node	16	Solve problems with Super Mesh and Super Node	CO 2	Understand
10	DC Network Theorems	17	Understand DC Network Theorems to solve different types of Networks	CO 3	Understand
11	AC Network Theorems	17	Understand AC Network Theorems to solve different types of Networks	CO 3	Understand
12	Faradays law of electro magnetic Induction	19	Understand Fundamental Principle of Electrical circuits	CO 4	Understand
13	Magnetic Circuits	20	Understand Self inductance of Inductive coils	CO 4	Understand

S.No	Topic(s)	TLO No	Topic Learning Outcome's	Course Outcome	Blooms Level
		21	Able to Identify Mutual inductance in inductive coils	CO 4	Understand
14	Series magnetic circuits	22	Able to Find applications of Series magnetic circuit	CO 5	Understand
15	Parallel magnetic circuits	23	Understand Applications of Parallel magnetic circuits	CO 5	Understand
16	Two port Network	24	Understand Applications of Transmission lines	CO 5	Understand
17	Network topology	25	Understand Importance of graph theory in electrical circuits	CO 6	Understand
18	Duality of Networks	26	Understand the Applications of duality in electrical circuits	CO 6	Understand

19. Employability Skills

<p>Example: Communication skills / Programming skills / Project based skills /</p> <p>From maintaining power infrastructure to developing navigation and communications systems, electrical engineers play crucial roles across nearly every industry. With advanced electrical engineering skills, experts can lead the design, testing and manufacturing of the equipment that keep the world running.</p>
--

20. Content Delivery / Instructional Methodologies:

✓	 Power Point Presentation	✓	 Chalk & Talk	✓	 Assignments	x	 MOOC
x	 Open Ended Experiments	x	 Seminars	x	 Mini Project	✓	 Videos

21. Evaluation Methodology:

The course will be evaluated for a total of 100 marks, with 40 marks for Continuous Internal Assessment (CIA) and 60 marks for Semester End Examination (SEE). CIA is conducted for a total of 40 marks, with 20 marks for Continuous Internal Examination (CIE), and 05 marks for each Definitions and Terminology / Quiz and remaining 10 marks for Tech Talk / Assignments.

Table 4: Outline for Continuous Internal Assessments (CIA - I and CIA - II) and SEE

Activities	CIA - I	CIA - II	SEE	Total Marks
Continuous Internal Examination (CIE)	10 Marks	10 Marks		20 Marks
Definitions and Terminology / Quiz	05 Marks	05 Marks		10 Marks
Tech Talk / Assignment	05 Marks	05 Marks		10 Marks
Semester End Examination (SEE)	-	-	60 Marks	60 Marks
Total	-	-	100 Marks	

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each module. Each question carries 12 marks. There could be a maximum of two sub divisions in a question.

The expected percentage of cognitive level of the questions is broadly based on the criteria given in below Table.

Percentage of Cognitive Level	Blooms Taxonomy Level
10%	Remember
35%	Understand
55%	Apply

22. Course content - Number of modules: Five:

MODULE I	INTRODUCTION TO ELECTRICAL CIRCUITS . Number of Lectures: 09
	Circuit concept: Basic definitions, Ohm's law at constant temperature, classifications of elements, independent and dependent sources, voltage and current relationships for passive elements, Single phase AC circuits: Representation of alternating quantities, properties of different periodic wave forms, phase and phase difference, concept of impedance and admittance, power in AC circuits.
MODULE II	ANALYSIS OF ELECTRICAL CIRCUITS Number of Lectures: 09
	Circuit analysis: Source transformation, Kirchhoff's laws, total resistance, inductance and capacitance of circuits, Star - delta transformation technique, mesh analysis and nodal analysis, inspection method, super mesh, super node analysis.
MODULE III	NETWORK THEOREMS (DC AND AC) . Number of Lectures: 10
	Network Theorems: Tellegen's, superposition, reciprocity, Thevenin's, Norton's, maximum power transfer, Milliman's and compensation theorems for DC excitations, numerical problems. Network Theorems: Tellegen's, superposition, reciprocity, Thevenin's, Norton's, maximum power transfer, Milliman's and compensation theorems for AC excitations, numerical problems.
MODULE IV	MAGNETIC CIRCUITS Number of Lectures: 09
	Magnetic circuits: Faraday's laws of electromagnetic induction, concept of self and mutual inductance, dot convention, coefficient of coupling, composite magnetic circuit, analysis of series and parallel magnetic circuits.

MODULE V	TWO PORT NETWORK AND GRAPH THEORY Number of Lectures: 08
	Two Port Network: Two port parameters, interrelations, two port Interconnections. Network topology: Definitions, incidence matrix, basic tie set and basic cut set matrices for planar networks, duality and dual networks.

TEXTBOOKS

1. A Sudhakar, Shyammoan S Palli, “*Circuits and Networks*”, Tata McGraw-Hill, 4th Edition, 2010.
2. M E Van Valkenberg, “*Network Analysis*”, PHI, 3rd Edition, 2014.

REFERENCE BOOKS:

1. John Bird, “*Electrical Circuit Theory and Technology*”, Newnes, 2nd Edition, 2003.
2. C L Wadhwa, “*Electrical Circuit Analysis including Passive Network Synthesis*”, New Age International, 2nd Edition, 2009.
3. David A Bell, “*Electric circuits*”, Oxford University Press, 7th Edition, 2009.
4. E Hughes, “*Electrical and Electronics Technology*”, Pearson Education, 2010.
5. A Chakrabarthy, “*Electric Circuits*”, Dhanipat Rai & Sons, 6th Edition, 2010.
6. V D Toro, “*Electrical Engineering Fundamentals*”, Prentice Hall India, 1989.

MATERIALS ONLINE:

1. lectronic Resources: <https://www.igniteengineers.com>
2. <https://www.ocw.nthu.edu.tw>
3. <https://www.uotechnology.edu.iq>
4. <https://www.iare.ac.in>

23. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO - PO Mapping		
CONTENT DELIVERY (THEORY)			
1	Introduction to Electrical Circuits	CO 1	T1: 2.1
2	Basic Definitions and Ohm's Law at Constant Temperature	CO 1	T1:2.4

S.No	Topics to be covered	CO's	Reference
3	Classifications of Elements	CO 1	T1:2.4
4	Voltage and current relationships for passive elements	CO 1	T1:2.5
5	Introduction to Single phase AC circuits, Representation of alternating quantities	CO 1	T1: 2.1
6	Properties of different periodic wave forms, Phase and phase difference	CO 1	T1:2.4
7	Concept of Impedance, Admittance and Power in AC Circuits	CO 1	T1:2.4
8	Source transformation	CO 2	T1:1.5- 1.6
9	Kirchhoff's laws	CO 2	T1:1.8- 1.12
10	Introduction to Electrical Circuits	CO 1	T1: 2.1
11	Equivalent Values of Series, Parallel R, L & C Networks	CO 2	T1:1.13- 1.18
12	Star to Delta or Delta to Star Transformation Technique	CO 2	T1:1.1- 1.18
13	Mesh Analysis Solved Technique with simple example and Animation	CO 2	T1:5.1- 5.2
14	Nodal analysis Solved Technique with simple example and Animation	CO 2	T1:5.3
15	Inspection Method Solved Technique with simple example and Animation	CO 2	T1:5.7
16	Super mesh analysis Solved Technique with simple example and Animation	CO 2	T1:5.4- 5.6
17	Super node analysis Solved Technique with simple example and Animation	CO 2	T1:6.5- 6.11
18	Tellegen's theorem for DC excitations Solved Technique with simple example and Animation	CO 3	T1:7.1-7.4
19	Superposition theorem for DC excitations Solved Technique with simple example and Animation	CO 3	T1:5.3
20	Reciprocity theorem for DC excitations Solved Technique with simple example and Animation	CO 3	T1:5.7
21	Thevenin's theorem for DC excitations Solved Technique with simple example and Animation	CO 3	T1:5.1- 5.2
22	Norton's theorem for DC excitations Solved Technique with simple example and Animation	CO 3	T1:5.3
23	Maximum power transfer theorem for DC excitations Solved Technique with simple example and Animation	CO 3	T1:5.7
24	Milliman's theorem for DC excitations Solved Technique with simple example and Animation	CO 3	T1:5.4- 5.6
25	Compensation theorem for DC excitations Solved Technique with simple example and Animation	CO 3	T1:6.5- 6.11
26	Tellegen's theorem for AC excitations	CO 3	T1:7.1-7.4
27	Superposition theorem for AC excitations	CO 3	T1:8.4- 8.6
28	Reciprocity theorem for AC excitations	CO 3	T1: 8.12-8.15

S.No	Topics to be covered	CO's	Reference
29	Thevenin's theorem for AC excitations	CO 3	T1:8.4- 8.6
30	Norton's theorem for AC excitations	CO 3	T1: 8.12-8.15
31	Maximum power transfer theorem for AC excitations	CO 3	T1:8.4- 8.6
32	Milliman's and compensation theorems theorem for AC excitations	CO 3	T1: 8.12-8.15
33	Faraday's laws of electromagnetic induction	CO 4	T1:8.4- 8.6
34	Concept of self and mutual inductance	CO 4	T1: 8.12-8.15
35	Dot convention, coefficient of coupling, composite magnetic circuit	CO 4	T1:8.4- 8.6
36	Analysis of series magnetic circuits	CO 4	T1: 8.12-8.15
37	Analysis of parallel magnetic circuits	CO 4	T1:8.4- 8.6
38	Two port parameters (Z, Y, T, ABCD)	CO 5	T1: 8.12-8.15
39	Two port Interconnections	CO 5	T1:8.4- 8.6
40	Incidence matrix, basic tie set and basic cut set matrices for planar networks	CO 5	T1:8.12-8.15
PROBLEM SOLVING/ CASE STUDIES			
1	Total resistance, inductance and capacitance of circuits	CO 2	T1:10.8
2	Star - delta transformation technique	CO 2	T1:10.9- 10
3	Mesh analysis and Nodal analysis	CO 2	T4:10.10
4	Super mesh and Super node analysis.	CO 2	T1:8.2
5	Tellegen's and reciprocity theorems for DC excitations	CO 3	T1:1.1
6	Thevenin's and Norton's theorems for DC excitations	CO 3	T1:1.5- 1.6
7	maximum power transfer, Milliman's and compensation theorems for DC excitations	CO 3	T1:1.8- 1.12
8	Tellegen's and reciprocity theorems for excitations	CO 3	T1:1.13- 1.18
9	Thevenin's and Norton's theorems for AC excitations	CO 3	T1:1.19.1- 1.19.2
10	maximum power transfer, Milliman's and compensation theorems for AC excitations	CO 3	T1:1.19.1- 1.19.2
11	Dot convention, coefficient of coupling, composite magnetic circuit	CO 4	T1:1.193
12	analysis of series and parallel magnetic circuits	CO 4	T1:1.19.6
13	Two port parameters (Z, Y, T, ABCD)	CO 5	T1:1.19.
14	Incidence matrix, basic tie set and basic cut set matrices for planar networks	CO 5	T1:2.11.1
15	Duality and dual networks	CO 5	T1:2.11.1
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Introduction To Electrical Circuits	CO 1, CO2	R4:2.1

S.No	Topics to be covered	CO's	Reference
2	Analysis Of Electrical Circuits	CO3	T4:7.3
3	Network Theorems (DC And AC)	CO 4	R4:5.1
4	Magnetic Circuits	CO 5	T1:7.5
5	Two Port Network And Graph Theory	CO 6	T1: 4.1
DISCUSSION OF TUTORIAL QUESTION BANK			
1	Introduction To Electrical Circuits	CO 1, CO2	R4:2.1
2	Analysis Of Electrical Circuits	CO3	T4:7.3
3	Network Theorems (DC And AC)	CO 4	R4:5.1
4	Magnetic Circuits	CO 5	T1:7.5
5	Two Port Network And Graph Theory	CO 6	T1: 4.1

24. PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES:

Program Outcomes	
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	Design/Development of Solutions: Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Program Outcomes	
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Life-Long Learning: Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
Program Specific Outcomes	
PSO 1	Design, Develop, Fabricate and Commission the Electrical Systems involved in Power generation, Transmission, Distribution and Utilization.
PSO 2	Focus on the components of power system, its analysis, operation, control and protection; electrical drives with its converter topologies for energy conversion, management and auditing in specific applications of industry and academia
PSO 3	Gain the Hands-On Competency Skills in PLC Automation, Process Controllers, HMI and other Computing Tools necessary for entry level position to meet the Requirements of the Employer.

25. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Strength	Proficiency Assessed by
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz/AAT
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT
PO 4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	2	Assignments

26. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Strength	Proficiency Assessed by
PSO 2	Focus on the components of power system, its analysis, operation, control and protection; electrical drives with its converter topologies for energy conversion, management and auditing in specific applications of industry and academia	2	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

27. MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOME	PROGRAM OUTCOMES												PSO'S			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	
CO 1	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	✓	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
CO 6	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

28. JUSTIFICATIONS FOR CO – PO / PSO MAPPING - DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Recall the basics of mathematics, engineering sciences and other sciences to understand the concept of DC and AC Circuits.	3
	PO 2	Validate the principles of different laws associated with electrical circuits from obtained principles using basics fundamentals of mathematics and engineering sciences.	5
CO 2	PO 1	Recall the basics of mathematics, engineering sciences and other sciences to understand the concept of Kirchhoff's laws	3
	PO 2	Analyze mesh analysis and nodal analysis technique using principles of mathematics, science and engineering fundamentals	5
CO 3	PO 1	Recollect the concept of Electrical circuits basics analysis.	3
	PO 2	Describes the different Theorems with AC and DC excitation from obtained principles using basics fundamentals of mathematics and engineering sciences.	5

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
	PO 4	Conduct Investigations of Complex Problems with AC and DC excitation Use research methods including design of experiments.	5
CO 4	PO 1	Apply the knowledge of mathematics, science, engineering fundamentals to the solution of magnetic circuits	3
	PO 2	Describes the fundamental characteristics of electromagnetic induction, self and mutual inductance in the single coil and coupled coils magnetic circuits using basics fundamentals of mathematics and engineering sciences.	5
CO 5	PO 1	Recall the basics of mathematics, engineering sciences and other sciences to understand the concept of two port network and graph theory.	3
	PO 2	Validate the principles of different parameters and network topology from obtained principles using basics fundamentals of mathematics and engineering sciences.	5
	PSO 2	Identify complex engineering problems on two port network and graph theory using first principles of mathematics, natural sciences, and engineering sciences.	2
CO 6	PO 1	Recall the basics of mathematics, engineering sciences and other sciences to understand the concept of duality.	3

29. TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	5	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	5	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	5	-	5	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	5	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	5	-	-	-	-	-	-	-	-	-	-	-	2	-
CO 6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-

30. PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	50	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	100	50	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	100	50	-	45	-	-	-	-	-	-	-	-	-	-	-
CO 4	100	50	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	100	50	-	-	-	-	-	-	-	-	-	-	-	50	-
CO 6	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-

31. COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

2 - $40\% < C < 60\%$ – Moderate

1-5 $< C \leq 40\%$ – Low/ Slight

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	3	2	-	1	-	-	-	-	-	-	-	-	-	-	-
CO 4	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	3	2	-	-	-	-	-	-	-	-	-	-	-	2	-
CO 6	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL	18	10	-	1	-	-	-	-	-	-	-	-	-	2	-
AVERAGE	3	2	-	1	-	-	-	-	-	-	-	-	-	2	-

32. ASSESSMENT METHODOLOGY DIRECT:







CIE Exams	✓	SEE Exams	✓	Seminars	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	✓	Quiz	✓		









33. ASSESSMENT METHODOLOGY INDIRECT:




x	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback
✓	Early Semester Feedback	✓	Assessment of activities/ Modeling & Experimental Tools in Engineering by Experts

31. Relevance to Sustainability goals

Write brief description about the course and how its relevance to SDGs.

1		
2		
3		
4		<p>Quality Education: This subject will improve the quality education in engineers and gives the awareness in electrical usage in day-to-day life.</p>
5		
6		

7		<p>Affordable and Clean Energy: Understanding electrical circuits is crucial for developing sustainable energy solutions. Students who learn to design and optimize circuits can contribute to the development of efficient and clean energy systems, such as renewable energy sources and smart grids.</p>
8		
9		<p>Industry, Innovation, and Infrastructure: : Engineering drawing principles is crucial for developing and maintaining sustainable infrastructure and technological innovations. It contribute to designing safer, more durable, and environmentally friendly infrastructure projects. Electrical circuits are the foundation of modern technology and infrastructure. The skills gained in this course are essential for creating and maintaining advanced infrastructure, including telecommunications, transportation, and manufacturing systems.</p>
10		
11		
12		<p>Responsible Consumption and Production This subject impacts the demand of electricity and need for saving energy</p>
13		
14		

15		
16		
17		

Approved by: Board of Studies in the meeting conducted on _____.

Signature of Course Coordinator
 Dr. L. Rajasekhar Goud, Associate Professor

HOD,EEE



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

OBJECT ORIENTED PROGRAMMING COURSE TEMPLATE

1	Department	ELECTRICAL AND ELECTRONICS ENGINEERING				
2	Course code	ACSD01				
3	Course Title	OBJECT ORIENTED PROGRAMMING				
4	Class / Semester	I / I				
5	Regulation	BT-23				
6	Structure of the course	Theory			Practical	
		Lecture 3	Tutorials 0	Credits 3	Lab -	Credits -
7	Type of course (Tick type of course)	Core ✓	Professional Elective -	Open Elective -	VAC -	MOOCs -
8	Course Offered	Odd Semester <input checked="" type="checkbox"/>		Even Semester <input type="checkbox"/>		
9	Total lecture, tutorial and practical hours for this course (16 weeks of teaching per semester)					
	Lectures: 48 hours		Tutorials: 0 hours		Practical: – hours	
10	Course Coordinator	Mr. D. Atchuta Ramacharyulu				
11	Date Approved by BOS	28/08/2023				
12	Course Webpage	https://www.iare.ac.in/?q=pages/btech-course-syllabi-bt23-cse				
13	Course Prerequisites	Level	Course Code	Semester	Prerequisites	
		-	-	-	-	

14. Course Overview

The course provides a solid foundation in object-oriented programming concepts in using them. It includes concepts object-oriented concepts such as information hiding, encapsulation, and polymorphism. It contrasts the use of inheritance and composition as techniques for software reuse. It provides an understanding of object-oriented design using graphical design notations such as Unified Modelling Language (UML) as well as object design patterns.

15. Course Objectives:

The students will try to learn:

I	The fundamental concepts and principles of object-oriented programming in high-level programming languages.
II	Advanced concepts for developing well-structured and efficient programs that involve complex data structures, numerical computations, or domain-specific operations.
III	The design and implementation of features such as inheritance, polymorphism, and encapsulation for tackling complex problems and creating well-organized, modular, and maintainable code.
IV	The usage of input/output interfaces to transmit and receive data to solve real-time computing problems.

16. Course Outcomes:

After successful completion of the course, students should be able to:

CO 1	Interpret the features of object-oriented programming languages, comparison, and evolution of programming languages.
CO 2	Model the real-world scenario using class diagrams and exhibit communication between objects.
CO 3	Estimate the need for special functions for data initialization.
CO 4	Outline the features of object-oriented programming for binding the attributes and behavior of a real-world entity.
CO 5	Use the concepts of streams and files that enable data management to enhance programming skills.
CO 6	Develop contemporary solutions to software design problems using object-oriented principles.

17. Topic Learning Outcome (TLOs):

S No	Topic(s)	TLO No	Topic Learning Outcome	Course Outcome	Blooms Level
1	Objects and legacy systems	1	Summarize fundamental concepts of programming through a procedural approach.	CO 1	Understand
		2	Differentiate between OOP and other programming paradigms such as procedural programming.	CO 1	Understand
2	Object-oriented programming	3	Gain knowledge to design and implement software solutions using OOP principles.	CO 1	Remember

S No	Topic(s)	TLO No	Topic Learning Outcome	Course Outcome	Blooms Level
		4	Discuss applications of OOP in software development, graphical user interface development, and mobile application development.	CO 1	Understand
3	Abstraction: Levels of abstraction	5	Identify the data components and behaviors of multiple abstract data types.	CO 1	Remember
		6	Apply techniques of decomposition to break a program into smaller pieces.	CO 1	Apply
		7	Implement a coherent abstract data type with loose coupling between components and behaviors.	CO 6	Apply
4	Classes and objects: Fields, methods, messages	8	Interpret knowledge by defining classes and creating instances to represent and interact with real-world entities or concepts.	CO 2	Understand
		9	Instantiate objects from classes to understand the relationship between classes and objects.	CO 2	Remember
5	Access specifiers: public, private, protected	10	Enumerate access specifiers' visibility and accessibility of class members (variables and methods) within different parts of a program.	CO 2	Remember
6	Class diagrams	11	Create and interpret class diagrams to visually represent classes, relationships, and interactions.	CO 2	Apply
7	Encapsulation	12	Review the encapsulation principle by specifying who can access and modify class members.	CO 3	Remember
		13	Implement encapsulation by using access modifiers (public, private, protected) to control access to class members.	CO 2	Apply
		14	Use static fields to keep a count of the number of objects that have been instantiated or to store a value that must be shared among all instances.	CO 6	Apply









S No	Topic(s)	TLO No	Topic Learning Outcome	Course Outcome	Blooms Level
8	Special member functions: Constructors, destructors	15	Select the constructor methods in initializing object attributes when instances are created.	CO 3	Remember
		16	Illustrate destructors to manage resources and perform cleanup operations in the classes such as closing files, releasing locks, or cleaning up cached data.	CO 6	Apply
9	Overloading: Functions, operators, constructors	17	Express the behavior of operators of a class that enriches programming skills in various ways that are both intuitive and flexible.	CO 3	Understand
		18	Infer that data is in a compatible format for specific operations or assignments to avoid unexpected behavior or data loss.	CO 3	Understand
		19	List the types of inheritance to facilitate code reuse, organization, and hierarchy for modeling complex systems.	CO 4	Remember
10	Inheritance: Subclasses, and method overriding	20	Use subclassing to design class hierarchies that allow code to be reused for distinct subclasses.	CO 4	Apply
		21	Identify the type of inheritance to create specialized classes that inherit the properties and behaviors of more general classes.	CO 4	Remember
11	Virtual functions	22	Demonstrate code flexibility using virtual functions to work with different types of objects through a common interface.	CO 4	Understand
12	Polymorphism	23	Review polymorphism on different derived classes to be treated as objects of their common base class.	CO 4	Remember
		24	Understand and demonstrate polymorphic behavior through function overriding and function overloading.	CO 4	Understand

S No	Topic(s)	TLO No	Topic Learning Outcome	Course Outcome	Blooms Level
13	Streams and files	25	Illustrate console input and output to create applications that interact with users, and process data.	CO 5	Understand
		26	Label objects to store them in files and deserialize them to recreate objects from files.	CO 5	Remember
		27	Demonstrate file-handling operations to enrich programming capabilities to create more sophisticated applications that interact with and manipulate external data sources effectively.	CO 5	Understand
		28	Use output with manipulators and predefined manipulators for formatting input and output data.	CO 6	Apply
14	Command line arguments	29	Interpret software systems and applications to configure and control via command-line arguments.	CO 5	Understand

18. Employability Skills

Example: Communication skills / Programming skills / Project based skills /
1. Programming skills - The tech industry evolves rapidly, and staying up-to-date with the latest programming languages, frameworks, and development practices is crucial. Combining OOP skills with a commitment to continuous learning demonstrates a student's dedication to staying relevant in a dynamic field.
2. Project-based skills - Creating projects that utilize OOP principles allows a student to apply theoretical knowledge to real-world scenarios. This hands-on experience helps solidify their understanding of how OOP concepts work in practice.

19. Content Delivery / Instructional Methodologies:

✓	 Power Point Presentation	✓	 Chalk & Talk	✓	 Assignments	x	 MOOC
x	 Open Ended Experiments	x	 Seminars	x	 Mini Project	✓	 Videos

20. Evaluation Methodology:

The course will be evaluated for a total of 100 marks, with 40 marks for Continuous Internal Assessment (CIA) and 60 marks for Semester End Examination (SEE). CIA is conducted for a total of 40 marks, with 20 marks for Continuous Internal Examination (CIE), 05 marks for each Definitions and Terminology / Quiz, and the remaining 10 marks for Tech Talk / Assignments.

Outline for Continuous Internal Assessments (CIA - I and CIA - II) and SEE:

Activities	CIA - I	CIA - II	SEE	Total Marks
Continuous Internal Examination (CIE)	10 Marks	10 Marks		20 Marks
Definitions and Terminology / Quiz	05 Marks	05 Marks		10 Marks
Tech Talk / Assignment	05 Marks	05 Marks		10 Marks
Semester End Examination (SEE)	-	-	60 Marks	60 Marks
Total	-	-	100 Marks	

Semester End Examination (SEE): The SEE is conducted for 60 marks of 3 hours duration. The syllabus for the theory courses is divided into FIVE modules and each module carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with “either” or “choice” will be drawn from each module. No choice is given in the first two modules. Each question carries 12 marks. There could be a maximum of two sub-divisions in a question.

21. Course content - Number of modules: Five

MODULE I	Object-oriented concepts Number of Lectures: 09
	Objects and legacy systems, procedural versus Object-oriented programming, top-down and bottom-up approaches and their differences, benefits of OOP, applications of OOP, and features of OOP. Abstraction: Layers of abstraction, forms of abstraction, abstraction mechanisms.
MODULE II	Classes and objects Number of Lectures: 09
	Classes and objects: Object data, object behaviors, creating objects, attributes, methods, messages, creating class diagrams. Access specifiers and initialization of class members: Accessing members and methods, access specifiers - public, private, protected, memory allocation. Static members, static methods.
MODULE III	Special member functions and overloading Number of Lectures: 09
	Constructors and destructors: Need for constructors and destructors, copy constructors, dynamic constructors, parameterized constructors, destructors, constructors and destructors with static members. Overloading: Function overloading, constructor overloading, operator overloading - rules for overloading operators, overloading unary and binary operators, friend functions.

MODULE IV	Inheritance and polymorphism Number of Lectures: 09
	Inheritance: types of inheritance, base class, derived class, usage of final, ambiguity in multiple and multipath inheritances, virtual base class, overriding member functions, order of execution of constructors and destructors. Polymorphism and virtual functions: Virtual functions, pure virtual functions, abstract classes, introduction to polymorphism, static polymorphism, dynamic polymorphism.
MODULE V	Console I/O and working with files Number of Lectures: 09
	Console I/O: Concept of streams, hierarchy of console stream classes, unformatted I/O operations, managing output with manipulators. Working with files: Opening, reading, writing, appending, processing, and closing different types of files, and command line arguments.

TEXTBOOKS

1. Matt Weisfeld, *The Object-Oriented Thought Process*, Addison Wesley Object Technology Series, 4th Edition, 2013.

REFERENCE BOOKS:

1. Timothy Budd, *Introduction to object-oriented programming*, Addison Wesley Object Technology Series, 3rd Edition, 2002.
2. Gaston C. Hillar, *Learning Object-Oriented Programming*, Packt Publishing, 2015.
3. Kingsley Sage *Concise Guide to Object-Oriented Programming*, Springer International Publishing, 1st Edition, 2019.
4. Rudolf Pecinovskiy, *OOP - Learn Object Oriented Thinking and Programming*, Tomas Bruckner, 2013.
5. Grady Booch, *Object-oriented analysis and design with applications*, Addison Wesley Object Technology Series, 3rd Edition, 2007.

MATERIALS ONLINE:

1. <https://docs.oracle.com/javase/tutorial/java/concepts/>
2. <https://www.w3schools.com/cpp/>
3. <https://www.edx.org/learn/object-oriented-programming>
4. <https://www.geeksforgeeks.org/introduction-of-object-oriented-programming/>

22. Course plan:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
OBE DISCUSSION			
Discussion on Outcome Based Education, CO, POs, and PSOs			
CONTENT DELIVERY (THEORY)			
1	Objects and legacy systems	CO 1	T1, Pg: 05
2	Object-oriented programming	CO 1	T1, Pg: 06
3	Procedural versus object-oriented programming	CO 1	T1, Pg: 07, R4: Pg: 13
4	Top-down and bottom-up approaches and their differences	CO 1	R5: 1.5
5	Benefits and applications of OOP	CO 1	R5: 1.6
6	Features of OOP	CO 1	T1, Pg: 12
7	Abstraction and layers of abstraction	CO 1	R1: 2.1
8	Forms of abstraction	CO 1	R1: 2.2
9	Abstraction mechanisms	CO 1	R1: 2.3
10	Object data, object behaviors, creating objects	CO 2	T1, Pg:12, 13
11	Attributes, methods, messages	CO 2	T1, Pg:19, 20
12	Classes	CO 2	T1, Pg: 17
13	Creating class diagrams with examples	CO 2	T1, Pg: 20
14	Accessing members	CO 2	R5: 3.1
15	Accessing methods	CO 2	R5: 3.2
16	Access specifiers - public, private, protected with examples	CO 2	T1, Pg: 188
17	Memory allocation	CO 2	T1, Pg: 90
18	Static members, static methods	CO 2	T1, Pg: 90
19	Constructors need constructors and destructors	CO 3	T1, Pg: 71
20	Copy constructors with examples	CO 3	R1: 15.1
21	Dynamic constructors with examples	CO 3	R1: 15.3
22	Parameterized constructors and destructors	CO 3	R1: 15.3.1
23	Constructors and destructors with static members	CO 3	R1: 15.3.2
24	Function overloading, constructor overloading	CO 3	R1: 15.3.2
25	Operator overloading - rules for overloading operators	CO 3	R1: 15.3.2
26	Overloading unary and binary operators	CO 3	R1: 15.3.2
27	Friend functions	CO 3	R1: 15.3.2
28	Inheritance and types of inheritance	CO 4	T1, Pg: 153
29	Base class, derived class, usage of final	CO 4	T1, Pg: 45
30	Ambiguity in multiple and multipath inheritance	CO 45	T1, Pg: 136

S.No	Topics to be covered	CO's	Reference
31	Virtual base class, overriding member functions	CO 4	T1, Pg: 137
32	Order of execution of constructors and destructors	CO 4	T1, Pg: 28 R1: 14.1
33	Virtual functions, pure virtual functions	CO 4	T1, Pg: 28
34	Abstract classes	CO 4	T1, Pg: 21
35	Introduction to polymorphism	CO 4	T1, Pg: 21
36	Static polymorphism, dynamic polymorphism.	CO 4	T1, Pg: 21
37	Concept of streams, hierarchy of console stream classes.	CO 5	T1, Pg: 225
38	Unformatted I/O operations	CO 5	T1, Pg: 221
39	Managing output with manipulators and predefined manipulators.	CO 5	T1, Pg: 225
40	Data streams, the opening of a file	CO 5	R1: 2.5
41	Reading/writing a character from/into a file	CO 5	T1, Pg: 225
42	Appending into a file	CO 5	T1, Pg: 232
43	Processing and closing files	CO 6	T1, Pg: 227
44	Different types of files and file systems.	CO 5	T1, Pg: 226
45	Command line arguments	CO 5	T1, Pg: 228
46	Question bank discussion	CO 6	T1
47	Question bank discussion	CO 6	T1
48	Question bank discussion	CO 6	T1
PROBLEM SOLVING/ CASE STUDIES			
1	Design a class to represent books with attributes like title, author, and ISBN. Create a class for library patrons with borrowing history and due dates. Implement methods to borrow and return books, tracking availability, and due dates.	CO 1	
2	Design a class for products with properties like name, price, and description. Develop a shopping cart class that allows users to add and remove products. Use objects to create an interactive shopping experience with calculated totals.	CO 1	
3	Create a class for students with attributes like name, age, and enrolment status. Design a class for courses with properties like title, instructor, and schedule. Implement methods to enroll students in courses and track their progress.	CO 1	
4	Design a class representing a geometric shape (e.g., circle, rectangle). Use the const keyword to declare methods that provide information about the shape without modifying its properties.	CO 2	

S.No	Topics to be covered	CO's	Reference
5	Design a university class with nested classes for departments and courses. Utilize nested classes to represent the hierarchical structure of the university's organization.	CO 2	
6	Design a class representing employees with attributes like name, employee ID, and position. Use a constructor to initialize employee information when an object is created. Implement a destructor to handle any cleanup tasks or logging when an employee object is destroyed.	CO 2	
7	Implement a class for complex numbers with overloaded operators for addition, subtraction, multiplication, and division. Allow users to perform arithmetic operations on complex numbers using intuitive syntax.	CO 3	
8	Design a class for representing dates and overload comparison operators. Allow users to compare dates and determine their chronological order.	CO 3	
9	Create a utility to convert measurements between different units (e.g., inches to centimeters, pounds to kilograms). Utilize type conversion to handle unit conversions based on user input.	CO 3	
10	Design a base class Character with virtual functions for movement, attack, and interaction. Implement derived classes PlayerCharacter and EnemyCharacter that override the virtual functions. Use polymorphism to handle interactions between various characters in the game.	CO 4	
11	Create a base class Employee with virtual functions for calculating salary and displaying information. Implement derived classes RegularEmployee and ContractEmployee that override the virtual functions.	CO 4	
12	Design classes representing accounts (e.g., savings, checking) and customers. Use encapsulation to hide sensitive data and provide methods to deposit, withdraw, and check balances. Apply inheritance to create specialized account types, such as VIP accounts with additional features.	CO 4	
13	Develop an application to manage tasks and to-do lists. Use console stream classes to display tasks, prompt users for new tasks, and mark tasks as completed. Enable users to save and load their to-do lists to/from text files using file stream classes.	CO 5	
14	Create a calculator application that performs basic arithmetic operations. Utilize console stream classes to prompt users for operands and operators, and display the calculation results.	CO 5	

S.No	Topics to be covered	CO's	Reference
15	Create a utility that parses and analyzes log files. Read log files, extract relevant information, and present summaries. Use file streams to process large log files efficiently.	CO 5	
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Introduction to programming and object legacy.	CO 1	
2	Constructor and destructor.	CO 2	
3	Operator overloading.	CO 3	
4	Data hiding.	CO 4	
5	Command line arguments.	CO 5	
DISCUSSION OF TUTORIAL QUESTION BANK			
1	Classes and objects.	CO 1	
2	Constructors and destructors.	CO 2	
3	Overloading a unary and binary operator using friend function and member function.	CO 3	
4	Ambiguity in derived classes for multipath inheritance.	CO 4	
5	Console stream classes.	CO 5	

23. Program outcomes and Program specific outcomes:

Program Outcomes	
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	Design/Development of Solutions: Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Program Outcomes	
PO 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Life-Long Learning: Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
Program Specific Outcomes	
PSO 1	Design, Develop, Fabricate and Commission the Electrical Systems involved in Power generation, Transmission, Distribution and Utilization.
PSO 2	Focus on the Components of Electrical Drives with its Converter Topologies for Energy Conversion, Management and Auditing in Specific applications of Industry and Sustainable Rural Development.
PSO 3	Gain the Hands-On Competency Skills in PLC Automation, Process Controllers, HMI and other Computing Tools necessary for entry level position to meet the Requirements of the Employer.

24. How program outcomes are assessed:

Program Outcomes		Strength	Proficiency Assessed by
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/SEE
PO 2	Problem analysis: Identity, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/SEE

PO 3	Design/Development of Solutions: Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and Environmental considerations.	3	CIE/SEE
PO 5	Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.	3	CIE/SEE
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	Tech talk/Definitions and terminology
PO 12	Life-Long Learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	CIE/SEE

25. How program-specific outcomes are assessed:

Program Specific Outcomes		Strength	Proficiency Assessed by
PSO 3	Gain the Hands-On Competency Skills in PLC Automation, Process Controllers, HMI and other Computing Tools necessary for entry level position to meet the Requirements of the Employer.	3	Tech talk /Definitions and terminology/ Assignments

3 = High; 2 = Medium; 1 = Low

26. Mapping of each CO with PO(s), PSO(s):

COURSE OUTCOME	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	✓	-	-	-	-	✓	-	-	-	-	✓
CO 2	✓	✓	✓	-	✓	-	-	-	-	✓	-	-	-	-	-
CO 3	✓	-	✓	-	✓	-	-	-	-	-	-	-	-	-	✓
CO 4	✓	-	✓	-	✓	-	-	-	-	✓	-	✓	-	-	-
CO 5	✓	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	-
CO 6	✓	✓	✓	-	✓	-	-	-	-	✓	-	✓	-	-	-

27. Justifications for CO – PO / PSO mapping - DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Understand (knowledge) the basic concept of object-oriented programming while evaluating mathematical expressions in program statements. These concepts provide insight into expression evaluation by applying the principles of mathematics and science.	3
	PO 5	With the help of modern engineering tools, we can easily understand the basic concept of objects and classes while evaluating mathematical expressions in program statements.	1
	PO 10	Extend the knowledge of object-oriented programming to communicate effectively with the engineering community.	1
	PSO 3	Acquire sufficient knowledge of object-oriented concepts and apply it in real-time to build a successful career and do higher studies.	2
CO 2	PO 1	By applying the knowledge of mathematics, science, and engineering fundamentals we can effectively use the properties of OOP.	3
	PO 2	Apply nested classes in problem identification, statement, and validation.	5
	PO 3	Apply constructors and destructors to investigate and understand different complex engineering problems efficiently.	8
	PO 5	Apply static members to model complex engineering activities.	1
	PO 10	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	3
CO 3	PO 1	Summarize indexing and slicing mechanisms for extracting a portion of data in a sequence using principles of mathematics, and engineering fundamentals.	8
	PO 3	Demonstrate the importance of indexing mechanisms in sequences while developing solutions for complex engineering problems and design systems using principles of mathematics, science, and engineering fundamentals. Use creativity to develop more innovative solutions.	6
	PO 5	Demonstrate overloading operators with the usage of modern tools.	1

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
	PSO 3	Infer sufficient knowledge of container data types and apply it in real-time for building a successful career and doing higher studies.	2
CO 4	PO 1	Demonstrate different modules/packages in object-oriented programming while developing solutions using the fundamentals of mathematics, science, and engineering.	3
	PO 3	Understand the usage of modules/packages while developing solutions for complex engineering problems and design systems using principles of mathematics, science, and engineering fundamentals. Use creativity to develop more innovative solutions.	8
	PO 5	Interpret different string functions by using modern tools.	1
	PO 10	Extend the focus to understanding the usage of modules/packages and communicating effectively with the engineering community.	2
	PO 12	Summarize string handling functions that involve manipulating and managing text or character data for tasks like data validation, formatting, and communication.	7
CO 5	PO 1	Make use of parameter passing and different types of arguments in user-defined functions to design efficient modular programs by applying the knowledge of mathematics, science, and Engineering fundamentals.	3
	PO 2	Apply modular programming concepts for problem identification, formulation, and data collection.	8
	PO 3	Select a strong foundation for writing efficient modular programs using parameter-passing mechanisms for career building by understanding the requirements and communicating effectively with the engineering community.	7
	PO 5	Develop different functions by using modern tools.	1
CO 6	PO 1	Apply scientific principles and methodologies, mathematical principles, and other engineering disciplines for procedural and object-oriented programming.	3
	PO 2	Apply object-oriented concepts in problem identification, statement, and validation.	7
	PO 3	Identify the need for object-oriented concepts while developing solutions for complex engineering problems and design systems using principles of mathematics, science, and engineering fundamentals. Use creativity to develop more innovative solutions.	7
	PO 5	Develop object-oriented principles using modern tools.	1
	PO 10	Apply the knowledge of object-oriented programming to communicate effectively with the engineering community.	2

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
	PO 12	Identify the need for object-oriented principles for the preparation and the ability to engage in independent and lifelong learning	6

28. Total count of key competencies for CO – PO / PSO mapping:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	3	-	-	-	-	1	-	-	-	-	3
CO 2	3	2	3	-	3	-	-	-	-	3	-	-	-	-	-
CO 3	3	-	3	-	3	-	-	-	-	-	-	-	-	-	3
CO 4	3	-	3	-	3	-	-	-	-	2	-	3	-	-	-
CO 5	3	2	3	-	3	-	-	-	-	-	-	-	-	-	-
CO 6	3	3	3	-	3	-	-	-	-	2	-	3	-	-	-

29. Percentage of key competencies CO – PO / PSO:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	0.0	0.0	0.0	100	0.0	0.0	0.0	0.0	20	0.0	0.0	0.0	0.0	100
CO 2	100	50	80	0.0	100	0.0	0.0	0.0	0.0	60	0.0	0.0	0.0	0.0	0.0
CO 3	100	0.0	60	0.0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100
CO 4	100	0.0	80	0.0	100	0.0	0.0	0.0	0.0	40	0.0	88	0.0	0.0	0.0
CO 5	100	80	70	0.0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CO 6	100	80	70	0.0	100	0.0	0.0	0.0	0.0	40	0.0	75	0.0	0.0	0.0

30. Course articulation matrix PO / PSO mapping:

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

2 - $40\% < C < 60\%$ – Moderate

1-5 $< C \leq 40\%$ – Low/ Slight

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	-	-	-	3	-	-	-	-	1	-	-	-	-	3

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 2	3	2	3	-	3	-	-	-	-	3	-	-	-	-	-
CO 3	3	-	3	-	3	-	-	-	-	-	-	-	-	-	3
CO 4	3	-	3	-	3	-	-	-	-	2	-	3	-	-	-
CO 5	3	2	3	-	3	-	-	-	-	-	-	-	-	-	-
CO 6	3	3	3	-	3	-	-	-	-	2	-	3	-	-	-
TOTAL	-	7	15	-	-	-	-	-	-	8	-	6	-	-	6
AVERAGE	3	2.3	3	-	3.0		-	-	-	2.0	-	3.0	-	-	3.0

31. Assessment methodology - Direct:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	-	Student Viva	-	Certification	-
Definitions and Terminology	✓	Tech talk / 5 Minutes Video	✓	Open Ended Experiments	-
Assignments	✓	Quiz	✓	Tech Talk	✓





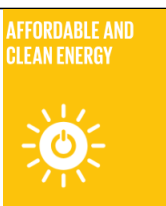


32. Assessment methodology - Indirect:








x	Assessment of mini projects by experts	✓	End Semester OBE Feedback
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33. Relevance to Sustainability goals

Write a brief description of the course and its relevance to SDGs.

1		
2		

3	 <p>GOOD HEALTH AND WELL-BEING</p>	
4	 <p>QUALITY EDUCATION</p>	<p>Quality education: Guarantee an education system that is both inclusive and fair, offering high-quality learning experiences and lifelong opportunities accessible to all.</p>
5	 <p>GENDER EQUALITY</p>	
6	 <p>CLEAN WATER AND SANITATION</p>	
7	 <p>AFFORDABLE AND CLEAN ENERGY</p>	
8	 <p>DECENT WORK AND ECONOMIC GROWTH</p>	
9	 <p>INDUSTRY, INNOVATION AND INFRASTRUCTURE</p>	<p>Industry, innovation, and infrastructure: Strong OOP skills enable to design and development of services like microservice architecture, cloud computing, machine learning, and AI integration in a modular and maintainable way, contributing to a more flexible and scalable infrastructure.</p>

10		
11		<p>Sustainable cities and communities: OOP skills can develop software solutions that contribute to urban sustainability, improve quality of life, and address challenges like smart city solutions, energy efficiency and monitoring, waste management systems, public transportation optimization, environmental sensor networks, education, and awareness faced by modern cities.</p>
12		
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Approved by: Board of Studies in the meeting conducted on 28-08-2023.

Signature of Course Coordinator
Mr. D.Atchuta Ramacharyulu, Assistant Professor

HOD EEE



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE TEMPLATE

1	Department	ELECTRICAL AND ELECTRONICS ENGINEERING			
2	Course Title	PROFESSIONAL COMMUNICATION LABORATORY			
3	Course Code	AHSD04			
4	Program	B.Tech			
5	Semester	I Semester			
6	Regulation	BT23			
7	Structure of the course	Practical			
		Lecture Hours 3		Practical Hours 3	
8	Course Offered	Odd Semester <input checked="" type="checkbox"/>	Even Semester <input type="checkbox"/>		
9	Course Coordinator	Dr Jan Mohmad Pandit			
10	Date Approved by BOS	24/08/2023			
11	Course Webpage	https://www.iare.ac.in/?q=pages/btech-course-syllabi-bt23-ae			
12	Course Prerequisites	Level	Course Code	Semester	Prerequisites
		B.Tech	AHSD04	I	-

13. Course Overview

This laboratory course is designed to introduce students to create a wide exposure on language learning techniques of the basic elements of listening skills, speaking skills, reading skills and writing skills. In this laboratory, students are trained in communicative English language skills, phonetics, word accent, word stress, rhythm, intonation, oral presentations and extempore speeches. Students are also taught in terms of seminars, group-discussions, presenting techniques of writing, participating in role plays, telephonic etiquettes, asking and giving directions, information transfer, debates, description of persons, places and objects etc. The laboratory encourages students to work in a group, engage in peer-reviews and inculcate team spirit through various exercises on grammar, vocabulary, and pronunciation games etc. Students will make use of all these language skills in academic, professional and real time situations.

18. COURSE OBJECTIVES:

The students will try to learn:

I	English speech sounds, word accent, intonation and stress patterns for effective pronunciation.
II	Critical aspect of speaking and reading for interpreting in-depth meaning between the sentences.

III	Language techniques for social interactions such as public speaking, group discussions and interviews.
IV	Computer-assisted multi-media instructions and independent language learning.

19. COURSE OUTCOMES:








After successful completion of the course, students should be able to:

CO 1	Articulate the use of draw, modify and dimension commands of AutoCAD for development of 2D and 3D drawings.	Understand
CO 2	Differentiate stress shifts, syllabification and make use of past tense and plural markers effectively in connected speech; besides participate in role plays with confidence.	Understand
CO 3	Apply weak forms and strong forms in spoken language and maintain intonation patterns as a native speaker to avoid mother tongue influence; moreover, practice various etiquettes at professional platform.	Understand
CO 4	Demonstrate Errors in pronunciation and the decorum of oral presentations; for that reason, take part joining in group discussions and debates with much critical observations	Understand
CO 5	Strengthen writing effective messages, notices, summaries and also able to write reviews very critically of art and academical videos.	Understand
CO 6	Argue scholarly, giving the counters to open ended experiments, and also writing slogans for the products talentedly.	Understand

14. Employability Skills

<p>1. Employment advantage: Effective English language and communication skills are crucial in many aspects of life, including education, business, workplace and social interactions. Proficient English language skills enable individuals to express themselves clearly, understand others, and engage in meaningful conversations. As the primary language of communication across the globe, proficiency in English is a highly sought-after skill in the international workplace and one of the benefits of learning English is therefore that it significantly boosts our job opportunities</p>

16. Content Delivery / Instructional Methodologies:

✓	 Day to Day lab evaluation	✓	 Demo Video	✓	 Viva Voce questions	x	 Open Ended Experiments
x	 Competitions	x	 hackathons	x	 Certifications	x	Probing Further Questions

17. Evaluation Methodology:

Each laboratory will be evaluated for a total of 100 marks consisting of 40 marks for internal assessment and 60 marks for semester end lab examination. Out of 40 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance including viva voce, 10 marks for the final internal lab assessment and remaining 10 marks for The remaining 10 marks are for Laboratory Report/Project and Presentation, which consists of the Design (or) Software / Hardware Model Presentation (or) App Development (or) Prototype Presentation submission which shall be evaluated after completion of laboratory course and before semester end practical examination.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 40 marks (Table 1), with 20 marks for continuous lab assessment during day-to-day performance including viva voce, 10 marks for final internal lab assessment and remaining 10 marks for Laboratory Report / Project and Presentation.

Table 3: CIA marks distribution

Component				
Type of Assessment	Day to Day performance and viva voce examination	Final internal lab assessment	Laboratory Report / Project and Presentation	Total Marks
CIA marks	20	10	10	40

Continuous Internal Examination (CIE): One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

Table 4: Experiment based

Objective	Analysis	Design	Conclusion	Viva voce	Total
					20

Table 5: Programming based

Objective	Analysis	Design	Conclusion	Viva voce	Total
					20

Semester End Examination:

The Semester End Examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed from the other colleges which will be decided by the Head of the institution.

In the Semester End Examination held for 3 hours, total 60 marks are divided and allocated as shown below:

1. 10 marks for write-up
2. 15 for experiment/program
3. 15 for evaluation of results
4. 10 marks for presentation on another experiment/program in the same laboratory course and
5. 10 marks for viva-voce on concerned laboratory course.

20. SYLLABUS:

CO 1	Recognise English speech sounds in order to execute formal and informal communication
	<ol style="list-style-type: none">1. Introduction to pronunciation2. Introducing self and introducing others and feedback3. Introduction to phonetics, listening to English sounds, Vowel and Consonant sounds4. Describing a person or place or a thing using relevant adjectives – feedback5. Pronunciation practice
CO 2	Construct required dialogues in role plays in verbal communication
	<ol style="list-style-type: none">1. Role plays on fixed expressions in various situations2. Structure of syllables3. Asking for directions and giving directions4. Weak forms and strong forms5. Intonation
CO 3	ADifferentiate mother tongue influence while speaking English in JAM sessions, debates, group discussions and telephonic conversations.
	<ol style="list-style-type: none">1. Word accent and stress shifts2. JAM Sessions using public address system3. Extempore-Picture4. Etiquette5. Debates6. Listening comprehension7. Group discussion
CO 4	Pronounce past tense and plural markers and weak forms and strong forms as a native speaker.
	<ol style="list-style-type: none">1. Past tense and plural markers2. Neutralization of Mother Tongue Influence (MTI)3. Weak forms and strong forms4. Common errors in pronunciation practice through tongue twisters5. Minimal pairs

CO 5	Demonstrate the techniques of writing leaflets, messages and notices..
	<ol style="list-style-type: none"> 1. Writing slogan related to the image 2. Providing reviews and remarks 3. Writing slogan related to the image 4. Demonstration on how to write leaflets, messages and notices
CO 6	Use language appropriately during interviews and oral presentations.
	<ol style="list-style-type: none"> 1. Oral presentations 2. Techniques and methods to write summaries and reviews of videos 3. Information transfer 4. Open ended experiments-phonetics practice 5. Open ended experiments-text to speech

Note: One Course Outcome may be mapped to multiple number of experiments.

TEXTBOOKS

1. Professional Communication laboratory manual.

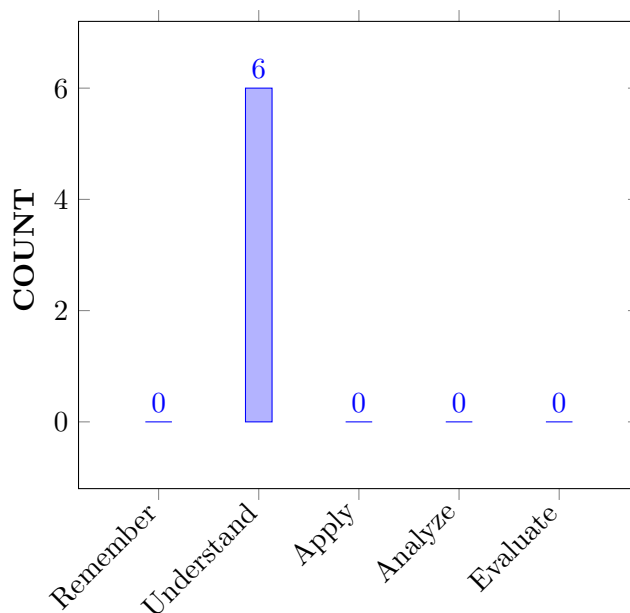
REFERENCE BOOKS:

1. Meenakshi Raman, Sangeetha Sharma, Technical Communication Principles and Practices, Oxford University Press, New Delhi, 3rd Edition, 2015..
2. Rhirdion, Daniel, Technical Communication, Cengage Learning, New Delhi, 1st Edition, 2009..

MATERIALS ONLINE:

1. Cambridge online pronunciation dictionary <https://dictionary.cambridge.org/>
2. Cambridge online pronunciation dictionary <https://dictionary.cambridge.org/>
3. Repeat after us <https://brycs.org/clearinghouse/3018/>
4. Language lab <https://brycs.org/clearinghouse/3018/>
5. Oxford online videos

22. COURSE KNOWLEDGE COMPETENCY LEVEL



BLOOMS TAXONOMY

33. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	CALL LAB: Introduction to pronunciation ICS LAB: Introducing self and introducing others and feedback:	CO 1	Understand
2	CALL LAB: Introduction to phonetics, listening to English sounds, Vowel and Consonant sounds. ICS LAB: Describing a person or place or a thing using relevant adjectives – feedback	CO 1	Understand
3	CALL LAB: Structure of syllables. ICS LAB: JAM Sessions using public address system	CO 2	Understand
4	CALL LAB: Word accent and stress shifts. ICS LAB: Asking for directions and giving directions	CO 2	Understand
5	CALL LAB: Past tense and plural markers ICS LAB: Role plays on fixed expressions in various situations	CO 2	Understand
6	CALL LAB: Weak forms and strong forms ICS LAB: Extempore-Picture	CO 3	Understand
7	CALL LAB: Intonation ICS LAB: Interpretation of Proverbs and Idioms	CO 3	Understand
8	CALL LAB: Neutralization of Mother Tongue Influence (MTI) ICS LAB: Etiquette	CO 3	Understand

S.No	Topics to be covered	CO's	Reference
9	CALL LAB: Common errors in pronunciation practice through tongue twisters ICS LAB: Oral Presentations	CO 4	Understand
10	CALL LAB: Minimal pairs ICS LAB: Debates	CO 4	Understand
11	CALL LAB: Listening comprehension ICS LAB: Group discussion	CO 4	Understand
12	CALL LAB: Demonstration on how to write leaflets, messages and notices. ICS LAB: Techniques and methods to write summaries and reviews of videos	CO 5	Understand
13	CALL LAB: Pronunciation practice ICS LAB: Information transfer	CO 5	Understand
14	CALL LAB; Open Ended Experiments-Phonetics Practice ICS LAB: Providing reviews and remarks	CO 6	Understand
15	CALL LAB: Open Ended experiments-Text to Speech. ICS LAB: Writing slogan related to the image	CO 6	Understand

23. PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES:

Program Specific Outcomes	
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	Design/Development of Solutions: Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Program Specific Outcomes	
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Life-Long Learning: Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
Program Specific Outcomes	
PSO 1	Design, Develop, Fabricate and Commission the Electrical Systems involved in Power generation, Transmission, Distribution and Utilization.
PSO 2	Focus on the Components of Electrical Drives with its Converter Topologies for Energy Conversion, Management and Auditing in Specific applications of Industry and Sustainable Rural Development.
PSO 3	Gain the Hands-On Competency Skills in PLC Automation, Process Controllers, HMI and other Computing Tools necessary for entry level position to meet the Requirements of the Employer.

24. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Strength	Proficiency Assessed by
PO 9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	3	CIE/Quiz/AAT
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions	5	CIE/Quiz/AAT

25. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Strength	Proficiency Assessed by
PSO 1	Design, Develop, Fabricate and Commission the Electrical Systems involved in Power generation, Transmission, Distribution and Utilization.	-	-
PSO 2	Focus on the Components of Electrical Drives with its Converter Topologies for Energy Conversion, Management and Auditing in Specific applications of Industry and Sustainable Rural Development..	-	-
PSO 3	Gain the Hands-On Competency Skills in PLC Automation, Process Controllers, HMI and other Computing Tools necessary for entry level position to meet the Requirements of the Employer.	-	-

3 = High; 2 = Medium; 1 = Low

26. MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOME	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-

27. JUSTIFICATIONS FOR CO – PO / PSO MAPPING - DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 10	Discuss the significance of individual learning and the advantages of being a team member and also develop leadership qualities.	5
CO 2	PO 9, PO 10	Demonstrate about roleplays and its impact to enhance fluency levels. Strengthen word accent and stress shifts while doing group discussions.	3, 5
CO 3	PO 9, PO 10	Use intonation in connected speech while participating debates. Identify the number syllables in words and pronounce them as a native speaker.	3, 5
CO 4	PO 10	Pronouns the sentences within the tone boundaries maintaining the melody of the language	3

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 5	PO 10	Interpret writing leaflets, messages and notices like a professional.	5
CO 6	PO 9, PO 10	Explain the procedure of preparing for interviews and academical oral presentations. Besides, recognising English speech sounds in order to maintain speaking efficiency	3, 5

28. TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	3	5	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	3	5	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	3	5	-	-	-	-	-

29. PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	100	100	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	100	100	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	100	100	-	-	-	-	-

30. COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

2 - $40\% < C < 60\%$ – Moderate

1-5 $< C \leq 40\%$ – Low/ Slight

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 2	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO 6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
TOTAL	-	-	-	-	-	-	-	-	9	18	-	-	-	-	-
AVERAGE	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-

31. ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Laboratory Practices	✓
Certification	-	Student Viva	✓	Open Ended Experiments	-

32. ASSESSMENT METHODOLOGY INDIRECT:

x	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback
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Experiments for enhanced learning (EEL):




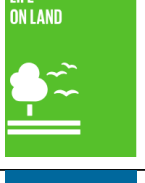


S.No	Design Oriented Experiments

15. Relevance to Sustainability goals

Write brief description about the course and how its relevance to SDGs.

1		
2		

3		
4		<p>English language has become linguafranca across the globe. For that reason, it is compulsory to learn this language at advanced level. In MNC companies, those who have excellent communication skills ,their carrer graph is going to high very quickly. Hence ,the role of English language has become a part of the life.</p>
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16		
17		

Approved by: Board of Studies in the meeting conducted on _____.

Signature of Course Coordinator
 Dr Jan Mohmad Pandit, Assistant Professor

HOD



INSTITUTE OF AERONAUTICAL ENGINEERING (Autonomous)

Dundigal, Hyderabad - 500 043

COURSE TEMPLATE

1	Department	ELECTRICAL AND ELECTRONICS ENGINEERING			
2	Course Code	AEED04			
3	Course Title	ELECTRICAL CIRCUITS LABORATORY			
4	Semester	I			
5	Regulations	BT-23			
6	Structure of the course	Practical			
		Lecture Hours -	Practical Hours 36		
7	Course Offered	Odd Semester <input checked="" type="checkbox"/>	Even Semester <input type="checkbox"/>		
8	Course Coordinator	Mr. P.Shiva Kumar			
9	Date Approved by BOS	24/08/2023			
10	Course Webpage	https://www.iare.ac.in/sites/default/files/BT23/AEED04.pdf			
11	Course Prerequisites	Level	Course Code	Semester	Prerequisites
		Intermediate	-	-	Physics

12. Course Overview

The course is designed to provide students with hands-on experience and practical skills in the field of electrical engineering. It serves as a complement to the theoretical concepts learned in the concurrent electrical circuits course. This course explores fundamental electrical concepts, such as Ohm's Law, circuit analysis, network theorems, and component characterization. This course is useful for students to gain an in-depth understanding of fundamental electrical circuits, components, measurement techniques, and trouble shooting

13. Course Objectives:

The students will try to learn:

I	The basic laws, network reduction techniques and theorems for different circuits.
II	The circuit design, measurement, testing, and analysis using laboratory equipment such as multimeters, and power supplies.
III	The types of two port network parameters for different circuits.

14. Course Outcomes:








After successful completion of the course, students should be able to:

CO1	Calculate the source resistance, currents, voltage and power in an electrical circuit using various laws associated with electrical circuits	Understand
CO2	Evaluate the alternating quantities for different periodic waveforms.	Understand
CO3	Describe the superposition principle, reciprocity and maximum power transfer condition for the electrical network with DC excitation.	Understand
CO4	Demonstrate Thevenin's and Norton's theorems to reduce complex networks into simple equivalent networks with DC excitation.	Apply
CO5	Apply Faraday's laws of electromagnetic induction in the construction of magnetic circuits.	Apply
CO6	Make use of the two port parameters to be measured easily, without solving for all the internal voltages and currents in the different networks.	Apply

15. Employability Skills

1. Innovative Thinking: This course helps the students to think innovative through different experiments and tests.
2. Technological Knowledge: Here they gain technical knowledge on electrical equipment.
3. Safety awareness: Students get holistic safety awareness about electricity which is very important for anyone.

16. Content Delivery / Instructional Methodologies:

✓	 Day to Day lab evaluation	✓	 Demo Video	✓	 Viva Voce questions	x	 Open Ended Experiments
x	 Competitions	x	 hackathons	x	 Certifications	✓	Probing Further Questions

17. Evaluation Methodology:

Each laboratory will be evaluated for a total of 100 marks consisting of 40 marks for internal assessment and 60 marks for semester end lab examination. Out of 40 marks for internal assessment, continuous lab assessment will be done for 20 marks for the day today's performance including viva voce, 10 marks for the final internal lab assessment, and the remaining 10 marks for Laboratory Report/Project and Presentation, which consists of the Design (or) Software / Hardware Model Presentation (or) AppDevelopment (or) Prototype Presentation submission which shall be evaluated after completion of laboratory course and before semester end practical examination.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 40 marks (Table 1), with 20 marks for continuous lab assessment-during day-to-day performance including viva voce, 10 marks for final internal lab assessment and remaining 10 marks for Laboratory Report/Project and Presentation.

Table 1.0: CIA marks distribution

Component				
Type of Assessment	Day to Day performance and viva voce examination	Final internal lab assessment	Laboratory Report / Project and Presentation	Total Marks
CIA marks	20	10	10	40

Continuous Internal Examination (CIE): One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

Table 2.0: Experiment based

Objective	Analysis	Design	Conclusion	Viva voce	Total
4	4	4	4	4	20

Table 3.0: Programming based

Objective	Analysis	Design	Conclusion	Viva voce	Total

Semester End Examination:

The Semester End Examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed from the other colleges which will be decided by the Head of the institution.

In the Semester End Examination held for 3 hours, total 60 marks are divided and allocated as shown below:

1. 10 marks for write-up
2. 15 for experiment/program
3. 15 for evaluation of results
4. 10 marks for presentation on another experiment/program in the same laboratory course and
5. 10 marks for viva-voce on concerned laboratory course.

18. Course Content:

CO 1	Solve the source resistance, currents, voltage and power using various laws associated with electrical circuits.
	<ol style="list-style-type: none">1. Introduction to electrical circuits2. Exercises on Basic Electrical Circuit Law's3. Exercises on Mesh Analysis4. Exercises on Nodal Analysis
CO 2	Analyze the alternating quantities for different periodic waveforms
	<ol style="list-style-type: none">1. Exercises on Characteristics of Periodic Waveforms
CO 3	Perform the superposition principle, reciprocity and maximum power transfer condition for the electrical network with DC excitation
	<ol style="list-style-type: none">1. Exercises on Superposition Theorem2. Exercises on Reciprocity Theorem3. Exercise on Maximum Power Transfer Theorem
CO 4	Demonstrate Thevenin's and Norton's theorems to reduce complex networks into simple equivalent networks with DC excitation
	<ol style="list-style-type: none">1. Exercises on Thevenin's Theorem2. Exercises on Norton's Theorem
CO 5	Apply Faraday's laws of electromagnetic induction for calculating the various performance parameters in magnetic circuits.
	<ol style="list-style-type: none">1. Exercises on Determination of Circuit Impedance2. Exercise on Series and Parallel Resonance
CO 6	Use the connecting wires of good continuity, short circuit of connecting wire leads damage of circuit parameters.
	<ol style="list-style-type: none">1. Exercise on Z and Y Parameters2. Exercise on H and ABCD Parameters

19. Course Plan:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's	Reference
1	Course Description on Outcome Based Education (OBE): Course Objectives, Course Outcomes (CO), Program Outcomes (PO) and CO-PO Mapping	-	
2	Introduction to electrical circuits	CO 1	T1:2.1 R1:1.12.3
3	Exercises on Basic Electrical Circuit Law's	CO 1	T1:1.12-1.18 R1:1.15
4	Exercises on Mesh Analysis	CO 1	T1:5.1-5.2 R1:1.16
5	Exercises on Nodal Analysis	CO 2	T1:5.3 R1:1.13.1
6	Exercises on Characteristics of Periodic Waveforms	CO 3	T1:2.4 R1:1.13.2
7	Exercises on Superposition Theorem	CO 3	T1:2.4 R1:1.13.3
8	Exercises on Reciprocity Theorem	CO 3	T1:5.1-5.2 R1:1.7.1
9	Exercise on Maximum Power Transfer Theorem	CO 3	T1:5.3 R1:1.17.3
10	Exercises on Thevenin's Theorem	CO 4	T1:5.3 R1:2.6.1
11	Exercises on Norton's Theorem	CO 4	T1:5.7 R1:2.6.2
12	Exercises on Determination of Circuit Impedance	CO 5	T1:1.3-1.8 R1:2.10
13	Exercise on Series and Parallel Resonance	CO 5	T1:8.12-8.14
14	Exercise on Z and Y Parameters	CO 6	T1:8.12-8.14
15	Exercise on H and ABCD Parameters	CO 6	T1:8.12-8.14

20 Experiments for Enhanced Learning (EEL):

S.No	Design Oriented Experiments
1	Design series and parallel networks using resistors, inductors and capacitors
2	Using MATLAB Verify phase relations of RLC circuits

21. Program Outcomes & Program Specific Outcomes:

Program Outcomes	
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	Design/Development of Solutions: Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Life-Long Learning: Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
Program Specific Outcomes	
PSO 1	Design, Develop, Fabricate and Commission the Electrical Systems involved in Power generation, Transmission, Distribution and Utilization

Program Outcomes	
PSO 2	Focus on the Components of Electrical Drives with its Converter Topologies for Energy Conversion, Management and Auditing in Specific applications of Industry and Sustainable Rural Development
PSO 3	Gain the Hands-On Competency Skills in PLC Automation, Process Controllers,HMI and other Computing Tools necessary for entry level position to meet the Requirements of the Employer.

22. How program outcomes are assessed:

Program Outcomes		Strength	Proficiency Assessed by
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	CIE/Quiz/AAT
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	CIE/Quiz/AAT
PO 5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	2	CIE/Quiz/AAT
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations,and give and receive clear instructions.	2	CIE/Quiz/AAT

23. How program specific outcomes are assessed:

Program Specific Outcomes		Strength	Proficiency Assessed by
PSO 3	Gain the Hands-On Competency Skills in PLC Automation, Process Controllers,HMI and other Computing Tools necessary for entry level position to meet the Requirements of the Employer.	1	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

24. Mapping of each CO with PO(s),PSO(s):

COURSE OUTCOME	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	✓	-	-	✓	-	-	-	-	✓	-	-	-	-	✓
CO 2	✓	✓	-	-	✓	-	-	-	-	✓	-	-	-	-	✓
CO 3	✓	✓	-	-	✓	-	-	-	-	✓	-	-	-	-	✓
CO 4	✓	✓	-	-	✓	-	-	-	-	✓	-	-	-	-	✓
CO 5	✓	✓	-	-	✓	-	-	-	-	✓	-	-	-	-	✓
CO 6	✓	✓	-	-	✓	-	-	-	-	✓	-	-	-	-	✓

25. Justifications for CO – PO / PSO mapping - direct:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Apply the basics of mathematics, engineering sciences and other sciences to understand the concept of DC and AC Circuits.	3
	PO 2	Validate the principles of different laws associated with electrical circuits from obtained principles using basics fundamentals of mathematics and engineering sciences.	3
	PO 5	Validate the principles of different laws associated with electrical circuits using digital simulation	1
	PO 10	Improve the documentation skills for their problem-solving approaches, calculations, and findings, resulting in well-structured and informative reports	1
	PSO 3	Verify the various electrical circuit laws using computing tools like Simulink	1
CO 2	PO 1	Recall the basics of mathematics, engineering sciences and other sciences to understand the concept of Kirch- hom's laws	3
	PO 2	Analyze mesh analysis and nodal analysis technique using principles of mathematics, science and engineering fundamentals	5
	PO 5	Analyze mesh analysis and nodal analysis technique using digital simulation	1
	PO 10	Improve the documentation skills for their problem-solving approaches, calculations, and findings, resulting in well-structured and informative reports	1

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
	PSO 3	Verify mesh and nodal analysis using computing tools like Simulink	1
CO 3	PO 1	Apply the basics of mathematics, engineering sciences and other sciences to understand the network theorems	3
	PO 2	Describes the different Theorems with AC and DC excitation from obtained principles using basics fundamentals of mathematics and engineering sciences.	5
	PO 5	Construct various electrical circuits to validate Theorems with DC excitation using digital simulation	1
	PO 10	Improve the documentation skills for their problem-solving approaches, calculations, and findings, resulting in well-structured and informative reports	1
	PSO 3	Verify the superposition principle, reciprocity and maximum power transfer condition for the electrical network with DC excitation using computing tools like Simulink	1
CO 4	PO 1	Apply the knowledge of mathematics, science, engineering fundamentals to the solution of magnetic circuits	3
	PO 2	Describes the fundamental characteristics of electromagnetic induction, self and mutual inductance in the single coil and coupled coils magnetic circuits using basics fundamentals of mathematics and engineering sciences.	5
	PO 5	Construct various electrical circuits to validate Thevenin's and Norton's theorems using digital simulation	1
	PO 10	Improve the documentation skills for their problem-solving approaches, calculations, and findings, resulting in well-structured and informative reports	1
	PSO 3	Verify Thevenin's and Norton's theorems for the electrical network with DC excitation using computing tools like Simulink	1
CO 5	PO 1	Recall the basics of mathematics, engineering sciences and other sciences to understand the concept of two port network and graph theory.	3
	PO 2	Validate the principles of different parameters and network topology from obtained principles using basics fundamentals of mathematics and engineering sciences.	5
	PO 5	Validate the principles of different parameters and network topology using digital simulation.	1

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
	PO 10	Improve the documentation skills for their problem-solving approaches, calculations, and findings, resulting in well-structured and informative reports	1
	PSO 3	Study the frequency response characteristics of series resonance circuit and plot the waveforms using computing tools like Simulink	1
CO 6	PO 1	Identify complex engineering problems on two port network and graph theory using first principles of mathematics, natural sciences, and engineering sciences.	3
	PO 2	Recall the basics of mathematics, engineering sciences and other sciences to understand the concept of duality.	5
	PO 5	Determine the H and ABCD parameters for Circuit using digital simulation.	1
	PO 10	Improve the documentation skills for their problem-solving approaches, calculations, and findings, resulting in well-structured and informative reports	1
	PSO 3	Evaluate the two port network parameters in various electrical circuits using computing tools like Simulink	1

26. Total count of key competencies for CO – (PO, PSO) MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	5	-	-	1	-	-	-	-	3	-	-	-	-	2
CO 2	3	5	-	-	1	-	-	-	-	3	-	-	-	-	2
CO 3	3	5	-	-	1	-	-	-	-	3	-	-	-	-	2
CO 4	3	5	-	-	1	-	-	-	-	3	-	-	-	-	2
CO 5	3	5	-	-	1	-	-	-	-	3	-	-	-	-	2
CO 6	3	5	-	-	1	-	-	-	-	3	-	-	-	-	2

27. Percentage of key competencies for CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	100	50	-	-	100	-	-	-	-	60	-	-	-	-	28.5
CO 2	100	50	-	-	100	-	-	-	-	60	-	-	-	-	28.5
CO 3	100	50	-	-	100	-	-	-	-	60	-	-	-	-	28.5
CO 4	100	50	-	-	100	-	-	-	-	60	-	-	-	-	28.5

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 5	100	50	-	-	100	-	-	-	-	60	-	-	-	-	28.5
CO 6	100	50	-	-	100	-	-	-	-	60	-	-	-	-	28.5

28. Course articulation matrix (PO – PSO mapping):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

2 - $40\% < C < 60\%$ – Moderate

1-5 $< C \leq 40\%$ – Low/ Slight

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	-	-	3	-	-	-	-	3	-	-	-	-	1
CO 2	3	2	-	-	3	-	-	-	-	3	-	-	-	-	1
CO 3	3	2	-	-	3	-	-	-	-	3	-	-	-	-	1
CO 4	3	2	-	-	3	-	-	-	-	3	-	-	-	-	1
CO 5	3	2	-	-	3	-	-	-	-	3	-	-	-	-	1
CO 6	3	2	-	-	3	-	-	-	-	3	-	-	-	-	1
TOTAL	18	12	-	-	18		-	-	-	-	-	-	-	-	-
AVERAGE	3	2	-	-	3		2	-	-	-	-	-	-	-	-

29. Assessment methodology direct:









CIE Exams	✓	SEE Exams	✓	Laboratory Practices	✓
Certification	-	Student Viva	✓	Open Ended Experiments	-








30. Assessment methodology indirect:

x	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback
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31. Relevance to Sustainability goals

Write brief description about the course and how its relevance to SDGs.

1	 <p>NO POVERTY</p>	
2	 <p>ZERO HUNGER</p>	
3	 <p>GOOD HEALTH AND WELL-BEING</p>	
4	 <p>QUALITY EDUCATION</p>	<p>Quality Education: This subject will improve the quality education in engineers and gives the awareness in electrical usage in day-to-day life.</p>
5	 <p>GENDER EQUALITY</p>	
6	 <p>CLEAN WATER AND SANITATION</p>	
7	 <p>AFFORDABLE AND CLEAN ENERGY</p>	<p>Affordable and Clean Energy: Understanding electrical circuits is crucial for developing sustainable energy solutions. Students who learn to design and optimize circuits can contribute to the development of efficient and clean energy systems, such as renewable energy sources and smart grids.</p>
8	 <p>DECENT WORK AND ECONOMIC GROWTH</p>	

9		<p>Industry, Innovation, and Infrastructure: : Engineering drawing principles is crucial for developing and maintaining sustainable infrastructure and technological innovations. It contribute to designing safer, more durable, and environmentally friendly infrastructure projects. Electrical circuits are the foundation of modern technology and infrastructure. The skills gained in this course are essential for creating and maintaining advanced infrastructure, including telecommunications, transportation, and manufacturing systems.</p>
10		
11		
12		<p>Responsible Consumption and Production This subject impacts the demand of electricity and need for saving energy</p>
13		
14		
15		

16		
17		

Approved by: Board of Studies in the meeting conducted on _____.

Signature of Course Coordinator

HOD,EEE



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE TEMPLATE

1	Department	ELECTRICAL AND ELECTRONICS ENGINEERING			
2	Course Title	OBJECT ORIENTED PROGRAMMING WITH JAVA			
3	Course Code	ACSD02			
4	Program	B.Tech			
5	Semester	I Semester			
6	Regulation	BT-23			
7	Structure of the course	Practical			
		Tutorial Hours 1		Practical Hours 2	
8	Course Offered	Odd Semester <input checked="" type="checkbox"/>	Even Semester <input type="checkbox"/>		
9	Course Coordinator	Mr. D. Atchuta Ramacharyulu			
10	Date Approved by BOS	25/08/2023			
11	Course Webpage	www.iare.ac.in/--/--			
12	Course Prerequisites	Level	Course Code	Semester	Prerequisites
		-	-	-	-
		-	-	-	-

13. COURSE OVERVIEW

This course provides a solid foundation in object-oriented programming concepts and hands-on experience in using them. It introduces the concepts of abstraction and reusable code design via the object-oriented paradigm. Through a series of examples and exercises students gain coding skills and develop an understanding of professional programming practices. Mastering Java facilitate the learning of other technologies.

14. COURSE OBJECTIVES

The students will try to learn:

I	The strong foundation with the Java Virtual Machine, its concepts and features.
II	The systematic understanding of key aspects of the Java Class Library
III	The usage of a modern IDE with an object oriented programming language to develop programs.

15. COURSE OUTCOMES








After successful completion of the course, students should be able to:

CO 1	Develop non-trivial programs in an modern programming language.
CO 2	Apply the principles of selection and iteration.
CO 3	Appreciate uses of modular programming concepts for handling complex problems.
CO 4	Recognise and apply principle features of object-oriented design such as abstraction and encapsulation.
CO 5	Design classes with a view of flexibility and reusability.
CO 6	Code, test and evaluate small usecases to conform to a specification.

16. EMPLOYABILITY SKILLS

1. Problem-Solving and Critical Thinking: Students learn to analyze complex problems, design solutions using Java's object-oriented principles, and translate real-world scenarios into code.
2. Debugging and Troubleshooting: Debugging challenges in the lab help students master error identification, interpretation, and use of debugging tools, essential for real-world software development.

17. CONTENT DELIVERY / INSTRUCTIONAL METHODOLOGIES

✓	 Day to Day lab evaluation	✓	 Demo Video	✓	 Expected Viva Voce questions	✓	 Open Ended Experiments
X	 Competitions	X	 hackathons	✓	 Certifications	✓	Probing Further Questions

18. EVALUATION METHODOLOGY

Each laboratory will be evaluated for a total of 100 marks consisting of 40 marks for internal assessment and 60 marks for semester end lab examination. Out of 40 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance including viva voce, 10 marks for the final internal lab assessment and remaining 10 marks for The remaining 10 marks are for Laboratory Report/Project and Presentation, which consists of the Design (or) Software / Hardware Model Presentation (or) App Development (or) Prototype Presentation submission which shall be evaluated after completion of laboratory course and before semester end practical examination.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 40 marks (Table 1), with 20 marks for continuous lab assessment during day-to-day performance including viva voce, 10 marks for final internal lab assessment and remaining 10 marks for Laboratory Report / Project and Presentation.

Table 3: CIA marks distribution

Component				
Type of Assessment	Day to Day performance and viva voce examination	Final internal lab assessment	Laboratory Report / Project and Presentation	Total Marks
CIA marks	20	10	10	40

Continuous Internal Examination (CIE): One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

Table 4: Experiment based

Objective	Analysis	Design	Conclusion	Viva voce	Total
					20

Table 5: Programming based

Objective	Analysis	Program	Results	Viva voce	Total
4	4	6	4	2	20

Semester End Examination:

The Semester End Examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed from the other colleges which will be decided by the Head of the institution.

In the Semester End Examination held for 3 hours, total 60 marks are divided and allocated as shown below:

1. 10 marks for write-up
2. 15 for experiment/program
3. 15 for evaluation of results
4. 10 marks for presentation on another experiment/program in the same laboratory course and
5. 10 marks for viva-voce on concerned laboratory course.

19. COURSE CONTENT

CO 1	Develop non-trivial programs in an modern programming language.
	<ol style="list-style-type: none">1. Getting Started Exercises2. Exercises on Number Systems (for Science/Engineering Students)
CO 2	Apply the principles of selection and iteration.
	<ol style="list-style-type: none">1. Exercises on Decision and Loop2. Exercises on Input, Decision and Loop3. Exercises on Nested-Loops (Patterns)4. Magic(Special) Numbers5. Exercises on String and char Operations6. Exercises on Arrays
CO 3	Appreciate uses of modular programming concepts for handling complex problems.
	<ol style="list-style-type: none">1. Exercises on Methods2. Exercises on Command-line Arguments and Recursion3. More (Difficult) Exercises
CO 4	Recognise and apply principle features of object-oriented design such as abstraction and encapsulation.
	<ol style="list-style-type: none">1. Exercises on Classes and Objects
CO 5	Design classes with a view of flexibility and reusability.
	<ol style="list-style-type: none">1. Exercises on Inheritance
CO 6	Code, test and evaluate small usecases to conform to a specification.
	<ol style="list-style-type: none">1. Exercises on Polymorphism, Abstract Classes and Interfaces

Note: One Course Outcome may be mapped to multiple number of experiments.

Text Books

1. Farrell, Joyce. “*Java Programming*”, Cengage Learning B S Publishers, 8th Edition, 2020
2. Schildt, Herbert. ” *Java: The Complete Reference*” 11th Edition, McGraw-Hill Education, 2018.

Reference Books

1. Deitel, Paul and Deitel, Harvey. "Java: How to Program", Pearson, 11th Edition, 2018.
2. Evans, Benjamin J. and Flanagan, David. "Java in a Nutshell", O'Reilly Media, 7th Edition, 2018.
3. Bloch, Joshua. "Effective Java", Addison-Wesley Professional, 3rd Edition, 2017.
4. Sierra, Kathy and Bates, Bert. "Head First Java", O'Reilly Media, 2nd Edition, 2005.

Materials Online

1. <https://docs.oracle.com/en/java/>
2. <https://www.geeksforgeeks.org/java>
3. <https://www.tutorialspoint.com/java/index.htm>
4. <https://www.coursera.org/courses?query=java>

20. COURSE PLAN

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's
1	Getting Started Exercises	CO 1
2	Exercises on Number Systems (for Science/Engineering Students)	CO 1
3	Exercises on Decision and Loop	CO 2
4	Exercises on Input, Decision and Loop	CO 2
5	Exercises on Nested-Loops (Patterns)	CO 2
6	Magic(Special) Numbers	CO 2
7	Exercises on String and char Operations	CO 2
8	Exercises on Arrays	CO 2
9	Exercises on Methods	CO 3
10	Exercises on Command-line Arguments, Recursion	CO 3
11	More (Difficult) Exercises	CO 3
12	Exercises on Classes	CO 4
13	Exercises on Inheritance	CO 5
14	Exercises on Polymorphism, Abstract Classes and Interfaces	CO 6

Experiments for enhanced learning (EEL):

S.No	Design Oriented Experiments
1.	Given an array of integers nums and an integer target, return indices of the two numbers such that they add up to target.
2.	Given a sorted array of distinct integers and a target value, return the index if the target is found. If not, return the index where it would be if it were inserted in order.
3.	Given a roman numeral, convert it to an integer.

4.	Implement the myAtoi(string s) function, which converts a string to a 32-bit signed integer
5.	Given a string s, find the length of the longest substring without repeating characters.

21. PROGRAM OUTCOMES & PROGRAM SPECIFIC OUTCOMES

Program Outcomes	
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	Design/Development of Solutions: Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Life-Long Learning: Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

Program Specific Outcomes	
PSO 1	Design, Develop, Fabricate and Commission the Electrical Systems involved in Power generation, Transmission, Distribution and Utilization.
PSO 2	Focus on the Components of Electrical Drives with its Converter Topologies for Energy Conversion, Management and Auditing in Specific applications of Industry and Sustainable Rural Development.
PSO 3	Gain the Hands-On Competency Skills in PLC Automation, Process Controllers, HMI and other Computing Tools necessary for entry level position to meet the Requirements of the Employer.

22. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes		Strength	Proficiency Assessed by
PO 1	Engineering knowledge: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1	LAB PRO-GRAMS/CIE/SEE
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	3	LAB PRO-GRAMS/CIE/SEE
PO 3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	3	LAB PRO-GRAMS/CIE/SEE
PO 5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	3	LAB PRO-GRAMS/CIE/SEE
PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	2	LAB PRO-GRAMS/CIE/SEE
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	3	LAB PRO-GRAMS/CIE/SEE

23. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Strength	Proficiency Assessed by
PSO 3	Gain the Hands-On Competency Skills in PLC Automation, Process Controllers, HMI and other Computing Tools necessary for entry level position to meet the Requirements of the Employer.	2	LAB PRO-GRAMS/CIE/SEE

3 = High; 2 = Medium; 1 = Low

24. MAPPING OF EACH CO WITH PO(s),PSO(s):

COURSE OUTCOME	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	-	-	✓	-	-	-	-	-	-	-	-	-	✓
CO 2	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	✓
CO 4	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	✓	-	-	-	✓	-	-	-	-	-	-	-	-	-
CO 6	-	✓	-	-	-	✓	-	✓	-	-	-	-	-	-	-

25. JUSTIFICATIONS FOR CO – PO / PSO MAPPING - DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1
	PO 5	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	1
	PSO 3	Make use of programming skills to pursue Higher Studies and develop employability skills.	1

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 2	PO 1	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1
	PO 2	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	7
CO 3	PO 1	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2
	PO 2	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	7
	PSO 3	Make use of programming skills to pursue Higher Studies and develop employabilty skills	4
CO 4	PO 2	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	7
	PO 3	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	6
CO 5	PO 2	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	7
	PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	1

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 6	PO 2	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	7
	PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	3
	PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	4

26. TOTAL COUNT OF KEY COMPETENCIES FOR CO – (PO, PSO) MAPPING:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	-	-	1	-	-	-	-	-	-	-	-	-	1
CO 2	1	7	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	1	7	-	-	-	-	-	-	-	-	-	-	-	-	1
CO 4	-	7	6	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	7	-	-	-	1	-	-	-	-	-	-	-	-	-
CO 6	-	7	-	-	-	3	-	2	-	-	-	-	-	-	-

27. PERCENTAGE OF KEY COMPETENCIES FOR CO – (PO, PSO):

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	33.3	-	-	-	100	-	-	-	-	-	-	-	-	-	33.33
CO 2	33.3	70	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	33.3	70	-	-	-	-	-	-	-	-	-	-	-	-	33.33
CO 4	-	70	60	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	70	-	-	-	20	-	-	-	-	-	-	-	-	-
CO 6	-	70	-	-	-	60	-	66.6	-	-	-	-	-	-	-

28. COURSE ARTICULATION MATRIX (PO – PSO MAPPING):

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

2 - $40\% < C < 60\%$ – Moderate

1-5 $< C \leq 40\%$ – Low/ Slight

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	-	-	3	-	-	-	-	-	-	-	-	-	1
CO 2	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	1	3	-	-	-	-	-	-	-	-	-	-	-	-	1
CO 4	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	3	-	-	-	1	-	-	-	-	-	-	-	-	-
CO 6	-	3	-	-	-	3	-	3	-	-	-	-	-	-	-
TOTAL	3	15	3	-	3	4	-	3	-	-	-	-	-	-	2
AVERAGE	1	3	3	-	3	2	-	3	-	-	-	-	-	-	1

29. ASSESSMENT METHODOLOGY DIRECT:




CIE Exams	✓	SEE Exams	✓	Laboratory Practices	✓
Certification	-	Student Viva	✓	Open Ended Experiments	-

30. ASSESSMENT METHODOLOGY INDIRECT:







x	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback
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31. RELEVANCE TO SUSTAINABILITY GOALS

Write brief description about the course and how its relevance to SDGs.

X		
X		
X		

✓	 <p>QUALITY EDUCATION</p>	<p>Quality Education: The students can gain a deeper understanding of how technology can be harnessed to address global challenges. This promotes quality education by fostering critical thinking and problem-solving skills in the context of sustainable development.</p>
X	 <p>GENDER EQUALITY</p>	
X	 <p>CLEAN WATER AND SANITATION</p>	
X	 <p>AFFORDABLE AND CLEAN ENERGY</p>	
X	 <p>DECENT WORK AND ECONOMIC GROWTH</p>	
✓	 <p>INDUSTRY, INNOVATION AND INFRASTRUCTURE</p>	<p>Industry, Innovation, and Infrastructure: Java programming skills are essential for developing innovative software solutions. Students working on projects related to sustainable development can contribute to building resilient infrastructure and promoting inclusive and sustainable industrialization.</p>
X	 <p>REDUCED INEQUALITIES</p>	
✓	 <p>SUSTAINABLE CITIES AND COMMUNITIES</p>	<p>Sustainable Cities and Communities: Java programming plays a crucial role in developing applications for smart cities, efficient transportation, and waste management systems. Through projects in the lab, students can explore ways to create more sustainable urban environments.</p>

X		
✓		<p>Climate Action: Students can create climate-related applications, such as carbon footprint calculators or climate data analysis tools, using Java programming. This directly contributes to SDG 13 by raising awareness and facilitating climate action.</p>
X		
X		
X		
✓		<p>Partnerships for the Goals: Collaborative projects can foster partnerships among students, educators, and local communities. These partnerships enhance knowledge sharing and the development of innovative solutions that align with multiple SDGs.</p>

Approved by: Board of Studies in the meeting conducted on _____.

Signature of Course Coordinator
Mr. D. Atchuta Ramacharyulu, Assistant Professor

HOD,EEE



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MANUFACTURING PRACTICE COURSE TEMPLATE

1	Department	ELECTRICAL AND ELECTRONICS ENGINEERING			
2	Course Code	AMED02			
3	Course Title	MANUFACTURING PRACTICE			
4	Semester	I Semester			
5	Regulation	BT-23			
6	Structure of the course	Practical			
		Lecture Hours -		Practical Hours 2	
7	Course Offered	Odd Semester <input checked="" type="checkbox"/>	Even Semester <input checked="" type="checkbox"/>		
8	Course Coordinator	Dr. Ch. Sandeep			
9	Date Approved by BOS	24/08/2023			
10	Course Webpage	https://www.iare.ac.in/?q=pages/btech-course-syllabi-bt23-cseaiml			
11	Course Prerequisites	Level	Course Code	Semester	Prerequisites
		-	-	-	No prerequisites

12. Course Overview:

This course provides the opportunity to become confident with new tools, equipment, and techniques for creating physical objects and mechanisms with a variety of materials. The students will learn the concepts of 3D printing, laser cutting, circuit board soldering, wood carving and CNC machining. Skills learned in the course enable the students about the design process in digital manufacturing used in various industrial applications.

13. Course objectives:

The students will try to learn:

I	The digital and additive manufacturing techniques used in various industrial applications in the current era to develop prototype models.
II	The unconventional machining processes and their selective applications as an alternative to traditional manufacturing methods.
III	The standard electrical wiring practices for domestic and industrial appliances.
IV	The soldering and de-soldering components on a circuit board safely and correctly.

14. Course outcomes:








After successful completion of the course, students should be able to:

CO 1	Practice the various types of manufacturing methods for preparing the given material to desired shape by using traditional and unconventional manufacturing practices.
CO 2	Execute the additive manufacturing technology for learning about the 3D printing processes and techniques.
CO 3	Select computer numerical control laser techniques for preparing the required geometrical profiles
CO 4	Demonstrate with the moulding techniques for producing cast components in complex shapes using different patterns
CO 5	Make use of computer numerical technologies to create products using wood carving techniques.
CO 6	Apply the plumbing skills to work with fittings and pipes made of PVC and galvanized steel.

15. Employability Skills:

1. Employment advantage: This can give competitive advantage when seeking employment to apply knowledge about engineering tools used in manufacturing of products.
2. Programming skills: Understanding basics of CNC programming for application in laying, shaping and cutting process for product development.
3. Project based skills: This can give hands on experience for design, analysis and fabrication of prototype model for real time applications.
4. Safety Awareness: Understanding the different machines, instruments and tools to handle in real-time environment and can apply this awareness to workplaces where safety is a priority.

16. Content delivery / Instructional methodologies:

✓	 Day to Day lab evaluation	✓	 Demo Video	✓	 Viva Voce questions	✓	 Open Ended Experiments
x	 Competitions	x	 hackathons	x	 Certifications	✓	Probing Further Questions

17. Evaluation methodology:

Each laboratory will be evaluated for a total of 100 marks consisting of 40 marks for internal assessment and 60 marks for semester end lab examination. Out of 40 marks of internal assessment, continuous lab assessment will be done for 20 marks for the day to day performance including viva voce, 10 marks for the final internal lab assessment and remaining 10 marks for The remaining 10 marks are for Laboratory Report/Project and Presentation, which consists of the Design (or) Software / Hardware Model Presentation (or) App Development (or) Prototype Presentation submission which shall be evaluated after completion of laboratory course and before semester end practical examination.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 40 marks (Table 1), with 20 marks for continuous lab assessment during day-to-day performance including viva voce, 10 marks for final internal lab assessment and remaining 10 marks for Laboratory Report / Project and Presentation.

Table 3: CIA marks distribution

Component				
Type of Assessment	Day to Day performance and viva voce examination	Final internal lab assessment	Laboratory Report / Project and Presentation	Total Marks
CIA marks	20	10	10	40

Continuous Internal Examination (CIE): One CIE exams shall be conducted at the end of the 16th week of the semester. The CIE exam is conducted for 10 marks of 3 hours duration.

Table 4: Experiment based

Objective	Analysis	Design	Conclusion	Viva voce	Total
4	4	4	4	4	20

Table 5: Programming based

Objective	Analysis	Design	Conclusion	Viva voce	Total
–	–	–	–	–	20

Semester End Examination:

The Semester End Examination shall be conducted with an external examiner and the laboratory teacher. The external examiner shall be appointed from the other colleges which will be decided by the Head of the institution.

In the Semester End Examination held for 3 hours, total 60 marks are divided and allocated as shown below:

1. 10 marks for write-up
2. 15 for experiment/program
3. 15 for evaluation of results
4. 10 marks for presentation on another experiment/program in the same laboratory course and
5. 10 marks for viva-voce on concerned laboratory course.

18. Course content:

CO 1	Practice the various types of manufacturing methods for preparing the given material to desired shape by using traditional and unconventional manufacturing practices.
	<ol style="list-style-type: none">1. Preparation of mild steel (MS) material for step turning with grooving operation. Try 1.1 Preparation of Mild Steel (MS) material for step turning with taper operation.2. Preparation of mild steel (MS) material for thread cutting and knurling operation. Try 2.1 Preparation of aluminium material for step turning with taper operation.3. Preparation of slotting operation. Try 3.1 Perform the boring and reaming operation on a rectangular work piece to obtain the required dimensions using vertical milling machine.4. Preparation of V-groove operation. Try 4.1 Perform the key ways on a cylindrical work piece to obtain the required dimensions using shaping machine.5. Demonstration on industry standard grinding. Try 5.1 Demonstration grinding methods and machines.
CO 2	Execute the additive manufacturing technology for learning about the 3D printing processes and techniques.
	<ol style="list-style-type: none">1. Preparation of stepped pulley with PLA material. Try 1.1 Preparation of spur gear with ABS material.

CO 3	Select computer numerical control laser techniques for preparing the required geometrical profiles on non-metallic materials.
	<p>1. Preparation of acrylic gears using CNC laser engraving / cutting machine. Try 1.1 Preparation of artistic components IARE logo using CNC laser engraving.</p> <p>2. Demonstration of articulated robot for lifting load. Try 2.1 Demonstration the pick and place operation for the articulated robot</p> <p>3. Demonstration of milling and lathe system switchable on one simulator. Try 3.1 Demonstration the combination of CNC Simulator with CNC machining simulation.</p>
CO 4	Demonstrate the assembly and disassembly of electrical equipment's and controls for safe domestic applications.
	<p>1. Preparation of wiring for a stair case arrangement using a two-way switch. Try 1.1 Prepare wiring for a tube light with switch control.</p> <p>2. Preparation of soldering from a circuit board. Try 2.1 Perform desoldering operation from a circuit board.</p> <p>3. Perform the maintenance of ceiling fan and ending the trouble shoot. problems. Try 3.1 Perform the maintenance for mixer grinder from a circuit board.</p>
CO 5	Make use of computer numerical technologies to create products using wood carving techniques.
	<p>1. Preparation of wooden wheel using computerized wood carving machine. Try 1.1 Preparation of IARE lettering using CNC wood carving.</p>

CO 6	Apply the plumbing skills to work with fittings and pipes made of PVC and galvanized steel.
	1. Preparation of PVC material for pipe threading and fitting. Try 1.1 Preparation of galvanized steel I joint.

TEXTBOOKS

- Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., “Elements of Workshop Technology”, Media promoters and publishers private limited, Mumbai, 2020.
- Kalpakjian S, Steven S. Schmid, “Manufacturing Engineering and Technology”, Pearson Education India Edition, 7 th Edition, 2019.

REFERENCE BOOKS:

- Rupinder Singh, J. Paulo Davim, “Additive Manufacturing: Applications and Innovations”, CRC Press, 2 nd Edition, August, 2021.
- Jeyaprakash Natarajan , Muralimohan Cheepu , Che-Hua Yang , “Advances in Additive Manufacturing Processes”, Bentham Books, 4 th Edition, September, 2021.

MATERIALS ONLINE:

- Lab manual
- Question bank

19. Course plan:

The course plan is meant as a guideline. Probably there may be changes.

S.No	Topics to be covered	CO's
1	Preparation of stepped pulley with PLA material using the principles of 3D printing and additive manufacturing techniques.	CO 1
2	Preparation of acrylic gears using CNC laser engraving / cutting machine.	CO 1
3	Preparation of wooden wheel using computerized wood carving machine.	CO 1
4	Preparation of PVC material for pipe threading and fitting using die sets.	CO 2
5	Preparation of mild steel (MS) material for step turning with grooving operation using computer numerical control (CNC) lathe machines.	CO 2

S.No	Topics to be covered	CO's
6	Preparation of mild steel (MS) material for thread cutting and knurling operation using conventional lathe machines.	CO 3
7	Preparation of slotting operation using milling machine.	CO 4
8	Preparation of V-groove operation using shaping machine.	CO 4
9	Preparation of wiring for a stair case arrangement using a two-way switch.	CO 5
10	Preparation of soldering and desoldering from a circuit board.	CO 6
11	Perform the maintenance of ceiling fan and ending the trouble shoot problems.	CO 6
12	Demonstration of articulated robot for lifting load.	CO 6
13	Demonstration of milling and lathe system switchable on one FANUC simulator.	CO 6
14	Demonstration on industry standard grinding.	CO 6

20. Experiments for enhanced learning (EEL):

S.No	Product Oriented Experiments
1	Divided Tenon Joint: It is the simplest form of Mortise and tenon joint and this joint is made by fitting a short tenon into a continuous groove. This joint has the advantage of being easy to cut and is often used to make cabinet doors and other light duty frame and panel assemblies.
2	Cross Fitting: It is the fundamental of type of fitting which are used fitting trade and it is formed by joining the two inclined shaped cut specimens together and is often used to join the universal bearings.
3	hard soldering: Metals and alloys of dissimilar compositions can be hard-soldered (brazed or silver-soldered) together, for example: copper to brass; copper to steel; brass to steel; cast iron to mild steel; and mild steel to stainless steel.
4	T-Pipe Joint: T-pipe is a type of fitting which is T-shaped having two outlets at 90 degrees to the main line. It is short piece of pipe with a lateral outlet. It is widely used as pipe fittings.
5	Concrete cube: Plastic or Steel Concrete Cube Moulds are used to form specimens for concrete compressive strength testing. They can also be used as sample containers in the determination of mortar set times as indicated in ASTM C403 and AASHTO T 197.

21. Program Outcomes and Program Specific Outcomes:

Program Outcomes	
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Program Outcomes	
PO 3	Design/Development of Solutions: Design solutions for complex Engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and Environmental considerations
PO 4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern Engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations
PO 6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	Life-Long Learning: Recognize the need for and having the preparation and ability to engage in independent and life-long learning in the broadest context of technological change
Program Specific Outcomes	
PSO 1	Design, Develop, Fabricate and Commission the Electrical Systems involved in Power generation, Transmission, Distribution and Utilization.
PSO 2	Focus on the Components of Electrical Drives with its Converter Topologies for Energy Conversion, Management and Auditing in Specific applications of Industry and Sustainable Rural Development.
PSO 3	Gain the Hands-On Competency Skills in PLC Automation, Process Controllers, HMI and other Computing Tools necessary for entry level position to meet the Requirements of the Employer..

22. How program outcomes are assessed:

Program Outcomes		Strength	Proficiency Assessed by
PO 1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1	Lab Exercises
PO 3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	1	CIA
PO 5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	3	Lab Exercises
PO 11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	1	SEE

23. How program specific outcomes are assessed:

Program Specific Outcomes		Strength	Proficiency Assessed by
PSO 1	Design, Develop, Fabricate and Commission the Electrical Systems involved in Power generation, Transmission, Distribution and Utilization.	3	Lab Exercises

3 = High; 2 = Medium; 1 = Low

24. Mapping of each CO with PO(s), PSO(s):

COURSE OUTCOME	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	✓	-	✓	-	✓	-	-	-	-	-	✓	-	-	-	-
CO 2	✓	-	✓	-	-	-	-	-	-	-	✓	-	-	-	-
CO 3	✓	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
CO 4	✓	-	✓	-	-	-	-	-	-	-	✓	-	✓	-	-
CO 5	-	-	-	-	✓	-	-	-	-	-	✓	-	-	-	-
CO 6	✓	-	-	-	✓	-	-	-	-	-	✓	-	-	-	-

25. Justifications for CO – PO/ PSO mapping -DIRECT:

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 1	PO 1	Apply the knowledge of engineering fundamentals to join given wooden pieces according to given sketch to develop required joint.	1
	PO 3	Conversion of given design into a practical output using design solution for complex engineering problems and design system components.	2
	PO 5	Develop the given resources and engineering tools into proper fitment as given in the diagrammatical representation.	1
	PO 11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	2
CO 2	PO 1	Apply the knowledge of engineering fundamentals to join given metal pieces according to given sketch to develop required joint.	1
	PO 5	Develop the given resources and engineering tools into proper fitment as given in the diagrammatical representation.	1
	PO 11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	2
CO 3	PO 1	Apply the knowledge of engineering fundamentals to make metal rod into given required shape according to given sketch to develop required joint.	1
	PO 5	Develop the given resources and engineering tools into required shape as given in the diagrammatical representation.	1
CO 4	PO 1	Apply the knowledge of engineering fundamentals to make the casting product from given materials according to given sketch to develop required shape.	1
	PO 3	Conversion of given design into a practical output using design solution for complex engineering problems and design system components	2
	PO 11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	2

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
	PSO 1	Design, Develop, Fabricate and Commission the Electrical Systems involved in Power generation, Transmission, Distribution and Utilization.	3
CO 5	PO 5	Develop the given resources and engineering tools into required shape as given in the diagrammatical representation	1
	PO 11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	1
CO 6	PO 1	Apply the knowledge of engineering fundamentals to make the required electrical connection according to given circuit diagram to develop connection.	1
	PO 5	Develop the given resources and engineering tools into proper fitment as given in the diagrammatical representation.	1
	PO 11	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	2

26. Total count of key competencies for CO – PO/ PSO mapping

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	2	-	1	-	-	-	-	-	2	-	-	-	-
CO 2	1	-	-	-	1	-	-	-	-	-	2	-	-	-	-
CO 3	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-
CO 4	1	-	2	-	-	-	-	-	-	-	2	-	-	-	3
CO 5	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-
CO 6	1	-	-	-	1	-	-	-	-	-	2	-	-	-	-

27. Percentage of key competencies CO – PO/ PSO:

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	33.3	-	20	-	100	-	-	-	-	-	16.6	-	-	-	-
CO 2	33.3	-	-	-	-	-	-	-	-	-	16.6	-	-	-	-
CO 3	33.3	-	-	-	100	-	-	-	-	-	-	-	-	-	-
CO 4	33.3	-	20	-	-	-	-	-	-	-	16.6	-	-	-	100
CO 5	-	-	-	-	100	-	-	-	-	-	16.6	-	-	-	-
CO 6	33.3	-	-	-	100	-	-	-	-	-	16.6	-	-	-	-

28. Course articulation matrix PO / PSO mapping:

CO'S and PO'S and CO'S and PSO'S on the scale of 0 to 3, 0 being no correlation, 1 being the low correlation, 2 being medium correlation and 3 being high correlation.

0 - $0 \leq C \leq 5\%$ – No correlation

2 - $40\% < C < 60\%$ – Moderate

1-5 $< C \leq 40\%$ – Low/ Slight

3 - $60\% \leq C < 100\%$ – Substantial /High

COURSE OUTCOMES	PROGRAM OUTCOMES												PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	-	1	-	3	-	-	-	-	-	1	-	-	-	-
CO 2	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CO 3	1	-	-	-	3	-	-	-	-	-	-	-	-	-	-
CO 4	1	-	1	-	-	-	3	-	-	-	-	-	-	-	3
CO 5	-	-	-	-	3	-	-	-	-	-	1	-	-	-	-
CO 6	1	-	-	-	3	-	3	-	-	-	1	-	-	-	-
Total	5	-	2	-	12	-	-	-	-	-	4	-	-	-	3
Average	3	-	1	-	3	-	-	-	-	-	1	-	-	-	3

29. Assessment methodology -Direct:





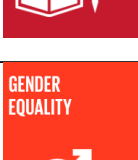



CIE Exams	✓	SEE Exams	✓	Laboratory Practices	✓
Certification	-	Student Viva	✓	Open Ended Experiments	✓








30. Assessment methodology -Indirect:

x	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback
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31. Relevance to Sustainability goals (SDGs):

Write brief description about the course and how its relevance to SDGs.

1		
2		
3		
4		<p>Quality Education: Manufacturing Practice course provides students with a strong foundation in CNC programming for application in laying, shaping and cutting process for product development, enhancing their learning experience and empowering them to address real- world challenges.</p>
5		
6		
7		
8		

9	<p>INDUSTRY, INNOVATION AND INFRASTRUCTURE</p> 	
10	<p>REDUCED INEQUALITIES</p> 	
11	<p>SUSTAINABLE CITIES AND COMMUNITIES</p> 	
12	<p>RESPONSIBLE CONSUMPTION AND PRODUCTION</p> 	<p>Responsible Consumption and Production: By focusing on efficient material use, waste reduction, and product durability, manufacturing practice can aid in designing products and systems that align with responsible consumption and production practices.</p>
13	<p>CLIMATE ACTION</p> 	
14	<p>LIFE BELOW WATER</p> 	
15	<p>LIFE ON LAND</p> 	

16	PEACE, JUSTICE AND STRONG INSTITUTIONS 		
17	PARTNERSHIPS FOR THE GOALS 		

Approved by: Board of Studies in the meeting conducted on 24.08.2023.

Signature of Course Coordinator
Mr.V.Suryaprakash Reddy, Assistant Professor

HOD, IT