INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE TEMPLATE

1	Department	**CSE (AIML)**				
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	Tutorials	Credits	Lab	Credits
		3	0	3	-	-
8	Type of course (**Tick type of course**)		Professional Elective -	Open Elective -	VAC -	MOOCs -
9	Course Offered	Odd Semester ✓		Even Semester ×		
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 Jetty Wilson				
12	Date Approved by BOS	24/08/2023				
13	Course Webpage	https://www.iare.ac.in/sites/default/files/BT23/AHSD01.pdf				
14	Course Prerequistes	**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	**Comunicate** 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 Out-come	Blooms Level
1	Introduction to communication skils	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 Out-come	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 skillas 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 Out-come	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 particularly 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 Out-come	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 Pressentation	✓	 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 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. 1. Anjana Tiwari, "*Communication Skills in English,* ", Khanna Publishing House: New Delhi, 2022.

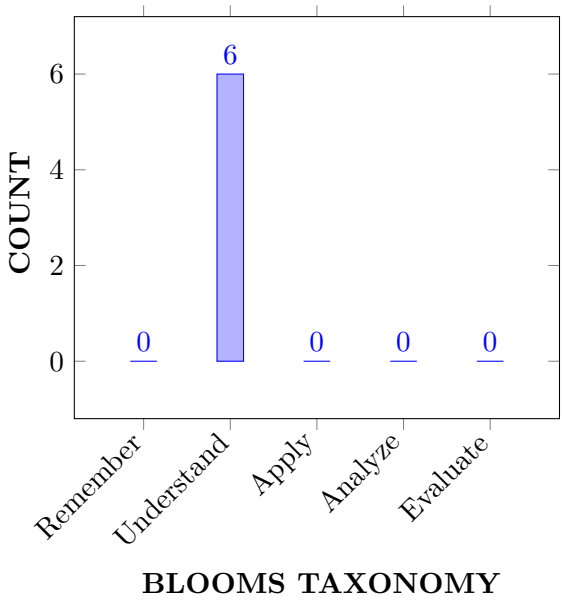
REFERENCE BOOKS:

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	Build skills to develop software applications in specialized areas of Computer Science and Engineering such as Artificial Intelligence, Machine Learning, Data Science, Web Development, Gaming, Augmented Reality / Virtual Reality (AR/VR).
PSO 2	Focus on exploring supervised, unsupervised and reinforcement learning and apply them to a range of AI problems.
PSO 3	Make use of AI and ML techniques for industrial applications in the areas of Autonomous Systems, IOT, Cloud Computing, Robotics, Natural Language Processing and emerging areas.

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	Build skills to develop software applications in specialized areas of Computer Science and Engineering such as Artificial Intelligence, Machine Learning, Data Science, Web Development, Gaming, Augmented Reality / Virtual Reality (AR/VR).	-	
PSO 2	Focus on exploring supervised, unsupervised and reinforcement learning and apply them to a range of AI problems.	-	

PSO 3	Make use of AI and ML techniques for industrial applications in the areas of Autonomous Systems, IOT, Cloud Computing, Robotics, Natural Language Processing and emerging areas.	-	

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
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≤ C≤ 5% – No correlation

2 - 40 % <C < 60% –Moderate

1-5 <C≤ 40% – Low/ Slight

3 - 60% ≤ 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	-	-	-	-	-

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
AVERAGE	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-

33. ASSESSMENT METHODOLOGY DIRECT:

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

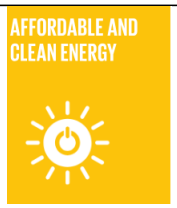
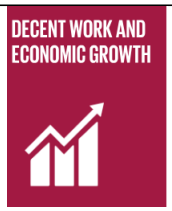
34. ASSESSMENT METHODOLOGY INDIRECT:

x	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback

35. Relevance to Sustainability goals

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

1		
2		
3		
4		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.

5	 GENDER EQUALITY	
6	 CLEAN WATER AND SANITATION	
7	 AFFORDABLE AND CLEAN ENERGY	
8	 DECENT WORK AND ECONOMIC GROWTH	
9	 INDUSTRY, INNOVATION AND INFRASTRUCTURE	
10	 REDUCED INEQUALITIES	
11	 SUSTAINABLE CITIES AND COMMUNITIES	

12		
13		
14		
15		
16		
17		

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

Signature of Course Coordinator **HOD**
Dr Jetty Wilson, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MATRICES AND CALCULUS

COURSE TEMPLATE

1	Department	**CSE (AIML)**				
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	Tutorials	Credits	Lab	Credits
		3	1	4	-	-
8	Type of course (**Tick type of course**)	Core ✓	Professional Elective -	Open Elective -	VAC -	MOOCs -
9	Course Offered	Odd Semester ✓		Even Semester ×		
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 Prerequistes -	**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 Out-come	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 Out-come	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 intervall	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 Out-come	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 Methologies:

✓	Power Point Pressentation	✓	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.

ReferenceE 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/resourcs/#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 Coefficeients for Fourier Expansion of Periodic Function in a Given Interval of Length (-π, π),(0,2π)	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,π)	CO 5	T1-10.7 R3:10.7
32	Half- Range Fourier Cosine Expansions in a Given Interval of Length (0,π)	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 (-l,l), Fourier Sine, Cosine Series in Interval (0,l)	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	Build suitable statistical models, tools and techniques to analyse large data sets for visualization and interpretation.
PSO 2	Focus on improving software reliability, network security or information retrieval systems.
PSO 3	Make use of computing theory, mathematics, statistical methods and the principles of optimization techniques in data analytics for providing solutions.

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	Build skills to develop software applications in specialized areas of Computer Science and Engineering such as Artificial Intelligence, Machine Learning, Data Science, Web Development, Gaming, Augmented Reality / Virtual Reality (AR/VR).	-	-
PSO 2	Focus on exploring supervised, unsupervised and reinforcement learning and apply them to a range of AI problems.	-	-

PSO 3	Make use of AI and ML techniques for industrial applications in the areas of Autonomous Systems, IOT, Cloud Computing, Robotics, Natural Language Processing and emerging areas.	-	-

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
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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
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	-	-	-	-	-	-	-	-	-	-	-	-	-
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≤ C≤ 5% – No correlation

2 - 40 % <C < 60% –Moderate

1-5 <C≤ 40% – Low/ Slight

3 - 60% ≤ 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	✓

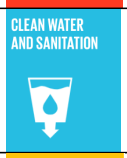
33. ASSESSMENT METHODOLOGY INDIRECT:

x	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback

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.
×		-
×		-
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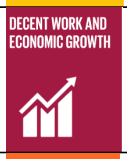
×		-
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Approved by: Board of Studies in the meeting conducted on ——————————.

Signature of Course Coordinator **HOD**
Mr. P.Shantan Kumar, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE TEMPLATE

1	Department	CSE (AIML)				
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	Tutorials	Credits	Lab	Credits
		3	0	3	-	-
7	Type of course (**Tick type of course**)	Core	Professional Elective	Open Elective	VAC	MOOCs
		✓	-	-	-	-
8	Course Offered	Odd Semester ✓		Even Semester ×		
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	Dr. J Sirisha Devi				
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 Prerequistes	**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 Out-come	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
		4	**Discuss** applications of OOP in software development, graphical user interface development, and mobile application development.	CO 1	Understand

S No	Topic(s)	TLO No	Topic Learning Outcome	Course Out-come	Blooms Level
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
8	Special member functions: Constructors, destructors	15	**Select** the constructor methods in initializing object attributes when instances are created.	CO 3	Remember

S No	Topic(s)	TLO No	Topic Learning Outcome	Course Out-come	Blooms Level
		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
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

S No	Topic(s)	TLO No	Topic Learning Outcome	Course Out-come	Blooms Level
		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 manipulatorsfor 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 Methologies:

✓	 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.
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.

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**	

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 Pecinovsky, *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

S.No	Topics to be covered	CO's	Reference
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
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

S.No	Topics to be covered	CO's	Reference
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	
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	

S.No	Topics to be covered	CO's	Reference
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	
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.
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	Build skills to develop software applications in specialized areas of Computer Science and Engineering such as Artificial Intelligence, Machine Learning, Data Science, Web Development, Gaming, Augmented Reality / Virtual Reality (AR/VR).
PSO 2	Focus on exploring supervised, unsupervised and reinforcement learning and apply them to a range of AI problems.
PSO 3	Make use of AI and ML techniques for industrial applications in the areas of Autonomous Systems, IOT, Cloud Computing, Robotics, Natural Language Processing and emerging areas.

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 1	Build skills to develop software applications in specialized areas of Computer Science and Engineering such as Artificial Intelligence, Machine Learning, Data Science, Web Development, Gaming, Augmented Reality / Virtual Reality (AR/VR).	3	Tech talk /Definitions
PSO 3	Make use of AI and ML techniques for industrial applications in the areas of Autonomous Systems, IOT, Cloud Computing, Robotics, Natural Language Processing and emerging areas.	3	Tech talk /Definitions and terminology/ Assignments

3 = High; 2 = Medium; 1 = Low

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

	PROGRAM OUTCOMES												PSO'S		
COURSE OUTCOME	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 1	Understand features of procedural as well as object-oriented programming while writing and analyzing computer programs in the areas related to Machine Learning, Big data, and Artificial Intelligence.	4
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
	PSO 1	Apply features of procedural as well as object-oriented programming while writing and analyzing computer programs in the areas related to machine learning, big data, and artificial intelligence.	5
	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 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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
	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
	PSO 1	Summarize indexing mechanisms to design and develop efficient real-time computational problems.	6
	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
	PSO 1	Demonstrate different modules to understand, design, and analyze computer programs in reducing the time and space complexities of various applications.	5
	PSO 3	Illustrate modern computer tools in implementing string handling mechanisms for various applications to become a successful professional in the domains.	2
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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
	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
	PSO 1	Develop design and analyze object-oriented programming in the areas of the concept of passing of parameters and arguments in functions to do modular programming.	6
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
	PO 12	Identify the need for object-oriented principles for the preparation and the ability to engage in independent and lifelong learning	6
	PSO 1	Focus on writing programs using procedural and object-oriented concepts for applications such as computational geometry, machine learning, big data, and artificial intelligence by understanding and applying the engineering principles of learning.	6
	PSO 3	Acquire sufficient knowledge of object-oriented concepts and apply it in real-time to build a successful career and pursue higher studies.	2

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	-	-	3	-	3
CO 3	3	-	3	-	3	-	-	-	-	-	-	-	3	-	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 4	3	-	3	-	3	-	-	-	-	2	-	3	3	-	3
CO 5	3	2	3	-	3	-	-	-	-	-	-	-	3	-	-
CO 6	3	3	3	-	3	-	-	-	-	2	-	3	3	-	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	66.6	0.0	0.0
CO 2	100	50	80	0.0	100	0.0	0.0	0.0	0.0	60	0.0	0.0	83.3	0.0	100
CO 3	100	0.0	60	0.0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	0.0	100
CO 4	100	0.0	80	0.0	100	0.0	0.0	0.0	0.0	40	0.0	88	83.3	0.0	100
CO 5	100	80	70	0.0	100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	0.0	0.0
CO 6	100	80	70	0.0	100	0.0	0.0	0.0	0.0	40	0.0	75	100	0.0	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≤ C≤ 5% – No correlation

2 - 40 % <C < 60% –Moderate

1-5 <C≤ 40% – Low/ Slight

3 - 60% ≤ 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	-	-
CO 2	3	2	3	-	3	-	-	-	-	3	-	-	3	-	3
CO 3	3	-	3	-	3	-	-	-	-	-	-	-	3	-	3
CO 4	3	-	3	-	3	-	-	-	-	2	-	3	3	-	3
CO 5	3	2	3	-	3	-	-	-	-	-	-	-	3	-	-
CO 6	3	3	3	-	3	-	-	-	-	2	-	3	3	-	3
TOTAL	18	7	15	-	18	-	-	-	-	8	-	6	18	-	12
AVERAGE	3	2.3	3	-	3.0		-	-	-	2.0	-	3.0	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	✓

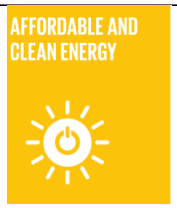
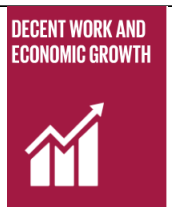
32. Assessment methodology - Indirect:

x	Assessment of mini projects by experts	✓	End Semester OBE Feedback

33. Relevance to Sustainability goals

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

1		
2		
3		
4		**Quality education:** Guarantee an education system that is both inclusive and fair, offering high-quality learning experiences and lifelong opportunities accessible to all.
5		

6		
7		
8		
9		**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.
10		
11		**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.
12		

13		
14		
15		
16		
17		

Approved by: Board of Studies in the meeting conducted on 28-08-2023.

Signature of Course Coordinator **HOD CSE (AIML)**
Dr. J Sirisha Devi, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE TEMPLATE

1	Department	**CSE(AIML)**				
2	Course Title	**Elements of Electrical and Electronics Engineering**				
3	Course Code	AEED01				
4	Class/ Semester	I/ I				
5	Regulation	BT-23				
6	Structure of the course	Theory			Practical	
		Lecture	Tutorials	Credits	Lab	Credits
		3	-	3	-	-
7	Type of course (**Tick type of course**)	Core	Professional Elective	Open Elective	VAC	MOOCs
		✓	-	-	-	-
8	Course Offered	Odd Semester ✓		Even Semester ×		
9	**Total lecture, tutorial and practical hours for this course (16 weeks of teaching per semester)**					
	Lectures: 48 hours		Tutorials: *Nil* hours		Practical: *Nil* hours	
10	Course Coordinator	Ms.M.Varalakshmi				
11	Date Approved by BOS	24/08/2023				
12	Course Webpage	www.iare.ac.in/—-/—-				
13	Course Prerequistes -	**Level**	**Course Code**	**Course title**	**Semester**	
		-	-	-	-	

14. Course Overview

The course provides basic foundation in electrical and electronics. It includes the concepts related to electrical circuits, the fundamental operating principles of electrical machines and the characteristics of semiconductor devices. It also empowers students to understand electronics and electrical systems in their daily lives, from household appliances to personal devices.

15. COURSE OBJECTIVES:

The students will try to learn:

I	The fundamentals of electrical circuits and analysis of circuits with DC and AC excitation using circuit laws.
II	The construction and operation of Electrical machines..
III	The operational characteristics of semiconductor devices with their applications. .

16. COURSE OUTCOMES:

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

CO 1	Make use ofbasic electrical laws for solving DC and AC circuits.	Understand
CO 2	Solve the network theorems to calculate the parameters in electrical circuits.	Understand
CO 3	Demonstrate the fundamentals of electromagnetism for the operation of DC and AC machines.	Uderstand
CO 4	Utilize the characteristics of diodes for the construction of rectifiers and regulators circuits.	Understand
CO 5	Interpret the transistor configurations for optimization of the operating point.	Apply
CO 6	Illustrate the amplifier circuits using transistors for computing hybrid parameters.	Apply

18. Topic Learning Outcome (TLOs):

SNo	TOPIC(S)	TLO No	Topic Learning Outcome's	Course Out-come:	Blooms Level
1	Electrical Circuits	TLO 1	Introduction to electrical circuits	CO1	Understand
		TLO 2	Basic Definitions of Electrical Circuits	CO 1	Understand
		TLO 3	Equivalent resistance of electrical circuits and source transformation of electrical circuits.	CO 1	Understand
2	Electrical laws	TLO 4	Basic Electric laws	CO 1	Understand
		TLO 5	Star to delta and delta bto star transformation	CO 1	Understand
3	Electrical analysis	TLO 6	Calculate voltages and currents with mesh analysis.	CO 1	Apply
		TLO 7	Calculate voltages and currents with nodal analysis	CO 1	Apply
4	AC Circuits	TLO 8	Demonstrate the basics of single-phase AC circuits	CO 1	Understand
5	Electrical Theorem	TLO9	Procedure for Superposition theorem	CO2	Understand
6	Electrical Theorem	TLO10	Procedure for Reciprocity theorem	CO2	Understand
7	Electrical Theorem	TLO11	Procedure for Thevenin's theorem	CO2	Understand
8	Electrical Theorem	TLO12	Procedure for Norton's theorem	CO2	Understand

SNo	TOPIC(S)	TLO No	Topic Learning Outcome's	Course Out-come:	Blooms Level
9	Electrical Theorem	TLO13	Procedure for Maximum Power Transfer theorem	CO2	Understand
10	3 phase voltages	TLO14	Voltage and current relationships in star and delta connections	CO2	Understand
11	DC Circuits	TLO 15	Apply the basic theorems to solve the problems on DC circuits.	CO2	Apply
12	3Phase cirrcuits	TLO 16	Basics of three-phase AC circuits	CO2	Understand
'13	DCmachines and AC machines	TLO 17	Illustrate the construction and operation of DC and AC motors and generators	CO3	Understand
14	DC machines	TLO 18	EMF equation of DC motors and generators	CO3	Understand
15	DC machines	TLO 19	Types of DC motors and generators	CO3	Understand
16	DC machines	TLO 20	Applications and losses of DC motors and generators	CO3	Understand
17	DC machines	TLO 21	Problems based on losses and Efficiency of DC motors and generators	CO3	Apply
18	semiconductor diode	TLO 22	Understand the basics of semiconductor elements	CO4	Understand
19	semiconductor diode characterictics	TLO 23	Illustrate the characteristics of the PN junction diode	CO4	Understand
20	rectifiers	TLO 24	Develop the rectifiers using diodes and their characteristics	CO4	Apply
21	Operation of semiconductor diode	TLO25	Operation of a diode as a switch	CO4	Understand
22	Zener diode	TLO26	Operation of Zener diode as the voltage regulator	CO4	Understand
23	Rectifier parameters	TLO27	Calculation of Rectifier parameters	CO4	Apply
24	Transistors	TLO28	Introduction to bipolar junction transistors	CO5	Understand
25	Transistor configurations	TLO29	Illustrate the characteristics of bipolar junction transistors with various configurations	CO5	Understand
26	Transistor principle	TLO30	Working principle of NPN Transistor	CO5	Understand
27	Transistor principle	TLO31	Working principle of PNP Transistor	CO5	Understand

SNo	TOPIC(S)	TLO No	Topic Learning Outcome's	Course Out-come:	Blooms Level
28	Transistor configuration	TLO32	Transistor characteristics under CE configuration	CO5	Understand
29	transistor configuration	TLO33	Transistor characteristics under CB configuration	CO5	Understand
30	transistor configuration	TLO34	Transistor characteristics under CC configuration	CO5	Understand
31	BJT characteristics	TLO35	Input and output characteristics of bipolar junction transistor	CO5	Understand
32	Amplifiers	TLO36	Understand the operation of a transistor as an amplifier	CO6	Understand
33	Amplifier circuits	TLO37	Understand the two port devices and networks of Amplifier circuits	CO6	Understand
34	Models of transistors	TLO38	Small signal operation and models for transistors	CO6	Understand
35	CE Amplifier	TLO39	Method of amplification in CE amplifier	CO6	Understand
36	H parameters	TLO40	Describe the h parameters of bipolar junction transistors with the concept of small signal operation	CO6	Understand

18. Employability Skills

Example: Communication skills / Programming skills / Project based skills /
Project based skills Elements of electrical and electronics engineering for students based on qualitative and quantitative analysis of experimental skills

19. Content Delivery / Instructional Methologies:

✓	 Power Point Pressentation	✓	 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), and 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.

21. Course Content-Number of Modules: Five

MODULE I	**INTRODUCTION TO ELECTRICAL CIRCUITS . | Number of Lectures: 09**
	Concept: Ohm's law, Kirchhoff's laws, the equivalent resistance of networks, star to delta transformation, mesh and nodal analysis (with DC source only). Single phase AC circuits: representation of alternating quantities, RMS, average, form and peak factor, RLC series circuit. .
MODULE II	**NETWORK THEOREMS AND THREE PHASE VOLTAGES . | Number of Lectures: 10**
	Network Theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power transfer theorems for DC excitation circuits. Three phase voltages (Definitions only): voltage and current relationships in star and delta connections. ;
MODULE III	**ELECTRICAL MACHINES AND SEMICONDUCTOR DIODES . |Number of Lectures: 10**
	DC and AC machines: Motors and generators, Principle of operation, parts, EMF equation, types, applications, losses and efficiency. **Semiconductor diode:** P-N Junction diode, symbol, V-I characteristics, half wave rectifier, full wave rectifier, bridge rectifier and filters, diode as a switch, zener diode as a voltage regulator..
MODULE IV	**BIPOLAR JUNCTION TRANSISTOR AND APPLICATIONS . | Number of Lectures: 10**
	Bipolar junction transistor: characteristics and configurations, working principle NPN and PNP transistor, CE, CB, CC configurations – input and output characteristics, transistor as a switch..

MODULE V	**TRANSISTOR AMPLIFIERS** . | **Number of Lectures: 09**
	Amplifier circuits: Two port devices and network. - Small signal models for transistors – concept of small signal operation - amplification in CE amplifier - h parameter model of a BJT- CE, CB and Emitter follower analysis..

TEXTBOOKS

1. M.S.Sukhija,T K Nagsarkar, " *Basic Electrical and Electronics Engineering* ." Oxford, 1st Edition, 2012.
2. Salivahanan, " *Electronics devices and Circuits* ." TMH, 4th Edition, 2012.

REFERENCE BOOKS:

1. C.L. Wadhwa & "*Electrical Circuit Analysis including Passive Network Synthesis*", International,2nd edition,2009.
2. DavidA Bell, "*Electric circuits*", Oxford University Press,7th edition,2009.
3. P.S Bimbra "*Electrical Machines*", KhannaPublishers,2nd edition,2008.
4. D.P. Kothari and I. J. Nagrath, " *Basic Electrical Engineering*", Tata McGraw Hill, 4th Edition, 2021.

MATERIALS ONLINE:

1. https://www.kuet.ac.bd/webportal/ppmv2/uploads/1364120248DC%20Machines
2. https://www.eleccompengineering.files.wordpress.com/2014/08/a-textbook-of-electrical-technologyvolume-ii-ac-and-dc-machines-b-l-thferaja.pdf
3. https://www.geosci.uchicago.edu/ moyer/GEOS24705/Readings/Klempner_Ch1.pdf
4. https://www.ibiblio.org/kuphaldt/electricCircuits/DC/DC.pdf
5. https://www.users.ece.cmu.edu/ dwg/personal/sample.pdf.
6. https://www.iare.ac.in

22. COURSE PLAN:

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

S.No	Topics to be covered	Course Out-come's	Reference
Discussion on OBE			
1	Discussion on Outcome Based Education, CO, POs and PSOs		
CONTENT DELIVERY (THEORY)			

S.No	Topics to be covered	Course Out-come's	Reference
1	Introduction to electrical circuits	CO 1	T1:1.1-1.3
2	Basic definitions of electrical circuits	CO 1	T1:1.4-1.8
3	Equivalent resistance of electrical circuits and Source transformation of electrical circuits	CO 1	T1:2.6
4	Star to delta and delta to star transformation	CO 1	T1:2.7
5	Mesh analysis and problems on mesh analysis	CO 1	T1:2.9
6	Nodal Analysis and problems on nodal analysis	CO 1	T1:2.8
7	Representation of alternating quantities average value, rms value, form factor and peak factor for various waveforms	CO 1	T1:4.1-4.5
8	Concept of impedance, admittance and complex power	CO 1	T1:4.7-4.8
9	Procedure for superposition theorem and problems	CO 2	T1:2.11
10	Procedure for reciprocity theorem and problems	CO 2	T1:2.11.1
11	Procedure for Thevinin's theorem and problems	CO 2	T1:2.11.2
12	Problems on Thevinin's theorem	CO 2	T1:2.11.3
13	Procedure for Norton's theorem and problems	CO 2	T1:2.11.4
14	Problems on Norton's theorem	CO 2	T1:2.11.5
15	Procedure for Maximum power transfer theorem and problems	CO 2	T1:2.11.6
16	Voltage and current relationships in star delta connections	CO 2	T1: 5.2
17	Construction and operation of DC machines	CO 3	T1: 9.2
18	Classification of DC generators and efficiency	CO 3	T1: 9.6
19	Types of DC motors, losses and efficiency	CO 3	T1: 9.7
20	Introduction to semiconductor devices	CO 4	T2: 1.1
21	PN junction diode, symbol and its voltage current characteristics	CO 4	T2: 1.2
22	Operation of half wave rectifier with and without filters	CO 4	T2: 1.9
23	Operation of full wave rectifier with and without filters	CO 4	T2: 1.10
24	Operation of diode as switch	CO 4	T2: 1.11
25	Operation of zener diode as voltage regulator	CO 4	T2: 1.12
26	Calculation of Rectifier parameters	CO 4	T2: 1.10
27	Introduction to bipolar junction transistors	CO 5	T2: 3.1
28	Working principle of NPN transistor	CO 5	T2: 3.1.2
29	Operation of PNP transistor	CO 5	T2: 3.1.3
30	Transistor characteristics under CB configuration	CO 5	T2: 3.6
31	Transistor characteristics under CE configuration	CO 5	T2: 3.7
32	Transistor characteristics under CC configuration	CO 5	T2: 3.8
33	Biasing and load line of transistors	CO 5	T2: 4.1
34	Operation of transistor as an amplifier	CO 6	T2: 3.9
35	Introduction to port devices and network	CO 6	T2: 5.2
36	Concept of small signal operation for transistors	CO 6	T2: 5.2.7

S.No	Topics to be covered	Course Out-come's	Reference
37	Amplification in common emitter amplifier	CO 6	T2: 5.3.1
38	Calculation of h parameter model of a BJT CE configuration	CO 6	T2: 5.3.2
39	Calculation of h parameter model of a BJT CB configuration	CO 6	T2: 5.3.3
40	Calculation of h parameter model of a BJT CC configuration.	CO 6	T2: 5.5
PROBLEM SOLVING/ CASE STUDIES			
1	Problems on equivalent resistance	CO 1	T1: 2.6
2	Problems on star to delta and delta to star transformation	CO 1	T1: 2.7
3	Problems on mesh and nodal analysis	CO 1	T1: 2.8-2.9
4	Problems on superposition theorem	CO 2	T1: 2.11
5	Problems on reciprocity theorem	CO 2	T1: 2.11.1
6	Problems on Maximum power transfer theorem	CO 2	T1: 2.11.2
7	Problems on emf equation of DC generators	CO 3	T1: 9.2
8	Problems on efficiency of DC generators	CO 3	T1: 9.3
9	Problems on DC motors	CO 3	T1: 9.4
10	Problems on efficiency of DC motors	CO 3	T1: 9.5
11	Problems on alternator emf equation	CO 4	T1: 7.4
12	Problems on alternators	CO 4	T1: 7.5
13	Problems on rectifiers using diodes	CO 4	T2: 1.10
14	Problems on transistors CB configuration	CO 5	T2: 3.6
15	Problems on transistors CE and CC configuration	CO 6	T2: 3.7-3.8
DISCUSSION OF DEFINITION AND TERMINOLOGY			
1	Introduction to Engineering Mechanics	CO 1	T1: 1.1-1.12
2	Definition and terminology from network theorems and three phase AC circuits	CO 2	T1: 2.1-2.12
3	Definition and terminology from electrical machines and diodes	CO 3, CO 4	T1: 7,8,9 T2: 1.1-1.12
4	Definition and terminology from transistors	CO 5	T2: 3.1-3.10
5	Definition and terminology from transistor amplifier circuits	CO 6	T2: 9.1-9.6
DISCUSSION OF TUTORIAL QUESTION BANK			
1	Question bank from electrical circuits	CO 1	T1: 1.1-1.12
2	Question bank from network theorems and three phase AC circuits	CO 2	T1: 1.1-1.12
3	Question bank from electrical machines and diodes	CO 3,CO 4	T1: 7,8,9 T2: 1.1-1.12
4	Question bank from electrical machines and diodes	CO 5	T2: 3.1-3.10
5	Question bank from transistor amplifier circuits	CO 6	T2:9.1-9.6

23. 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	Build skills to develop software applications in specialized areas of Computer Science and Engineering such as Artificial Intelligence, Machine Learning, Data Science, Web Development, Gaming, Augmented Reality / Virtual Reality (AR/VR).

Program Outcomes	
PSO 2	Focus on exploring supervised, unsupervised and reinforcement learning and apply them to a range of AI problems.
PSO 3	Make use of AI and ML techniques for industrial applications in the areas of Autonomous Systems, IOT, Cloud Computing, Robotics, Natural Language Processing and emerging areas.

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/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/SEE/AAT

25. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Strength	Proficiency Assessed by
PSO 1	Build skills to develop software applications in specialized areas of Computer Science and Engineering such as Artificial Intelligence, Machine Learning, Data Science, Web Development, Gaming, and Augmented Reality / Virtual Reality (AR/VR).	1	CIE/SEE/AAT

3 = High; 2 = Medium; 1 = Low

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

	PROGRAM OUTCOMES												PSO'S		
COURSE OUTCOME	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	Recollect the concept of electricity is described through scientific principles, importance Kirchhoff laws in relation with law of conservation of energy and charge circuits are explained using mathematics, engineering fundamentals and various source transformation techniques are adopted for solving complex circuits.	3
	PSO 1	Solve complex electrical circuits by applying basic circuit concepts by using computer programs	1
CO 2	PO 1	Demonstrate various network theorems in order to determine the same using principles of mathematics, science, and engineering fundamentals.	3
	PO 2	Verify various network theorems for their validation using mathematical calculations.	4
	PSO 1	Simplify complex electrical networks by applying various circuit theorems by using computer programs	1
CO 3	PO 1	The principle of operation and characteristics of DC and AC machines are explained by applying engineering fundamentals including device physics.	3
	PO 2	Calculate the voltage generated and torque developed in DC and AC generators and motors by using first principles of mathematics .	4
CO 4	PO1	Illustrate the volt-ampere characteristics of semiconductor devices to derive mathematical model for diode current, static and dynamic resistance by applying the principles of mathematics and scientific principles for solving complex engineering problems.	2
	PO 2	Understand the given problem statement and formulate the static and dynamic resistance from the volt-ampere characteristics of the semiconductor devices using experimental design.	3
CO 5	PO 1	Understand the characteristics and operation of transistors with the knowledge of engineering fundamentals	2
CO 6	PO 1	Understand the mathematical principles for design the biasing techniques for BJT amplifier circuits for stable operation by applying the methodology	2
	PO 2	Demonstrate the calculation of h parameters with small signal operation using the principles of mathematics and natural sciences.	4

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	4	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 2	3	4	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 3	3	4	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	2	3	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	2	4	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 6	2	4	-	-	-	-	-	-	-	-	-	-	1	-	-

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	40	-	-	-	-	-	-	-	-	-	-	33.33	-	-
CO 2	100	40	-	-	-	-	-	-	-	-	-	-	33.33	-	-
CO 3	100	40	-	-	-	-	-	-	-	-	-	-	33.33	-	-
CO 4	66.6	30	-	-	-	-	-	-	-	-	-	-	33.33	-	-
CO 5	66.6	40	-	-	-	-	-	-	-	-	-	-	33.33	-	-
CO 6	66.6	40	-	-	-	-	-	-	-	-	-	-	33.33	-	-

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≤ C≤ 5% – No correlation

2 - 40 % <C < 60% –Moderate

1-5 <C≤ 40% – Low/ Slight

3 - 60% ≤ 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	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 2	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 3	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 4	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 5	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
CO 6	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-
TOTAL	18	6	-	-	-	-	-	-	-	-	-	-	1	-	-

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
AVERAGE	3	1	-	-	-	-	-	-	-	-	-	-	1	-	-

31. ASSESSMENT METHODOLOGY DIRECT:

CIE Exams	✓	SEE Exams	✓	Seminars	-
Laboratory Practices	✓	Student Viva	✓	Certificates	-
Term Paper	-	5 Minutes Video	✓	Open Ended Experiments	-
Assignments	✓				

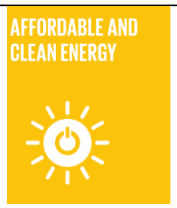
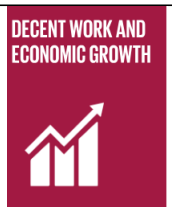
32. ASSESSMENT METHODOLOGY INDIRECT:

x	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback

33. Relevance to Sustainability goals

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

1		
2		
3		
4		This subject improves the quality of education in engineers and gives the awareness of electrical usage in day to day life.

5	 GENDER EQUALITY	
6	 CLEAN WATER AND SANITATION	
7	 AFFORDABLE AND CLEAN ENERGY	
8	 DECENT WORK AND ECONOMIC GROWTH	
9	 INDUSTRY, INNOVATION AND INFRASTRUCTURE	
10	 REDUCED INEQUALITIES	
11	 SUSTAINABLE CITIES AND COMMUNITIES	

12		Responsible Consumption and Production: This subject gives the importance of electricity, by learning how to optimize electrical energy for different applications, students can contribute to reducing energy consumption and minimizing electronic waste and the need for saving energy.
13		
14		
15		
16		
17		

Approved by: Board of Studies in the meeting conducted on - 24/08/2023

Signature of Course Coordinator **HOD**

Ms.M.Varalakshmi, Assistant Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE TEMPLATE

1	Department	**CSE (AIML)**			
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		Practical Hours	
		3		3	
8	Course Offered	Odd Semester ✓		Even Semester ×	
9	Course Coordinator	Dr Jetty Wilson			
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 Prerequistes	**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.	Understnad
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.	Understnad
CO 6	**Argue** scholarly, giving the counters to open ended experiments, and also writing slogans for the products talentedly.	Understand

14. Employability Skills

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

16. Content Delivery / Instructional Methologies:

✓	 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**
	1. Introduction to pronunciation 2. Introducing self and introducing others and feedback 3. Introduction to phonetics, listening to English sounds, Vowel and Consonant sounds 4. Describing a person or place or a thing using relevant adjectives – feedback 5. Pronunciation practice
CO 2	**Construct required dialogues in role plays in verbal communication**
	1. Role plays on fixed expressions in various situations 2. Structure of syllables 3. Asking for directions and giving directions 4. Weak forms and strong forms 5. Intonation
CO 3	**ADifferentiate mother tongue influence while speaking English in JAM sessions, debates, group discussions and telephonic conversations.**
	1. Word accent and stress shifts 2. JAM Sessions using public address system 3. Extempore-Picture 4. Etiquette 5. Debates 6. Listening comprehension 7. Group discussion
CO 4	**Pronounce past tense and plural markers and weak forms and strong forms as a native speaker.**
	1. Past tense and plural markers 2. Neutralization of Mother Tongue Influence (MTI) 3. Weak forms and strong forms 4. Common errors in pronunciation practice through tongue twisters 5. Minimal pairs

CO 5	**Demonstrate the techniques of writing leaflets, messages and notices..**
	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.**
	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.

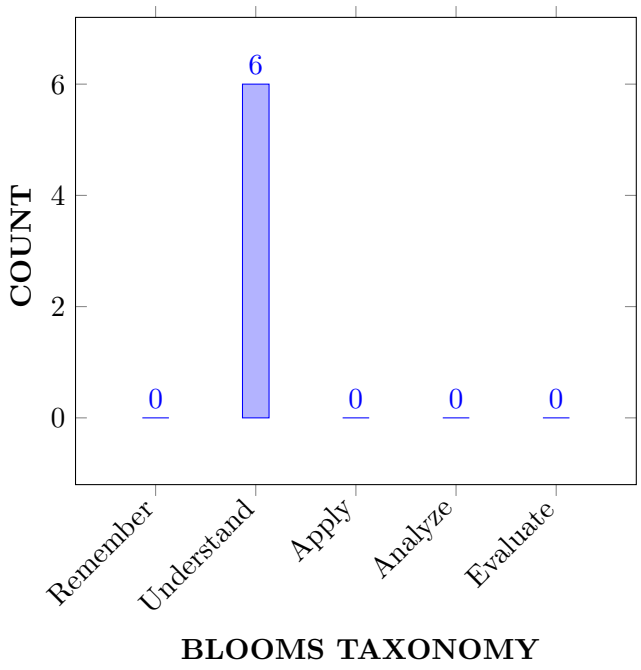
REFERENCE BOOKS:

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



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	Understnad
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	Understnad
3	CALL LAB: Structure of syllables. ICS LAB: JAM Sessions using public address system	CO 2	Understnad
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	Build skills to develop software applications in specialized areas of Computer Science and Engineering such as Artificial Intelligence, Machine Learning, Data Science, Web Development, Gaming, Augmented Reality / Virtual Reality (AR/VR).
PSO 2	Focus on exploring supervised, unsupervised and reinforcement learning and apply them to a range of AI problems.
PSO 3	Make use of AI and ML techniques for industrial applications in the areas of Autonomous Systems, IOT, Cloud Computing, Robotics, Natural Language Processing and emerging areas.

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	Build skills to develop software applications in specialized areas of Computer Science and Engineering such as Artificial Intelligence, Machine Learning, Data Science, Web Development, Gaming, Augmented Reality / Virtual Reality (AR/VR).	-	-
PSO 2	Focus on exploring supervised, unsupervised and reinforcement learning and apply them to a range of AI problems.	-	-
PSO 3	Make use of AI and ML techniques for industrial applications in the areas of Autonomous Systems, IOT, Cloud Computing, Robotics, Natural Language Processing and emerging areas.	-	-

3 = High; 2 = Medium; 1 = Low

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

	PROGRAM OUTCOMES												PSO'S		
COURSE OUTCOME	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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
CO 4	PO 10	Pronouns the sentences within the tone boundaries maintaining the melody of the language	3
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≤ C≤ 5% – No correlation

2 - 40 % <C < 60% –Moderate

1-5 <C≤ 40% – Low/ Slight

3 - 60% ≤ 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	-

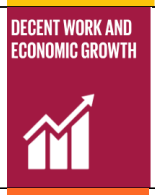
32. ASSESSMENT METHODOLOGY INDIRECT:

x	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback

15. Relevance to Sustainability goals

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

1		
2		
3		

4		**E**nglish language has become linguafranca across the globe. For that reason, it is compulsory to learn this language at advanced level. In MNC commpanies, 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.
5		
6		
7		
8		
9		
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17		

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

Signature of Course Coordinator **HOD**
Dr Jetty Wilson, Associate Professor

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE TEMPLATE

1	Department	**COMPUTER SCIENCE & ENGINEERING (AI&ML)**			
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 ✓		Even Semester ×	
9	Course Coordinator	Dr. Ch Sandeep			
10	Date Approved by BOS	25/08/2023			
11	Course Webpage	www.iare.ac.in/—-/—-			
12	Course Prerequistes	**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.**
	1. Getting Started Exercises 2. Exercises on Number Systems (for Science/Engineering Students)
CO 2	**Apply the principles of selection and iteration.**
	1. Exercises on Decision and Loop 2. Exercises on Input, Decision and Loop 3. Exercises on Nested-Loops (Patterns) 4. Magic(Special) Numbers 5. Exercises on String and char Operations 6. Exercises on Arrays
CO 3	**Appreciate uses of modular programming concepts for handling complex problems.**
	1. Exercises on Methods 2. Exercises on Command-line Arguments and Recursion 3. More (Difficult) Exercises
CO 4	**Recognise and apply principle features of object-oriented design such as abstraction and encapsulation.**
	1. Exercises on Classes and Objects
CO 5	**Design classes with a view of flexibility and reusability.**
	1. Exercises on Inheritance
CO 6	**Code, test and evaluate small usecases to conform to a specification.**
	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	Build skills to develop software applications in specialized areas of Computer Science and Engineering such as Artificial Intelligence, Machine Learning, Data Science, Web Development, Gaming, Augmented Reality / Virtual Reality (AR/VR).
PSO 2	Focus on exploring supervised, unsupervised and reinforcement learning and apply them to a range of AI problems.
PSO 3	Make use of AI and ML techniques for industrial applications in the areas of Autonomous Systems, IOT, Cloud Computing, Robotics, Natural Language Processing and emerging areas.

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 PROGRAMS/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 PROGRAMS/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 PROGRAMS/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 PROGRAMS/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 PROGRAMS/CIE/SEE
PO 8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	3	LAB PROGRAMS/CIE/SEE

23. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes		Strength	Proficiency Assessed by
PSO 1	Build skills to develop software applications in specialized areas of Computer Science and Engineering such as Artificial Intelligence, Machine Learning, Data Science, Web Development, Gaming, Augmented Reality / Virtual Reality (AR/VR).	2	LAB PROGRAMS/CIE/SEE
PSO 2	Focus on exploring supervised, unsupervised and reinforcement learning and apply them to a range of AI problems.	2	LAB PROGRAMS/CIE/SEE
PSO 3	Make use of AI and ML techniques for industrial applications in the areas of Autonomous Systems, IOT, Cloud Computing, Robotics, Natural Language Processing and emerging areas.	2	LAB PROGRAMS/CIE/SEE

3 = High; 2 = Medium; 1 = Low

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

	PROGRAM OUTCOMES												PSO'S		
COURSE OUTCOME	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 modern computer tools for creating innovative career paths, to be an entrepreneur and desire for higher studies.	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 1	Understand, design and analyze computer programs in the areas related to Algorithms, System Software, Web design, Big data, Artificial Intelligence, Machine Learning and Networking.	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
	PSO 1	Understand, design and analyze computer programs in the areas related to Algorithms, System Software, Web design, Big data, Artificial Intelligence, Machine Learning and Networking.	3
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
	PSO 1	Understand, design and analyze computer programs in the areas related to Algorithms, System Software, Web design, Big data, Artificial Intelligence, Machine Learning and Networking.	3
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	1
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
	PSO 1	Understand, design and analyze computer programs in the areas related to Algorithms, System Software, Web design, Big data, Artificial Intelligence, Machine Learning and Networking.	3
	PSO 2	Focus on improving software reliability, network security or information retrieval systems.	1

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

	PROGRAM OUTCOMES												PSO'S		
COURSE OUTCOMES	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	-	-	-	-	-	-	-	-	-	-	4	-	-
CO 4	-	7	6	-	-	-	-	-	-	-	-	-	3	-	-
CO 5	-	7	-	-	-	1	-	-	-	-	-	-	3	1	-
CO 6	-	7	-	-	-	3	-	2	-	-	-	-	3	1	-

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

	PROGRAM OUTCOMES												PSO'S		
COURSE OUTCOMES	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	-	-	-	-	-	-	-	-	-	50

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	33.3	70	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	33.3	70	-	-	-	-	-	-	-	-	-	-	66.6	-	-
CO 4	-	70	60	-	-	-	-	-	-	-	-	-	50	-	-
CO 5	-	70	-	-	-	20	-	-	-	-	-	-	50	50	-
CO 6	-	70	-	-	-	60	-	66.6	-	-	-	-	50	50	-

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≤ C≤ 5% – No correlation

2 - 40 % <C < 60% –Moderate

1-5 <C≤ 40% – Low/ Slight

3 - 60% ≤ 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	-	-	-	-	-	-	-	-	-	2
CO 2	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	1	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 4	-	3	3	-	-	-	-	-	-	-	-	-	2	-	-
CO 5	-	3	-	-	-	1	-	-	-	-	-	-	2	2	-
CO 6	-	3	-	-	-	3	-	3	-	-	-	-	2	2	-
TOTAL	3	15	3	-	3	4	-	3	-	-	-	-	9	4	2
AVERAGE	1	3	3	-	3	2	-	3	-	-	-	-	2	2	2

29. ASSESSMENT METHODOLOGY DIRECT:

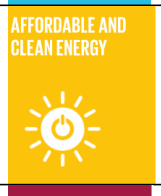
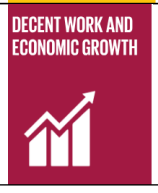
CIE Exams	✓	SEE Exams	✓	Laboratory Practices	✓
Certification	-	Student Viva	✓	Open Ended Experiments	-

30. ASSESSMENT METHODOLOGY INDIRECT:

x	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback

31.RELEVANCE TO SUSTAINABILITY GOALS

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

X		
X		
X		
✓		**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.
X		
X		
X		
X		

✓		**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.
X		
✓		**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.
X		
✓		**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.
X		
X		
X		

✓		**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.

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

Signature of Course Coordinator
Dr. C h Sandeep, Associate Professor

HOD,CSE (AI&ML)

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

COURSE TEMPLATE

1	Department	**CSE (AIML)**			
2	Course Code	AEED03			
3	Course Title	**ELECTRICAL AND ELECTRONICS ENGINEERING LAB**			
4	Semester	I			
5	Regulations	BT-23			
6	Structure of the course	Practical			
		Lecture Hours		Practical Hours	
		-		36	
7	Course Offered	Odd Semester ✓		Even Semester ×	
8	Course Coordinator	Mr. G.Viswanath			
9	Date Approved by BOS	24/08/2023			
10	Course Webpage	https://www.iare.ac.in/sites/default/files/BT23/AEED03.pdf			
11	Course Prerequistes	**Level**	**Course Code**	**Semester**	**Prerequisites**
		Intermediate	-	-	Physics

12. Course Overview

This course serves as a foundation course on electrical engineering. It covers a broad range of fundamental electrical circuits and devices. The concepts of current, voltage, power, basic circuit elements, electrical and electronic devices and their application in more complex electrical systems are to be imparted to the students

13. Course Objectives:

The students will try to learn:

I	The basic laws for different circuits.
II	The elementary experimental and modeling skills for handling problems with electrical machines in the industries and domestic applications to excel in professional career.
III	The intuitive knowledge needed to test and analyze the performance leading to design of electric machines by conducting various tests and calculate the performance parameters.
IV	Gain knowledge on semiconductor devices like diode and transistor

14. Course Outcomes:

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

CO1	**D**emonstrate an electric circuit by proving laws and solving theorems	Understand
CO2	**I**dentify the performance characteristics of DC shunt motor by suitable test.	Apply
CO3	**D**iscuss the performance of induction generator to study magnetizing characteristics.	Apply
CO4	**A**cquire basic knowledge on the working of diodes and rectifiers to study their characteristics.	Understand
CO5	**I**dentify transistor configuration to deduce its working characteristics.	Apply
CO6	**U**se of half wave and full wave rectifiers to study the characteristics.	Understand

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 Methologies:

✓	 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):

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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, cu'rrents, voltage and power using various laws associated with electrical circuits.**
	1. Introduction to electrical circuits 2. Exercises on Basic Electrical Circuit Law's 3. Exercises on Mesh Analysis 4. Exercises on Nodal Analysis
CO 2	**Analyze open circuit characteristics of DC Shunt Generator**
	1. Observe the voltage build up, critical field resistance, critical speed
CO 3	**Perform Open circuit and Short Circuit tests on single phase transformer to observe efficiency**
	1. Conduct Open circuit and Short circuit tests on Transformer
CO 4	**Demonstrate Thevenin's and Norton's theorems to reduce complex networks into simple equivalent networks with DC excitation**
	1. Exercises on Thevenin's Theorem 2. Exercises on Norton's Theorem
CO 5	**Apply Faraday's laws of electromagnetic induction for calculating the various performance parameters in magnetic circuits.**
	1. Exercises on Determination of Circuit Impedance 2. 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.**
	1. Exercise on Z and Y Parameters 2. 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 Determination of Circuit Impedance	CO 5	T1:2.4 R1:1.13.3
8	Exercises on Thevenin's Theorem.	CO 4	T1:5.1-5.2 R1:1.7.1
9	Exercises on Norton's Theorem	CO 4	T1:5.3 R1:1.17.3
10	Exercises on Superposition Theorem	CO 3	T1:5.3 R1:2.6.1
11	Exercises on Reciprocity Theorem	CO 3	T1:5.7 R1:2.6.2
12	Exercise on Series and Parallel Resonance	CO 5	T1:1.3-1.8 R1:2.10
13	Exercise on Maximum Power Transfer Theorem	CO 3	T1:8.12-8.14
14	Exercise on Half Wave Rectifier	CO 6	T1:8.12-8.14
15	Exercise on Full Wave Rectifier	CO 6	T1:8.12-8.14

20 Experiments for Enhanced Learning (EEL):

S.No	Design Oriented Experiments
1	To study the Speed Control methods of D.C. motor
2	To study the Rectifier working and it's characteristics

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 Outcomes	
Program Specific Outcomes	
PSO 1	Build skills to develop software applications in specialized areas of Computer Science and Engineering such as Artificial Intelligence, Machine Learning, Data Science, Web Development, Gaming, Augmented Reality / Virtual Reality (AR/VR)
PSO 2	Focus on exploring supervised, unsupervised and reinforcement learning and apply them to a range of AI problems
PSO 3	Make use of AI and ML techniques for industrial applications in the areas of Autonomous Systems, IOT, Cloud Computing, Robotics, Natural Language Processing and emerging areas

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 1	Build skills to develop software applications in specialized areas of Computer Science and Engineering such as Artificial Intelligence, Machine Learning, Data Science, Web Development, Gaming, Augmented Reality / Virtual Reality (AR/VR)	1	CIE/Quiz/AAT

3 = High; 2 = Medium; 1 = Low

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

	PROGRAM OUTCOMES												PSO'S		
COURSE OUTCOME	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 1	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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
	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
	PSO 1	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 andDC 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 1	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 1	Verify Thevenin's and Norton's theorems for the electrical network with DC excitation using computing tools like Simulink	1

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
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
	PO 10	Improve the documentation skills for their problem-solving approaches, calculations, and findings, resulting in well-structured and informative reports	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
	P0 10	Improve the documentation skills for their problem-solving approaches, calculations, and findings, resulting in well-structured and informative reports	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	-	-	1	-	-
CO 2	3	5	-	-	1	-	-	-	-	3	-	-	1	-	-
CO 3	3	5	-	-	1	-	-	-	-	3	-	-	1	-	-
CO 4	3	5	-	-	1	-	-	-	-	3	-	-	1	-	-
CO 5	3	5	-	-	1	-	-	-	-	3	-	-	-	-	-
CO 6	3	5	-	-	1	-	-	-	-	3	-	-	-	-	-

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	-	-	34	-	-
CO 2	100	50	-	-	100	-	-	-	-	60	-	-	34	-	-
CO 3	100	50	-	-	100	-	-	-	-	60	-	-	34	-	-
CO 4	100	50	-	-	100	-	-	-	-	60	-	-	34	-	-
CO 5	100	50	-	-	100	-	-	-	-	60	-	-	-	-	-
CO 6	100	50	-	-	100	-	-	-	-	60	-	-	-	-	-

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≤ C≤ 5% – No correlation

2 - 40 % <C < 60% –Moderate

1-5 <C≤ 40% – Low/ Slight

3 - 60% ≤ 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	-	-	-	-	-
CO 6	3	2	-	-	3	-	-	-	-	3	-	-	-	-	-
TOTAL	18	12	-	-	18		-	-	-	-	-	-	-	-	-
AVERAGE	3	2	-	-	3	-	2	-	-	-	-	-	-	-	-

29. Assessment methodology direct:

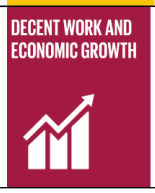
CIE Exams	✓	SEE Exams	✓	Laboratory Practices	✓
Certification	-	Student Viva	✓	Open Ended Experiments	-

30. Assessment methodology indirect:

x	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback

31. Relevance to Sustainability goals

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

1		
2		
3		
4		**Quality Education:** This subject will improve the quality education in engineers and gives the awareness in electrical usage in day-to-day life.
5		
6		
7		
8		

9		
10		
11		
12		**Responsible Consumption and Production** This subject impacts the demand of electricity and need for saving energy
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

MANUFACTURING PRACTICE
COURSE TEMPLATE

1	Department	I Semester: CSE (AI & ML) / IT / ECE / EEE			
		II Semester: CSE / CSE (DS) / CSE (CS)			
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 ✓		Even Semester ✓	
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 Prerequistes	**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 methologies:

✓	 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.**
	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 tapper 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 tapper 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.**
	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.**
	1. Preparation of acrylic gears using CNC laser engraving / cutting machine. **Try** 1.1 Preparation of artistic components IARE logo using CNC laser engraving. 2. Demonstration of articulated robot for lifting load. **Try** 2.1 Demonstration the pick and place operation for the articulated robot 3. Demonstration of milling and lathe system switchable on one simulator. **Try** 3.1 Demonstration the combination of CNC Simulator with CNC machining simulation.
CO 4	**Demonstrate the assembly and disassembly of electrical equipment's and controls for safe domestic applications.**
	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. 2. Preparation of soldering from a circuit board. **Try** 2.1 Perform desoldering operation from a circuit board. 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.
CO 5	**Make use of computer numerical technologies to create products using wood carving techniques.**
	1. Preparation of wooden wheel using computerized wood carving machine. **Try** 1.1 Preparation of IARE lettering using CNC wood carving.

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

1. 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.
2. Kalpakjian S, Steven S. Schmid, "Manufacturing Engineering and Technology", Pearson Education India Edition, 7 th Edition, 2019.

REFERENCE BOOKS:

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

MATERIALS ONLINE:

1. Lab manual
2. 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	Build skills to develop software applications in specialized areas of Computer Science and Engineering such as Artificial Intelligence, Machine Learning, Data Science, Web Development, Gaming, Augmented Reality / Virtual Reality (AR/VR).
PSO 2	Focus on exploring supervised, unsupervised and reinforcement learning and apply them to a range of AI problems.
PSO 3	Make use of AI and ML techniques for industrial applications in the areas of Autonomous Systems, IOT, Cloud Computing, Robotics, Natural Language Processing and emerging areas.

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 3	Make use of AI and ML techniques for industrial applications in the areas of Autonomous Systems, IOT,Cloud Computing, Robotics, Natural Language Processing and emerging areas.	3	Lab Exercises

3 = High; 2 = Medium; 1 = Low

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

	PROGRAM OUTCOMES												PSO'S		
COURSE OUTCOME	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 designsolution 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 engineeringand 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
	PSO 3	Apply the AI and ML techniques for industrial applications in the areas of autonomous systems and robotics..	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
	PSO 3	Apply the AI and ML techniques for industrial applications in the areas of autonomous systems and robotics.	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
	PSO 3	Apply the AI and ML techniques for industrial applications in the areas of autonomous systems and robotics.	2
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

COURSE OUTCOMES	PO'S PSO'S	Justification for mapping (Students will be able to)	No. of Key Competencies
	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
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
	PSO 3	Apply the AI and ML techniques for industrial applications in the areas of autonomous systems and robotics.	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	-	-	-	2
CO 2	1	-	-	-	1	-	-	-	-	-	2	-	-	-	2
CO 3	1	-	-	-	1	-	-	-	-	-	-	-	-	-	2
CO 4	1	-	2	-	-	-	-	-	-	-	2	-	-	-	-
CO 5	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-
CO 6	1	-	-	-	1	-	-	-	-	-	2	-	-	-	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	-	-	-	100
CO 2	33.3	-	-	-	-	-	-	-	-	-	16.6	-	-	-	100
CO 3	33.3	-	-	-	100	-	-	-	-	-	-	-	-	-	100
CO 4	33.3	-	20	-	-	-	-	-	-	-	16.6	-	-	-	-
CO 5	-	-	-	-	100	-	-	-	-	-	16.6	-	-	-	-
CO 6	33.3	-	-	-	100	-	-	-	-	-	16.6	-	-	-	100

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≤ C≤ 5% – No correlation

2 - 40 % <C < 60% –Moderate

1-5 <C≤ 40% – Low/ Slight

3 - 60% ≤ 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	-	-	-	3
CO 2	1	-	-	-	-	-	-	-	-	-	1	-	-	-	3
CO 3	1	-	-	-	3	-	-	-	-	-	-	-	-	-	3
CO 4	1	-	1	-	-	-	3	-	-	-	-	-	-	-	-
CO 5	-	-	-	-	3	-	-	-	-	-	1	-	-	-	-
CO 6	1	-	-	-	3	-	3	-	-	-	1	-	-	-	3
Total	5	-	2	-	12	-	-	-	-	-	4	-		-	12
Average	3	-	1	-	3	-	-	-	-	-	1	-	-	-	3

29. Assessment methodology -Direct:

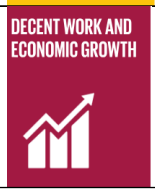
CIE Exams	✓	SEE Exams	✓	Laboratory Practices	✓
Certification	-	Student Viva	✓	Open Ended Experiments	✓

30. Assessment methodology -Indirect:

x	Assessment of Mini Projects by Experts	✓	End Semester OBE Feedback

31. Relevance to Sustainability goals (SDGs):

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

1		
2		
3		
4		**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.
5		
6		
7		
8		

9		
10		
11		
12		**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.
13		
14		
15		
16		

17		

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

Signature of Course Coordinator **HOD, ME**
Dr. Ch. Sandeep, Associate Professor